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TRENDS IN DIGITAL ADAPTATION OF SCHOOLS DURING THE COVID-19 PANDEMIC

Abstract. The COVID-19 pandemic has launched school digital transformation with educational technologies implemented in classrooms worldwide. Teachers and learners have faced the challenges of adaptation to a new mode – digitally-based distance teaching and learning. In this regard, a question arises, whether schools have adapted successfully to new digitally-based distance learning or failed. Therefore, the research is focused on revealing the trends in schools' digital adaptation and transformation during the COVID-19 pandemic worldwide. The research issue is solved due to a combination of various approaches, e.g. a qualitative content analysis of documents published online in 2020-2021 and conducting surveys and interviews of students at Ukrainian schools from December 2020 to February 2021. These approaches make it possible to reveal positive and negative trends in school digital transformation at macro- and micro levels from the perspective of pandemic-related measures on international and national levels, as well as students' perception of emergency distance learning. The research presents the ranks of countries in line with the accessibility and affordability of EdTech having been implemented in schools in crisis. Moreover, the research discusses the following issues: the COVID-19 pandemic impact on schools and school-related measures, EdTech implementation in classroom and schools' digital transition, digital divide and inequity in education, generation gap, learning loss and achievement gap, teacher's creativity and methodology shift. The collected data supports theoretical insights about trends in school education during the pandemic. The principal findings of the research are that the emergency integration of information technology in school education has changed the traditional way of teaching and learning worldwide. EdTech implementation encourages teachers to provide creative teaching and develop novel approaches to meet Net generation students' needs in a virtual educational environment. The research results can contribute to policymaking and strategy development of further school digital transformation in times of crisis.

Keywords: school education; digital transformation; distance learning; students' perspective; the COVID-19 pandemic.

1. INTRODUCTION

For a year during the COVID-19 pandemic (since March 2020), schools have experienced various formats – shutdowns, remote, hybrid and asynchronous and synchronous distance learning. These formats differ in their educational potential and impacts on education during the Coronavirus crisis. However, digitally-based distance learning could become the only accessible school response if pandemic risks increase in the future.

Time has passed since the first closure of schools in March 2020, but apparently not enough to draw final conclusions. Scholars continue debating the impact of the pandemic on teaching and learning, offering new evidence from around the world, e.g. [1], [2], [3], [4]. However, we can consider some lessons learnt from that period and observe the trends to prepare for new challenges. It becomes clear that the COVID-19 pandemic has affected traditional schools, modifying them to digitally-based distance learning as an alternative model in crisis. The Coronavirus has launched school digital transformation with educational technologies (EdTech) implementation in classrooms worldwide. As a result, teachers and students have faced the challenges of adaptation to a new mode – digitally-based distance teaching and learning.

Statement of the problem. However, there is no definite answer in the scientific literature on whether schools have adapted successfully to new digitally-based distance learning or failed. For example, Lim et al. [5, p. 61] warn that schools may not have benefited from EdTech use due to pressure on running schools, increased costs on EdTech and its 'rapid evolving nature'. However, scholars pay much attention to the COVID-19 pandemic impacts on schools. They reveal the negative consequences of virtual schooling caused by the lockdowns [4], [6], [7]. In turn, no investigation is focused on analysing current negative and positive trends, as any crisis could cause booms and busts. Moreover, there is no evidence from Ukraine among international schools responding to the COVID-19 pandemic. Therefore, the study objective is to explore schools' response to the COVID-19 pandemic worldwide and reveal the trends in their emergency digital transformation, with particular reference to Ukraine.

It is worth mentioning that a key notion – 'trends in digital adaptation of schools' is defined as complex phenomena. On the one hand, trends in education refer to the general direction in which the present educational systems, policies, theories and practices are developing or changing [8]. On the other hand, digital adaptation is the ability to perceive dramatic change and adjust through new combinations of technology, process and workforce management [8], [9]. Thus, trends in digital adaptation of schools refer to the direction of school developing or changing through adjustment to EdTech integration.

2. RESEARCH METHODOLOGY

As the study is focused on revealing the trends in schools' digital adaptation and transformation during the COVID-19 pandemic worldwide, a combination of various approaches is used. First, it is a qualitative content analysis of documents published online in 2020-2021 related to schools' responses to the COVID-19 pandemic. The resulting amount includes 42 documents. Second, a quantitative survey for data collecting was designed in Google Forms format and conducted online, with sampling based on a snowball technique. The resulting sample comprises 81 students from the capital schools. Third, a method of interviews was provided to explore some issues, for instance, revealing school students' experience of distance learning during the COVID-19 pandemic. The interviews were conducted by student teachers in February-March 2021 during the supervision and assistance practice at Kyiv and Kyiv region schools. This approach makes it possible to cover regional and capital schools with an interviewees sample of 248 respondents. The resulting sample comprises 329 students aged 10-16 from regional (78 students) and capital (251 students) schools. Thus, the data shown in this research corresponds to official portals for data, websites, blogs, reports, and publications collected for two waves of the COVID-19 pandemic, as well as surveys and interviews conducted at schools from December 2020 to February 2021.

