Informatization of Early Childhood Education: the EU Experience

Olga Puyo[1], Oleksandra Yemchyk[2], Lesya Klevaka[3], Svitlana Voloshyn[4], Andriy Dulibskyy[5]

[1]Ternopil Volodymyr Hnatiuk National Pedagogical University, Ternopil, Ukraine
[2]Lesya Ukrainka Volyn National University, Lutsk, Ukraine
[3]National University «Yuri Kondratyuk Poltava Polytechnic», Ternopil, Ukraine
[4]Drohobych Ivan Franko State Pedagogical University, Drohobych, Ukraine
[5]Lviv State University of Physical Culture named after Ivan Boberskyj, Lviv, Ukraine

Summary
Informatization of early childhood education in the EU occurs in the context of the use of ICT as a means of sharing experiences, practices in the education and training of preschool children, communication, both at the national level and locally - within educational institutions, as a means of document management, search, data processing and information for the management of early childhood educational institutions, and planning activities for these institutions. This article aims to identify the features of the informatization of early childhood education in EU countries. Results. The countries of the EU have different levels of workload on the staff of early childhood education institutions, which is caused by different numbers of preschoolers and workforce. The greatest load on the staff in France due to a large number of preschoolers, which, despite the reduction, remained the highest among all the countries. By comparison, Poland's significant workload is mitigated by the size of its workforce. With almost equal numbers of staff in Poland and Germany, the countries differ significantly in the number of preschoolers. The countries also have different funding mechanisms for early childhood education, which determines the potential for digitalization. In France, total spending on early childhood education has grown the least (by 11 % between 2012 and 2018), in Poland by 51 %, in the Czech Republic by 44 %, and in Germany by 49%. In France, 100 % is funded by the government, in Poland 78 % is funded by the government, in the Czech Republic and Germany 87 % and 85 % respectively is funded by the government. The results of the survey of teachers' training in the use of ICTs and the level of specialists' readiness to use them in their studies indicate a mismatch between education and the practice of using technology. At the same time, given the high level of professional training of teachers in the use of technology in education, a low level of practice of ICT use in teaching preschool children was revealed. Teachers require professional development of ICT skills.

Key words:
informatization, digitalization, early childhood education, pre-school children, EU early childhood education.

1. Introduction

Informatization of early childhood education in the EU is mainly concerned with the introduction of technology into the activities of preschool principals to search for, process management information, maintain documentation, communication, planning, and reporting. The use of ICT by preschool teachers to teach preschool children is limited, despite the positive attitude and perception of teachers about the potential of technology. At the same time, the level of accessibility of digital technology for early childhood schools has been growing in recent years. ICT is a potential and tool to improve preschool children's digital literacy skills. Research on the digital skills of elementary and secondary education students argues that the use of ICT at an earlier age is positively related to students' skills in school. Children's early literacy skills are becoming increasingly important. As a consequence, the use of technology is becoming increasingly necessary to develop digital skills at an early age. For example, interactive, dialogue-based book reading is an important teaching method that gives children the opportunity to develop early literacy skills (Plowman & Stephen, 2013; Yalçintas Sezgin & Ulus, 2017).

The digitalization of education in general at different educational levels contributes to the reform of early childhood education and the digitalization of institutions, the development of new teacher training programs with a focus on technology. It is the training programs for early childhood education specialists that promote a positive attitude toward digitalization of education and form an understanding of the potential of using ICTs in the education of preschool children. The knowledge and experience of specialists during training are extremely important for the effectiveness of early childhood education's digitalization. Preschool teachers use technology to support children's development.

This article aims to identify the peculiarities of the informatization of early childhood education in EU countries.

2. Literature review

There are two key areas of research on informatization in early childhood education in the academic literature: 1) the effectiveness and efficiency of informatization studied in the

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context of ICT use in early childhood educational institutions, and 2) attitudes, intentions, and attitudes, perceptions of early childhood educational staff toward technology.