The survey analysis is achieved through qualitative and quantitative methods. The collected data is visualised through tables and figures. In this regard, the presented results statistically indicate trends in school digital adaptation during the COVOD-19 pandemic.

3. FINDINGS

3.1.   The COVID-19 pandemic impact and school-related measures

The literature stresses the significant impact of the COVID-19 pandemic-related measures on schools. The international school closing has impacted over 60% of students. According to the official portal for European data [2], almost 1.6 billion children in 195 countries worldwide could not attend school at the peak of the crisis. In order to support continuity in education, countries provide measures varied on their economic background. The European Commission has listed online platforms and EU-funded projects for the Member States [2]. In Austria and Bulgaria, schoolbook publishers offer some of the content free of charge. In Kenya, electronic copies of textbooks have been made available for free for all students. Financial support was common practice for many countries to address the Coronavirus impact on education. For example, in Korea, the Ministry of Education has invested $250 million (about 4% of the total education budget in 2020) in supporting online education platforms, websites, school day-care services, and health equipment for teachers and students. In Peru, the Ministry of Education has spent $177 million purchasing tablets with solar chargers for students and teachers. In South Africa, a national telecom operator provided free access to learners [3]. California's schools and colleges received more than $6 billion for technology from the federal CARES Act [10]. In France, the United Kingdom, Norway, Portugal and the Netherlands, the schools remain open for children whose parents worked in essential services during the pandemic peaks [6]. Moreover, vulnerable students were given financial support and free school meals. Australia has provided students with support for travel, accommodation and tuition. In France, international students have received financial support, free food and plane tickets to return home. During school closures in the United Kingdom, schools provide free meals to students. In Spain, the families that benefited from a scholarship have received economic support and food. Schools in Italy, Portugal and Serbia provide vulnerable Roma families with running water, food and medication [6].

In Ukraine, the emergency school transition to distance education in the early stages was slow and without vital support from the government, which introduced a lockdown in March 2020. Schools closed and transmitted to remote learning, primarily through Viber and Telegram messengers, to complete tasks. Later, in March – April, to support schools in digital transition, the government created an educational portal "Naurok" (https://naurok.com.ua/) and launched the educational platform "All-Ukrainian School Online" (E-SCHOOL.net.ua) – television lessons in all subjects for grades 5-11. Final exams were cancelled in May. During the lockdown, schools were responsible for the educational process organisation without adequate financial support, and special teacher training was urgently needed to develop digital literacy and awareness of challenging EdTech, primarily for aged teachers. Though, recommendations on distance learning from the Ministry of Education and Science (MOES) appeared in June 2020, after the school year finished. On the new school year's eve in August 2020, the MOES implemented an online course "For teachers and school leaders on distance and blended learning." However, few teachers had opportunities and time to undergo appropriate training. In fact, in September-December 2020, teachers were forced to search for affordable digital platforms to provide distance learning.

Undoubtedly, during the spring of 2020, some teachers gained considerable experience working with digital tools and could improve their digital literacy skills. However, the problem of access to quality educational content remained relevant at the beginning of the new school year. The 2020/2021 academic year began with the adaptive quarantine introduced by the government, i.e. quarantine restrictions depending on zoning:

1. In the green and yellow zones, school attendance was allowed in compliance with all security measures.
2. In the orange zone – attending classes was allowed in groups of less than 20 pupils, except for preschool and secondary schools. Most classes were divided into two groups – learning in person and online. This shift took place every other day or week, depending on the school, which causes an additional workload for teachers.
3. In the red zone, students were utterly forbidden to attend school.

The zoning approach worked until November 2020, when the national government abolished the zones and introduced universe lockdown restrictions for all regions. Adaptive quarantine and zoning have further exacerbated the negative impact of various quality distance learning on students' academic achievement. After all, while some schools were operating, others were closed during the autumn of 2020. Furthermore, teachers had free and unregulated access to any educational platform during that period. Consequently, teachers were likely to have promoted various digital tools at hand. In December 2020, television lessons for grades 5-11 were continued on the "All-Ukrainian School Online" platform. Thus, the distance learning transition preparations were completed only at the end of the 2020/2021 school year and resulted in electronic registers implementation in school practice. Besides, the government has allocated almost ₴1 billion to combat the Coronavirus impact on schools, whose part was spent purchasing 400,000 laptops to equip teachers with digital devices for distance learning provision [11].

3.2. EdTech integration and school digital transition

On the eve of the COVID-19 pandemic, digital learning resources were available in some schools in only 20% of countries. Only 10% of countries had more robust digital learning opportunities, offering educational materials offline. No country has a universal digital curriculum for teaching and learning [2]. Schools in the majority of countries met the Coronavirus crisis unready and unprepared, e.g., in Serbia, teachers evidence a lack of educational institution readiness for digital challenges [12]. However, global schools responded to lockdowns with rapid EdTech implementation and digital transition. According to UNESCO data, most education systems of the 61 surveyed countries implemented measures related to distance learning [2]. The distribution of free ICT devices and educational materials to reach all learners is common in OECD Member Countries. For example, learners received nearly 125,000 computers with Internet connections in Chile and weekly homework packages in Italy and Greece. Australia, with its long-standing practice of using EdTech, offers real-time distance teaching (video conferences, phone and satellite lessons, virtual excursions) and non-real-time teaching (e-mail and online learning management systems (Moodle)) [6].