Liu, Toki & Pange (2014) examine the use of information and communication technology (ICT) in early childhood education in China and Greece in the context of three dimensions:
accessibility and use of ICTs in preschools;
ICTs and preschoolers;
ICTs and preschool teachers.

The use of ICT in the education and learning of preschoolers has a positive impact on children's cognitive, emotional, and speech skills (Liu, Toki & Pange, 2014). ICT contributes to preschoolers' academic success and improves learning, and school readiness outcomes, particularly performance is achieved in science subjects, language, music, math, and writing (Melović, 2020). At the same time, the effectiveness of ICT is also evident in its use in teaching children with disabilities, special educational needs. The use of ICT in learning increases the level of motivation, creativity, and social abilities of preschool children (Melović, 2020). Numerous studies in different countries have proven the importance of ICT in the learning activities of preschool children. Technology plays a key role in children's mental development, academic achievement, and abstract thinking (Kardas, Lee-Treweek & Leydon, 2017). The effective use of ICT by preschool teachers ensures that children's achievement levels in math, science, language, art, music, and provides for the development of social skills, imagination, and creativity (Romero Tena, López Lozano, & Puig Gutiérrez, 2020). In general, exposing children to technology at an early age provides benefits and advantages in later development (Medeiros & Coutinho, 2012). The results of Otterborn, Schönborn & Hultén (2019) research showed a high level of engagement with digital tablets in Swedish early childhood educational institutions, implementing digitalization measures in the context of teaching various subjects to develop social and general skills. In Swedish early childhood educational institutions, programming, invention, design, and engineering have been introduced thanks to ICT as a result of the use of tablets by children in technological subject areas. Digital adaptation was seen in Sweden as a pedagogical advantage of using tablets, but due to a lack of skills, technology has been little integrated into teaching practice. In many countries, however, these institutions do not have a tradition of teaching individual subjects, and research shows that many preschool teachers are unsure of what learning technologies should include and how to teach them (Sundqvist & Nilsson, 2018; Fridin, 2014).

Another line of research in the informatization of early childhood education concerns the attitudes, intentions, and attitudes of educators and staff toward ICTs and their use in educating and teaching preschoolers (Jimoyiannis & Komis, 2007; Masoumi, 2015; Preradović, Lešin & Boras, 2017). In general, preschool teachers have a favorable attitude towards the use of ICT in learning (Popa & Bucur, 2015). At the same time, educators note the possible risks associated with the side effects of technology use, leading to reservations, limitations, and moderate caution (Karagiannidis, Karamatsouki & Chorozidis, 2020). The opinion and attitude of preschool teachers are often determined by different factors: educator's experience in teaching and learning, experience in using ICT and knowledge, mastery of skills in using ICT in teaching, parenting, confidence in own abilities, taking professional development courses, and need for professional development of ICT skills (Kalogiannakis & Papadakis, 2019). Teachers' attitudes and beliefs about ICT use in teaching preschool children can be influenced by years of teaching, teacher self-efficacy in using ICT, and teacher accessibility to ICT (Jimoyiannis & Komis, 2006). Educator readiness to learn ICT skills is significantly related to psychological factors, namely internal ability to control, attitude toward computers, presented usefulness, sense of stress, ease, and anxiety (Jimoyiannis & Komis, 2007). At the same time, there are differences in the use of CIT among preschool teachers: preschool teachers show higher self-efficacy due to their experience with ICT, some categories of teachers may be more positive about the use of technology in early childhood educational institutions. The teachers who receive training to develop ICT skills tend to have more positive perceptions of their use, noting their potential to improve digital skills (Research Group of Smart Learning Institute Ting-Wen Chang, 2020).

The third area of research concerns the need for governmental efforts and activities at the national level to shape and implement educator training programs with attitudes and perceptions of ICTs as effective tools in the education of preschool children, developed during professional training. For example, in Greece, departments of early childhood education have integrated ICT modules into students' curricula. These modules are directed to the development of the digital competence of educators before learning how to use ICT in early childhood education (Masoumi, 2015).