In this regard, based on the summarised data from 77 countries collected by the OECD [6] and the World Bank [3], the research ranks countries in line with the accessibility and affordability of EdTech having been implemented in schools in crisis (see Table 1).

The results show that TV and radio broadcasting was the most affordable and usable EdTech during the COVID-19 pandemic due to its accessibility (95% of the population has a TV) to ensure learning continuity in low-income countries [13]. The next popular EdTech is the national

educational portal and websites created by countries, and the last one – learning platforms utilised for posting assignments, tests, grades and feedback to students as well as conducting virtual classes.

Table 1

EdTech emergency integration at school by countries

Rank	EdTech	Countries Group
73%	TV and radio broadcasting of video lessons	Afghanistan, Argentina, Austria, Bangladesh, Bhutan, Brazil, Bulgaria, Cambodia, China, Colombia, Costa Rica, Croatia, Ecuador, El Salvador, Ethiopia, Fiji, Finland, France, Gaza, Georgia, Guyana, Indonesia, Jamaica, Jordan, Kenya, Korea, Kuwait, Liberia, Libya, Madagascar, Mauritius, Mexico, Mongolia, Morocco, New Zealand, Nigeria, North Macedonia, Peru, Portugal, Rwanda, Saudi Arabia, Serbia, Sierra Leone, Somalia, South Africa, South Sudan, Spain, Tanzania, the Czech Republic, the Dominican Republic, the Kyrgyz Republic, Turkey, Uganda, Ukraine, and Zimbabwe.
60%	The national educational portal and a centralised education website	Argentina, Austria, Australia, Bermuda, Bolivia, Bulgaria, Chile, China, Colombia, Costa Rica, Cote D'Ivoire, Ecuador, Egypt, Finland, France, Gaza, Greece, Guyana, India, Indonesia, Italy, Japan, Jordan, Kenya, Korea, Liberia, Malaysia, Maldives, Mexico, Moldova, Mongolia, Morocco, Nigeria, Poland, Russia, Rwanda, South Africa, the Czech Republic, the Dominican Republic, the Kyrgyz Republic, the UK, the USA, Tunisia, Turkey, United Arab Emirates, and Uruguay.
28.5%	Learning platforms and cloud solutions from Microsoft and Google	Armenia, Austria, Australia (Moodle), Belize (the CXC Learning Hub), Bulgaria, Croatia (Loomen, Microsoft Teams, Yammer, LMS), Ecuador, El Salvador, Finland, Georgia, India, Jamaica, and Maldives.
16%	Social media applications	Bhutan, China, Finland, Jamaica, Peru, Rwanda, Serbia (Viber), South Africa, South Sudan, the Dominican Republic, the Kyrgyz Republic, and Ukraine (Viber, Telegram).
5%	MOOCs	Canada, China, India, and Korea.

In Ukraine, the following EdTechs are widely provided, i.e., collaboration platforms for live-video communication (Zoom – 70%, Google Meet – 21%) for virtual classes (91%) and social media applications (Viber – 36%, Telegram – 25%) for home assignments (61%), while digital learning management systems (Google Classroom – 24%) are less demanded at schools (see Table 2).

Table 2

School students' experience of distance learning during the COVID-19 pandemic

Students' evidence	Regional schools	Capital schools	Total
EdTech used at school	*N=78*	*N=113*	*N=191*
Zoom	90%	57%	**70%**
Viber	51%	26%	**36%**
Telegram	44%	12%	**25%**
Google Classroom	54%	3.5%	**24%**
Google Meet	29.5%	16%	**21%**
Attitude to distance learning	*N=78*	*N=178*	*N=256*
Interesting & beneficial	85%	40%	**53.5%**
Boring & non-beneficial	50%	23%	**31%**
Entertaining & advantageous	65%	14%	**29%**
Tiring & disadvantageous	45%	11%	**21%**

Technical problems	N=78	N=178	N=256
No problems	58%	28%	**37%**
Lack of Internet access at home	9%	21%	**17.5%**
Poor Internet connection	37%	6%	**16%**
Lack of access to devices	11.5%	7%	**8.5%**
School mode in future	*N=77*	*N=332*	*N=409*
Distance learning	22%	52%	**47%**
Traditional	38%	40%	**40%**
Hybrid	51%	16,5%	**23%**

3.3. Digital divide and inequity in education

The digital divide encompasses a gap between students' need to utilise digital tools for learning and teachers' capacity to incorporate EdTech into the classroom effectively. The digital divide is gaps in ICT access and use of digital tools based on income or education level [14, p. 104]. The 21st-century learners consider technology a tool for communication and interaction with others. In contrast, teachers "view technology as a tool to research and present information in a visual manner" [14, p.105]. This different understanding of EdTech bridges a digital gap between teachers' usage and students' needs in the classroom.