There is limited research in the scientific literature on professional training, readiness, practices of ICT use in early childhood education, and professional development for the use of ICT in early childhood education in EU countries.

3. Research Methods and Methodology

The first part of the study used the method of statistical analysis to assess early childhood education in the EU countries in the context of the load on educators, staff, growth in the number of preschoolers and teaching staff, the total costs of early childhood education in different countries, the funding mechanisms of early childhood education. For the detailed analysis, France, Poland, Czech Republic, Germany were chosen as examples of countries with different levels of load on the teaching staff, which can explain the use of technology to reduce the level of load on the tutors in the preparation, education, training of preschool children.

The second part of the study uses the results of the OECD Preschool Teacher Survey (2020), TALIS 2018 Results (Volume II). The Czech Republic and France were chosen to analyze the inclusion of ICT training subjects for preschool teachers, the use of ICT in the teaching of preschool children due to the availability of data. The analysis is based on data from 3,006 teachers in France and 3,447 teachers in the Czech Republic in early childhood education.

4. Results and Discussion

Informatization of early childhood education in EU countries is aimed at solving several problems, which are common for the different countries. ICTs are used as a means of sharing experiences and practices in the education and training of preschool children, communication, both at the national level and locally - within early childhood educational institutions, as a means of document management, search, processing of data and information for the management of early childhood educational institutions, planning of their education activities.

The UK (Average rate 27.74 for 2013-2019) and France (23.74) have the highest preschool teacher workload. The second group of countries in terms of workload is Turkey (17.05), Portugal (16.72), Norway (16.58), Netherlands (16,27), Romania (15.65), Poland (15.12), Belgium (14.87), Cyprus (14.75), Spain (14.57), where the average ratio of preschool teachers to staff ranges from 14-17. The third group includes the following countries: Austria (13.54), Czech Republic (13.4), Italy (12.78), Malta (12.55), Bulgaria (12.44), Hungary (12.35), Serbia (12.23), Slovakia (12.17), Luxembourg (11.81), Croatia (11.61), Liechtenstein (10.95), Slovenia (10.9), Greece (10.85), Latvia (10.55), Lithuania (10.32). The fourth group includes more developed countries: Finland (9,86), Germany (9.70), Denmark (7.70), Sweden (7.37), Iceland (5.31). For a further detailed analysis of the relationship between changes in early childhood education and informatization, the analysis was carried out on the example of one country in each group: France, Poland, the Czech Republic, and Germany (see Fg.1).

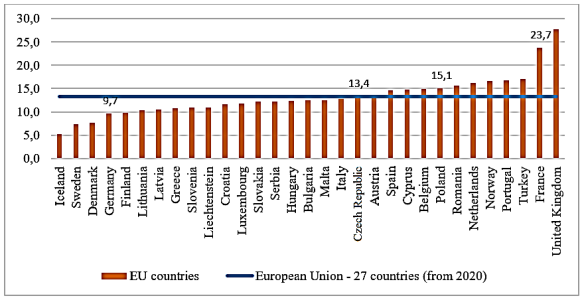

Figure 1. The ratio of pupils and students to teachers and academic staff in EU-27 in 2013-2019. The average rate (Pre-primary education)

Overall, the number of early childhood education staff in France increased by 8% with an annual growth rate of 1% over 2013-2019; in Poland, the figures were 22% and 4%; in the Czech Republic - 18% and 3% respectively, in Germany – 75% and 1% respectively (see Tab. 1). Countries vary in the number of preschool staff in the Czech Republic, the average labor force for 2013-2019 was 28.859 people, in Germany – 239.333; in France – 237.250, and in Poland – 233.412.