Impacted by the COVID-19 lockdown, many countries report the digital divide in distance learning. Globally, 50% of students do not have a household computer, and 43% do not have access to the Internet at home. In sub-Saharan Africa, 89% of learners do not have household computers and 82% lack Internet access. In Cameroon, only 20-25% of teachers have access to a computer, making the transition difficult or impossible. Therefore, to bridge this gap, 57% of school teachers have been trained to teach online [7]. In Armenia, 25% of students lack computer access, and 47% of teachers have never used ICT in their classes. In Canada, 15,000 teachers were trained to conduct classes online [13].

On the contrary, 65% of teachers have the necessary technical and pedagogical skills to integrate digital devices in the classroom across OECD countries. Besides, almost 50% of the education systems provide additional training to prepare teachers properly for distance teaching [2]. Gao & Hayes [10] report inequity in distance learning access among low-income African American and Latino students. Azubuike et al. [15] have found significant differences in digital tool access between students in public and private schools in Nigeria. It indicates the digital divide's dependence on socioeconomic status in access to digitally-based education. Nevertheless, by autumn 2020, 79% of students have expanded access to computers and the Internet due to government investments.

In Ukraine, 55.53% of schools faced challenges with a digitally-based learning environment due to a lack of experience. Therefore, the majority of schools were unprepared to provide distance learning during the Coronavirus crisis. Furthermore, 47.5% of teachers reported not using EdTech in their pedagogical activities before the pandemic. Moreover, most teachers did not receive guidance on distance learning or ICT tools implementation in the classroom. In addition, a significant problem that hindered effective teaching and learning was the lack of ICT devices at home (67.35%) and the low quality of Internet connection (46.9%) [4].

In turn, the transition to distance learning has revealed the inequality between students in villages and cities in ICT access, since over 4 million Ukrainians live in villages with poor Internet connections. 40% of schools located in villages or towns do not have access to high-speed Internet. Besides, 17% of schools are located in areas without any Internet provider, which means that digitally-based schooling here is a challenge for teachers and students. For example, in the mountainous district of the Ivano-Frankivsk region, 26% of students received assignments through

SMS due to a lack of Internet access. Besides, students report low access to ICT devices – the majority (81.6%) used mobile phones for distance learning, while the minority used laptops (45.6%) and computers (34.3%) [11].

Moreover, the questioned school students in Kyiv – the capital city and Kyiv region – show the iniquity in distance learning access, namely, only 64% of regional students' evidence about providing virtual classes by their schools. Though the majority of respondents face no technical problems, regional students (37%) have a poor Internet connection and students of the capital (21%) lack Internet access at home. Students' preference of the future school mode also significantly varies due to different distance learning qualities. Hence, the adopters of hybrid learning are regional students (51%) vs online learning preferred by students of the capital (52%) (see Table 2).

3.4. Generation gap

School adaptation to a digitally-based environment has deepened the generation gap referred to a particular age group with distinct cultural, economic and technological backgrounds [16]. Teachers have faced "digital natives' who are growing up with technology as a no remarkable feature of their world" [5, p. 65]. Traditional pedagogical approaches have proven insufficient for the digital school, requiring new methods to meet Net generation students' needs [17]. A virtual educational environment is likely to be more efficient for Generation Z students (the mid-1990s – early 2000s), who derive knowledge from the Internet and focus on a quick search for information. These students are "more partial towards learning via mobile applications and video content over the traditional form" [18, p. 1]. Embedding technology in education can become a vital problem-solving of low attention of the next Generation Alpha (between 2010 and 2024) [19]. Therefore, teachers should have a high level of digital literacy to teach online effectively. However, on pandemic eve, few secondary schools matched the 21-st century learning, with the teachers hanging on to the traditional instruction and ignoring students' preparation for the digital world [20]. The COVID-19 crisis accelerating digital school transition has revealed teachers' weak digital competence. For instance, before the COVID-19 pandemic, only two-thirds of Greek students were taught by competent digital teachers. During the school shutdowns, the teachers used digital tools primarily for searching and developing educational material, assessment, interacting, and communicating with students, but hardly for feedback and final evaluation [21]. Besides, teachers used the ICT devices in a more reproductive than constructive way, which impedes effective EdTech integration into education for students to gain 21st-century competencies [19]. Cruzado et al. [22] report teachers' low self-perception of their digital skills. They urgently require special training for improving awareness of EdTech and an around-the-clock mentoring system to assist a teacher in an emergency technological situation [23].

The majority of questioned students in Ukrainian schools (73.5%) point to their teachers' low digital literacy skills for conducting classes online effectively (see Table 4). On the other hand, students find distance learning interesting and beneficial (53.5%) (see Table 2). Furthermore, from the student's perspective, despite the preference for course books (62%), the use of digital resources such as video (59%) and online learning games (50%) would improve teacher instruction (see Figure 1).

As a result, Toth [24, p. 1] warns that systemic academic gaps and an economic collapse caused by the COVID-19 pandemic may lead to "a bleak future for many students", creating the Lost COVID-19 Generation. Therefore, the pandemic crisis requires rethinking teachers' digital skills as students have gained awareness of digitally-based learning, and together with teachers, they have experienced a significant turning point in the evolution of EdTech use. Furthermore, considering the prospect of online education playing a significant role as school systems adjust to the post-pandemic

world, teachers should clearly understand the emotional, social, and affective aspects of digitally-based education and be confident in their proficiency to respond appropriately [25].
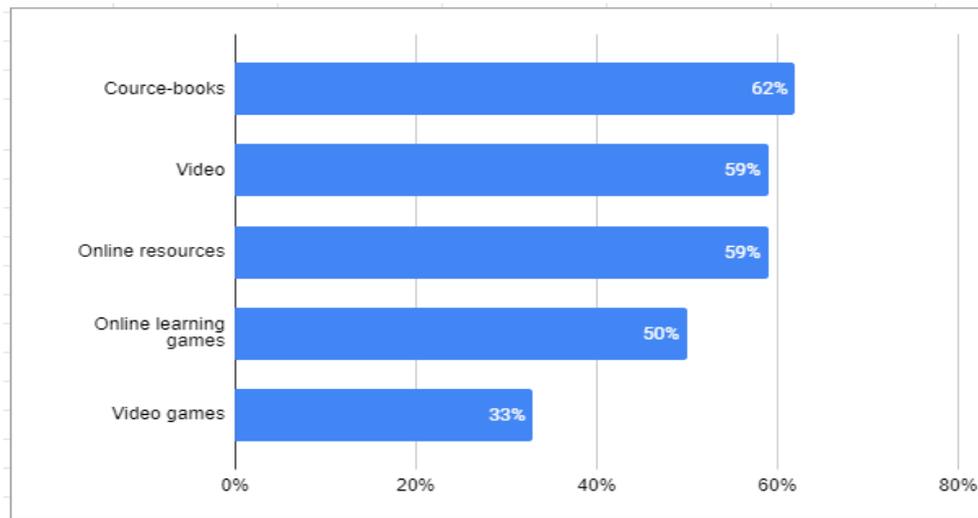
Figure 1. Resources students would like to be used at school more

3.5.   Adaptation gap

Distance learning during the Coronavirus lockdown is perceived differently and even opposite by teachers and students due to social and economic background. Globally, the majority of teachers rated remote learning effectiveness with low marks (at 1-5 out of 10) in spring 2020, namely 60% of teachers in Japan and the United States. Though among the adopters of online classes are teachers in Australia, Canada, and Germany, who find no difference in effectiveness between remote and traditional learning. Moreover, teachers evidence the attainment gap widening between public and private schools whose teachers have better access to ICT tools [26].

In general, teachers perceived distance learning with less enthusiasm than students. Almost 62% of surveyed teachers from Europe and North America provided virtual classes during the COVID-19 pandemic, although 79.1% had no prior experience with teaching online. More than 62% of respondents found remote teaching less effective than face-to-face classes [27]. Besides, distance learning has been less successful for teachers in Turkey than learning in person due to the lack of live communication and interaction. In addition, student engagement played a crucial role in teacher satisfaction. As a result, teachers have kept the traditional pedagogical methods in classes online [28]. Although Indonesian teachers positively perceived online learning during the COVID-19 pandemic, more than half of the respondents disagreed with its effectiveness [29]. The teachers reported barriers to practical virtual classes, both internal and external – difficulties arising from the student's home environment and the disturbances from other students in a virtual classroom [30]. In July 2020, about half of questioned adult Ukrainians did not support distance education [4].

On the contrary, school students show a positive attitude to digitally-based education. For example, in India, students liked online classes during the pandemic. However, 37% of respondents showed lack of teaching online improvement and 55% of students prefer the traditional learning mode during the post-pandemic time [31]. In Ukraine, the majority of students (58%) have enjoyed distance learning, and 75% of the respondents have adapted to it quickly. Besides, 62% of learners are satisfied with the national educational platform "Naurok". In learning online, students prefer

the opportunity to be trained in a comfortable home environment (49%), schooling flexibility (33%) and EdTech use (31%). However, students faced challenges with daily routine adaptation and self-organisation in a new learning environment (39%), a large amount of homework (37.5%) and a lack of communication with classmates (30%) (see Table 3). As a result, the student's future school perception varies from online (47%) to traditional (40%) mode (see Table 2).

Table 3

School students' adaptation to distance learning

Interview issues	Number of respondents
Distance learning adaptation range	*N=48*
Perfect	52%
Good	23%
Satisfactory	17%
Bad	8%
Distance learning preference	*N=161*
Like	58%
Dislike	42%
Advantages of distance learning	*N= 67*
Training in the comfortable home environment	49%
Educational process flexibility	33%
EdTech use	31%
Self-paced learning	10.5%
Self-directed learning	6%
Opportunity to revisit presentations and other materials	6%
Disadvantages of distance learning	*N=232*
New learning environment	39%
Large amount of homework	37.5%
Lack of communication with classmates	30%
Lack of communication with the teacher	8%
Poor collaboration platforms use proficiency	7%
Poor ICT skills	6.5%
Fast fatigue	4%