Table 1. Average and total growth rate of classroom teachers and academic staff of pre-primary education in EU-27, %

2014	2015	2016	2017	2018	2019	Average growth rate, %	Total growth 2019-2013 %
European Union - 27 countries (from 2020)							
2%	0%	2%	1%	7%	-1%	2%	12%
Czech Republic							
5%	3%	3%	3%	1%	2%	3%	18%
Germany							
0%	1%	1%	1%	2%	2%	1%	7%
France							
2%	1%	1%	2%	1%	1%	1%	8%
Poland							
0%	4%	4%	-2%	26%	-11%	4%	22%

At the same time in France, the number of preschoolers decreased by 2% in 2013-2019; in Poland – increased by 15% with an annual growth rate of 3%; in the Czech Republic, there was an overall growth of 3% with an annual growth rate of 0.4%; in Germany - by 9% with an increase of 2% each year. It should also be noted that the number of preschoolers varies in countries: 367.174 in the Czech Republic (average for 2013-2019); 2.287.459 in Germany; 2.563.477 in France, and 1.277.683 in Poland (see Tab.2).

Table 2. The average and total growth rate of Pupils enrolled in early childhood education (pre-primary education) in EU-27, %

2014	2015	2016	2017	2018	2019	Average growth rate, %	Total growth 2019-2013, %
European Union - 27 countries (from 2020)							
1%	-5%	-1%	4%	0%	0%	0%	-1%
Czech Republic							
3%	1%	0%	-1%	0%	0%	0%	3%
Germany							
1%	0%	2%	2%	2%	2%	2%	9%
France							
1%	0%	0%	-1%	-1%	-1%	0%	-2%
Poland							
7%	-5%	-8%	14%	5%	2%	3%	15%

Thus, the greatest pressure on the staff in France should be attributed to a large number of preschoolers, which, despite the reduction, remained the highest of all countries. In comparison, in Poland, the significant staff load will be mitigated by the number of staff, which the country has grown over the 2013-2019 period. With almost equal numbers of staff in Poland and Germany, the countries differ significantly in the number of preschoolers, which Germany has twice as many on average over 2013-2019. The Czech Republic has the smallest number of

preschoolers and staff at the same time, but the increase in the workforce has been greater than the increase in preschoolers.

In France, total spending on early childhood education increased by 11% between 2012 and 2018 (see Tab. 3), in Poland by 51%, in the Czech Republic by 44%, and in Germany by 49%. Countries also differ in their funding mechanisms for early childhood education. In France, 100% is financed by the government, in Poland 78% by the government, 18% by the private sector, 3% by international organizations, and 1% by other non-educational private institutions. The Czech Republic and Germany have similar funding mechanisms: 87% and 85%, respectively, are funded by the government, 10% and 15% by the private sector, and 2% in the Czech Republic are funded by other non-educational private institutions.

Table 3. Total educational expenditure on early childhood education by type of source

GEO/SECTOR	Total economy	Non-educational private sector	Other non-educational private entities	General government	International organizations
2012					
Czech Republic	920,8	80,4	11,1	829,3	0,0
Germany	21 902,9	5 292,2	0,0	16 610,7	0,0
France	14 672,6	1 075,3	3,3	13 593,8	0,2
Poland	2 959,5	775,7	0	2 144,5	39,3
2018					
Czech Republic	1 329,3	135,5	31,5	1 162,3	0,0
Germany	32 578,9	4 841,2	0	27 737,7	0,0
France	16 248,6	0	3,7	16 244,1	0,8
Poland	4475	807,9	32,1	3 494,2	140,8
Share, 2018					
Czech Republic	100%	10%	2%	87%	0%
Germany	100%	15%	0%	85%	0%
France	100%	0%	0%	100%	0%
Poland	100%	18%	1%	78%	3%
Growth 2018/2012					
Czech Republic	44%	69%	184%	40%	0%
Germany	49%	-9%	0%	67%	0%
France	11%	-100%	12%	19%	300%
Poland	51%	4%	0%	63%	258%

France and the Czech Republic were chosen for further analysis of informatization differences due to limited data for Poland and Germany. To assess informatization, we analyzed the responses of preschool teachers according to the OECD Teachers and School Leaders survey (see Tab. 4).