3.6. Learning loss and achievement gap

Low-quality remote/virtual instruction caused by emergency school digital transition during the COVID-19 pandemic put students at risk for significant learning loss and an achievement gap. Learning loss refers to "any specific or general loss of knowledge and skills or to reversals in academic progress, most commonly due to extended gaps or discontinuities in a student's education" [32, p. 1]. Current studies worldwide show significant learning loss after schooling online in crisis. For example, in the Netherlands, with a short lockdown, fair school funding and world-leading rates of school access, students made poor progress. A learning loss is about 3 points, primarily among students from less-educated homes (60%), which reveals inequity in education in low-developed countries or prolonged school closures [33]. In Britain, the spring 2021 state test results demonstrate an insignificant drop of 5 points, while student performance has dropped by 25 points [34]. Based on the Program for International Student Assessment (PISA), which measures 15-year-old students' reading, mathematics, and science literacy, recent studies estimate that Indonesian children have lost 11 points on the reading scale [35], in Kazakhstan – 8 PISA points and many students show functional illiteracy [36]. Under the projections of COVID-19-related

learning loss, students will likely retain about 70% of their reading and less than 50% of their maths skills [37]. According to the World Bank Group [3, p. 16] optimistic scenario, "students stand to lose 7 PISA points, and in the pessimistic scenario, to lose 27 PISA points".

Significant problems in distance learning, according to questioned adult Ukrainians in July 2020, were the lack of teachers' attention to the learners' needs (22%) and the students' performance decline (26%) [4]. The learning loss after the year of the pandemic is 8%. However, the national MOES does not consider this indicator critical. According to the State Service for Education Quality monitoring, the quality of distance learning has improved by 10-15% since December 2020, and in May 2021, it reaches 70-75% [11].

To narrow the achievement gap after the 1-st wave of the COVID-19 pandemic, many governments suspended or cancelled exams in May 2020. For example, in the USA, spring exams were cancelled. In Belize, final grades were awarded based on student performance and e-testing. In Egypt, exams were cancelled for grades 3-7 as well, and computer-based pilot tests were conducted for grades 10-11. Final exams for junior classes, in Indonesia, were replaced by online tests, and for high school, the final assessment was carried out based on the school performance for five semesters [3].

Thus, distance emergency teaching-learning has shown that traditional classroom instruction does not match digital educational settings. Toth [24, p. 8] believes that if teachers are not supported to reskill for distance learning, the achievement gaps will become achievement chasms.

3.7. Teacher's creativity and methodology shift

On the other hand, the COVID-19 pandemic school closure has resulted in various beneficial effects, e.g., rapid EdTech development and implementation at schools. For example, 22 digital platforms mobilisation to provide schools with free online courses in China, educational modules were developed to support teachers in training for online learning provision in Jamaica, and the government supported innovative initiatives in developing an educational Minecraft server in Poland [3]. Second, classes virtualisation worldwide, namely 81% of students in China [38], 89% of students in Bulgaria and 22 million students in Egypt attend virtual classes. In Croatia, teachers also provide virtual classrooms daily [3].

It is worth mentioning that school digitalisation has enhanced changes in teaching methods via EdTech. For example, in the academic year 2020/2021, an effective method was adaptive learning (50%) [39]. Teachers use asynchronous and synchronous interactive activities and homemade videos in Taiwan [40]. In the case of Ukraine, the survey analysis shows that during distance learning, teachers provide PowerPoint presentations (81%), visual aids (63%), and YouTube channels (51%) in classes online. In addition, teachers support their oral explanation or new material presentation with videos and visual aids (49%). Although teachers continue using course books (60.5%), online exercises on the Internet also occur (37%). Accordingly, there is a trend in learning ways shift as well. In virtual classes, students freely communicate and receive teachers' feedback (91%). Although the traditional course-book exercises still dominate (41.5%) in virtual classes, digital visualisation of learning material and online exercises are widely implemented. Moreover, the majority of students (56%) evidence the study load increase and addresses their parents' help when a home assignment is unclear (43%) (see Table 4).

The integration of EdTech in school education has changed the way of teaching and learning, but it has a significant impact on creative teaching. Anderson et al. [41] show that the COVID-19 pandemic caused one teacher to stress and lose creativity, while it could also boost other teachers' creativity. Though there is a lack of evidence about it, we assume that teachers with access to the right technology could conduct creative online teaching while developing a new educational

product. Faced with challenging digital environments, teachers could undoubtedly devise creative learning material. Bubb and Jones [42] evidence that 70% of Norwegian students have performed more creative tasks as their teachers have more time for creativity in online learning. In Canadian public schools, both teachers and students have been creative [43]. In Ukraine, in challenging distance learning, teachers use various ICT tools (PowerPoint presentations (81%), YouTube (51%)), offer students creative tasks (36%) and teacher-made tasks (17%) as well to foster student's engagement (see Table 4). Moreover, creative teachers transmitted their good digital practices through YouTube channels, contributing to training their colleagues.

These findings prove the scholars' belief that EdTech integration in schooling reshapes teachers' pedagogical knowledge and skills, fostering student motivation and focusing on bridging the gap between generations of students and teachers [14, p. 114]. EdTech in the classroom will evolve further, and "online education will eventually become an integral component of school education" [38, p. 1].