Table 4: Assignment of early childhood education teachers in France and the Czech Republic

	Frequency	%
France		
Female	1951	64,9
Male	1055	35,1
Total	3006	100,0
Czech Republic		
Female	2607	75,6
Male	840	24,4
Total	3447	100,0

In France, 48.4% of early childhood school teachers have received formal professional training in the use of technology (see Tab. 5); in the Czech Republic, 43.5%, with much lower readiness to use ICT in teaching (see Tab. 6).

Table 5. Elements in form. educ. Use of ICT for teaching

	Frequency	%
France		
Yes	1456	48,4
No	1347	44,8
Total	2803	93,2
Czech Republic		
Yes	1501	43,5
No	1903	55,2
Total	3404	98,8

27.1% of French teachers claimed a low level of readiness to use technology; in the Czech Republic, the figure is much higher - 38.4%. Below the average level of readiness to use ICT was reported by 29.5% of French teachers and 31.4% of Czech teachers. 19.6% of French teachers and 18.6% of Czech teachers are well prepared, 3.9% and 8.1% respectively claim a high level of readiness.

Table 6. Prep. for tch. elements Use of ICT for teaching

	France		Czech Republic	
	Frequency	%	Frequency	%
Not at all	814	27,1	1322	38,4
Somewhat	886	29,5	1083	31,4
Well	588	19,6	641	18,6
Very well	116	3,9	278	8,1
Total	2404	80,0	3324	96,4

In France, 14.1% of teachers in the teacher training programs included subjects to develop skills in technology, including information technology, computer studies, construction/surveying, electronics, graphics and design, keyboard skills, word processing, workshop technology/design technology. In the Czech Republic, the rate was 24.3% (see Tab. 7).

Table 7. Subject cat. inc in form.educ. and train Technology

	France		Czech Republic	
	Frequency	%	Frequency	%
Checked (yes)	424	14,1	836	24,3
Not checked (no)	2490	82,8	2578	74,8
Total	2914	96,9	3414	99,0

The low percentage of inclusion is due to the low use of technology in teaching preschool children: in France teachers use technology in teaching in 8.6% of cases; in the Czech Republic – 13.1% (see Tab. 8).

Table 8. The subjects taught in current school year Technology

	France		Czech Republic	
	Frequency	%	Frequency	%
Checked (yes)	258	8,6	453	13,1
Not checked (no)	2656	88,4	2961	85,9
Total	2914	96,9	3414	99,0

Despite the low percentage of teachers using technology in instruction, 41.4% of France and 40.2% of the Czech Republic said they had taken professional development courses in ICT skills needed in education (see Tab. 9).

Table 9. Areas prof.dev. ICT skills for teaching

	France		Czech Republic	
	Frequency	%	Frequency	%
Yes	1245	41,4	1385	40,2
No	1163	38,7	1924	55,8
Total	2408	80,1	3309	96,0

15.7% of French teachers and 18.2% of the Czech Republic teachers reported no need for professional development of ICT skills for learning, 23.5% and 29.9%, respectively, low level of need, 34.2% and 37%, respectively, medium level of need, 21.5% and 13.3%, respectively, high level of need (see Tab. 10).

Table 10. Prof.dev needs ICT skills for teaching

	France		Czech Republic	
	Frequency	%	Frequency	%
No need at present	471	15,7	628	18,2
Low level of need	707	23,5	1030	29,9
Moderate level of need	1029	34,2	1277	37,0
High level of need	647	21,5	459	13,3
Total	2854	94,9	3394	98,5

Thus, early childhood education in France and the Czech Republic is characterized by similar and different characteristics. The high level of staff loading in early childhood education in France is associated with a large number of preschoolers, despite the increase in the number of the labor force, the level of loading has not decreased. In the Czech Republic, the ratio of preschoolers to the number of personnel is much lower. At the same time, the number of preschoolers increased by 3% over 2013-2019, while the number of personnel increased by 18%. The countries have approximately the same trends in the training of preschool staff in the use of ICT in the upbringing and education of preschool children.