Table 4

Students' perception of teaching methods during distance learning

Interview issues	Number of respondents
ICT tools teachers use in classes online	*N=43*
PowerPoint presentation	81%
Visual aids (images, tables)	63%
Course-books	60.5%
YouTube channel	51%
Oral explanation only	49%
Internet service for multimedia didactic exercises	21%
Approaches to learning material presentation	*N=106*
Oral explanation is supported by videos and visual aids	48%
Various visual aids without feedback	29%
Material and exercises from the course-book	23%
Assignments offered by teachers	*N=106*
Exercises from the course-book	41.5%
Interactive exercises from the Internet	37%
Creative tasks	36%
Written tasks, essays	24.5%
Teacher-made assignments	17%
Teachers' feedback	*N=77*
Provide communication and feedback in class	91%
No feedback	9%
Teachers' ICT competence for effective online learning	*N=98*
Not enough	73.5%
Enough	26.5%
Study load change	*N=125*
Increased	56%
No change	28%
Decreased	16%
Parents help with learning	*N=82*
Parents help with unclear homework	43%
Self-directed learning	32%
Parents always help	24%

4. DISCUSSION AND CONCLUSIONS

The investigation of schools' response to the COVID-19 pandemic worldwide makes it possible to reveal the following trends in school digital adaptation and transformation:

Macro-level (international and national) – emergency school digital transition; schooling online in crisis; universal measures, primarily financial support varied on countries' economic background; rapid EdTech integration and schools digital transition; the most provided EdTech are TV and radio broadcasting, a national educational portal, websites, and learning platforms; iniquity in education between countries (developed vs developing), school location (cities vs villages), school finance (public vs private); low-quality remote/virtual instruction; learning loss and achievement gap; suspended or cancelled final exams; classes virtualisation.

Micro-level (teachers and students) – a digital divide between students' needs and teachers' weak digital competence; socioeconomic iniquity of teachers and students (low-income vs high-income) in access to digitally-based education; increase in generation gap; teachers' and students' opposite perception of distance learning; teachers' lack of experience in distance teaching; launching digital reskilling of school teachers; adaptation gap, i.e. students enjoy distance learning and have adapted to it quickly; changes in teaching methods via EdTech use; a diversity of ICT devices utilising; learning way shift – digital visualisation and online exercises promotion; study load increase; emergence of digital creative teaching.

The research findings show that the emergency integration of EdTech in school education has changed the way of teaching and learning. It encourages teachers to develop new methods to meet Net generation students' needs in a virtual educational environment. As a result, students perceive distance learning as an exciting and beneficial format. From their perspective, using digital resources such as video and online learning games would improve teachers' instruction. Students' need for digital games in the classroom is explained by gamification educational capacity, namely, motivation and rewards, which are essential in achieving the learning outcomes [44]. Thus, Generation Z students choose online learning as a future schooling mode.

Moreover, digital adaptation of schools during the COVID-19 pandemic shows negative and positive trends. On the one hand, emergency EdTech implementation in classrooms has driven various gaps, i.e. digital divide, generation gaps, achievement gap, attainment gap, learning gaps and inequity in education. On the other hand, the digital school transition has boosted online educational resources use and enhanced digital creative teaching. The emergency school digital adaptation during the COVID-19 pandemic has transformed teaching methods to meet Generation Z students' needs. They have received a digitally-based learning environment with virtual classes, EdTech use, online exercises, and visual learning aids. Confirming Miranda's [45] assumption, it is worth emphasising that if in pre-pandemic times, digital technology was part of students' everyday life activities, in the pandemic, it has become a part of their learning. Prospects for further research refer to the digital transformation of school education in the post-pandemic.

REFERENCES (TRANSLATED AND TRANSLITERATED)

[1] J-I. Pozo, M-P. Pérez Echeverría, B. Cabellos, and D.L. Sánchez, "Teaching and learning in times of covid-19: uses of digital technologies during school lockdowns," *Front. Psych.*, vol. 12, 2021, Art no. 656776, doi: 10.3389/fpsyg.2021.656776. (in English)

[2] "Education during COVID-19: moving towards e-learning," *The official portal for European data,* data.Europa.eu, Jun. 22, 2020. [Online]. Available: https://data.europa.eu/en/impact-studies/covid-19/education-during-covid-19-moving-towards-e-learning (in English)

[3] "Simulating the potential impacts of covid-19 school closures on schooling and learning outcomes: A set of global estimates (English)," *World Bank Group*, Washington, DC, Jun. 18, 2020. [Online]. Available: https://www.worldbank.org/en/topic/education/publication/simulating-potential-impacts-of-covid-19-school-closures-learning-outcomes-a-set-of-global-estimates (in English)

[4] "Coronavirus and education: Analysis of the pandemic impacts and consequences," *CEDOS*, 2020. [Online]. Available: https://cedos.org.ua/researches/koronavirus-ta-osvita-analiz-problem-i-naslidkiv-pandemii/ (in Ukrainian)

[5] C.-P. Lim, Y. Zhao, J. Tondeur, C.-S. Chai, and C.-C. Tsai, "Bridging the gap: Technology trends and use of technology in schools," *Ed. Tech. & Soc.,* vol. 16, no. 2, pp. 59–68, Apr. 2013. [Online]. Available: https://drive.google.com/file/d/15hZWq6K0VVQ0xqMezhFKagROwMf3ectH/view (in English)