In the context of professional development and professional development of preschool teachers, several training programs have been developed and implemented in EU countries at the national and European levels. For example, the programs "Preparing Teachers for ICT in Education", "Preparing Teachers for the Information Society/Basic Professional Development for All Teachers of Information and Communication Technologies" have been developed (Preradovic Lesin & Boras, 2016). In addition, teacher literacy and preparedness for using ICT in teaching have been proven in the academic literature (Melnyk et al., 2019). However, preschool teacher preparation programs lag far behind the systemic nature of elementary, secondary, or higher education and are characterized by a focus on digital technical skills rather than the use of ICT for preschoolers' development (Brazdeikis, 2020). Some research proves that preschool teachers have realized the importance of ICTs (Liu, 2017) and consider ICTs a useful tool for pedagogical practice and professional development. However, preschool teachers have a low level of confidence in their abilities and the potential of using ICT and its integration into early childhood education (Hofman, Mietlarek-Kropidłowska & Lachowicz, 2019). The literature notes an elementary set of digital competencies of preschool teachers and staff in general in the use of ICT (search, management information processing, documentation, communication, planning, reporting). The staff, in particular preschool managers, use standard software in their activities (PowerPoint, Flash, Photoshop, etc.). Thus, there is a lack of abilities and skills of educators in ICT integration and its use in learning activities (Vasiljević, 2020). The research found that most kindergartens have implemented courses for the professional training of educators, and most educators attended training on different topics of ICT use at different educational levels (Liu, 2017). However, the ineffectiveness of the training results was revealed, educators noted a lack of benefits and advantages in the use of technology in early childhood education (Holotescu, Grosseck & Andone, 2020). At the same time, numerous problems arise during preschool teacher training, such as the training potential of one educator, the mismatch between theory and practical use of ICT, the lack of systematicity of courses, and the diversity of educators' needs (Liu, 2017). It leads to the need to expand and reorganize teacher training modules (national, regional level, and local level – kindergarten) (Liu, 2017).

5. Conclusion

The informatization of early childhood education in the EU countries is aimed at solving several problems characteristic and common to different countries. ICTs are used as a means of sharing experiences and practices in the education and training of preschool children, communication, both at the national level and locally, within early childhood educational institutions, as a means of document management, search, processing of data and information for the management of early childhood education institutions, planning the activities of these institutions. In the EU countries, the level of workload on the staff of early childhood educational institutions varies, which is due to the different numbers of preschoolers and workforce. The greatest load on the staff is in France because of the large number of preschoolers, which, despite the reduction, remained the highest among all the countries. By comparison, Poland's significant workload will be mitigated by the number of staff, which the country has grown over 2013-2019; and with nearly equal numbers of staff in Poland and Germany, the countries differ significantly in the number of preschoolers, which Germany has twice as many on average over 2013-2019. The Czech Republic has the smallest number of preschoolers and staff at the same time, but the increase in the workforce has been greater than the increase in preschoolers. Countries also have different funding mechanisms for early childhood education, which determines the potential for digitalization. In France, total spending on early childhood education grew the least (by 11% between 2012 and 2018); in Poland by 51%; in the Czech Republic by 44%, and in Germany by 49%. In France, 100% is funded by the government, in Poland 78% is funded by the government, in the Czech Republic and Germany 87% and 85% respectively is funded by the government. The results of the survey of teachers' training in the use of ICTs and the level of specialists' readiness to use them in their studies indicate a mismatch between education and the practice of using technology. At the same time, given the high level of professional training of teachers in the use of technology in education, a low level of practice of ICT use in teaching preschool children was revealed. Teachers require professional development of ICT skills.

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