[6] "The impact of COVID-19 on student equity and inclusion: Supporting vulnerable students during school closures and school re-openings," *OESD Policy Responses to Coronavirus (COVID-*19), Nov. 19, 2020. [Online]. Available: https://www.oecd.org/coronavirus/policy-responses/the-impact-of-covid-19-on-student-equity-and-inclusion-supporting-vulnerable-students-during-school-closures-and-school-re-openings-d593b5c8/ (in English)

[7] "*COVID-19 highlights the digital divide in distance learning. International task force on teachers for education 2030,*" UNESCO, 2021. [Online]. Available: https://teachertaskforce.org/news/covid-19-highlights-digital-divide-distance-learning (in English)

[8] "Introduction to Trends and Issues," StuDocu. *California State University San Marcos*, 2022. [Online]. Available: https://www.studocu.com/en-us/document/california-state-university-san-marcos/sales-management/introduction-to-trends-and-issues/21816357 (in English)

[9] "What is Digital Adaptation?" *Digital Adoption Team*, 2022. [Online]. Available: https://www.digital-adoption.com/digital-adaptation/ (in English)

[10] N. Gao, and J. Hayes, "The digital divide in education," *Public Policy Institute of California*, Oct. 2021. [Online]. Available: https://www.ppic.org/publication/the-digital-divide-in-education/ (in English)

[11] "Health and education: How the COVID-19 pandemic affected access to public services in Ukraine," Analytical review, 2021. [Online]. Available: https://nus.org.ua/wp-content/uploads/2021/03/Analitychnyy-oglyad.pdf (in Ukrainian),

[12] D. Kulić, and A. Janković, "Teachers' perspective on emergency remote teaching during covid-19 at tertiary level," *Information Technologies and Learning Tools, T*., vol. 89, no. 3, pp. 78–89, Jun. 2022. doi: https://doi.org/10.33407/itlt.v89i3.4758. (in English)

[13] "Dealing with obstacles to distance learning," *UNESCO*, Apr. 20, 2020. [Online]. Available: https://en.unesco.org/news/dealing-obstacles-distance-learning. (in English)

[14] P. S. Lisenbee, "Generation gap between students' needs and teachers' use of technology in classrooms," *J. Lit. and Tech.*, vol. 17, no. 3, 2016. [Online]. Available: http://www.literacyandtechnology.org/uploads/1/3/6/8/136889/jlt_v16_3_lisenbee.pdf (in English)

[15] O. B. Azubuike, O. Adegboye, and H. Quadri, "Who gets to learn in a pandemic? Exploring the digital divide in remote learning during the COVID-19 pandemic in Nigeria," *Int. J. of Ed. Res.*, vol. 2, no. 2, 2021, doi: https://doi.org/10.1016/j.ijedro.2020.100022. (in English)

[16] "Generational breakdown: Info about all of the generations," *The Center for Generational Kinetics*, 2016. [Online]. Available: https://genhq.com/faq-info-about-generations/ (in English)

[17] N. Kushnir, A. Manzhula, and N.Valko, "Bridging the generation gap in ICT education," in *Communications in Computer and Information Science*, V. Ermolayev, Ed., ICTERI, Springer, Cham, vol. 412, 2013, pp. 229–251. doi: https://doi.org/10.1007/978-3-319-03998-5_12. (in English)

[18] A. Szymkowiak, B. Melovic, M. Dabic, K. Jeganathan, and G.S. Kundi, "Information technology and Gen Z: The role of teachers, the Internet, and technology in the education of young people," *Tech. in Soc.*, vol. 65, 2021, doi:10.1016/j.techsoc.2021.10156. (in English)

[19] Timofticiuc, N-C. "Bridging the generation gap by learning from our students," *Twinkle Star*, Aug. 13, 2019. [Online]. Available: https://twinklestar.ro/bridging-the-generation-gap-by-learning-from-our-students/ (in English)

[20] B. Henebery, "Bridging the generation gap in education," *The Educator*, May 6, 2015. [Online]. Available: https://www.theeducatoronline.com/k12/news/bridging-the-generation-gap-in-education/199994 (in English)

[21] M. Perifanou, A. A. Economides, and K. Tzafilkou, "Teachers' digital skills readiness during covid-19 pandemic," *IJET*, vol. 16, no. 8, pp. 238–25, 2021, doi: https://doi.org/10.3991/ijet.v16i08.21011. (in English)

[22] C. S. Cruzado, R. S. Campión, and M-T.S. Compaña, "Teacher digital literacy: The indisputable challenge after COVID-19," *Sust.*, vol. 13, 2021, Art no. 1858, doi: 10.3390/su13041858. (in English)

[23] B. A. Darwanto, S.E.S. Rini, and H. Herusatoto, "Technology: Language teachers' digital and navigating skills in emergency education," *XLing.*, vol. 14, no. 1, pp. 141–158, 2021, doi: 10.18355/XL.2021.14.01.12. (in English)

[24] M. D. Toth, "Achievement gaps and the lost covid-19 generation," *Learning Sciences International*, Aug. 21, 2020. [Online]. Available: https://www.learningsciences.com/blog/lost-covid-19-generation/ (in English)

[25] N. Selwyn, "Online learning: Rethinking teachers' 'digital competence' in light of COVID-19." *Lens*, Education Futures. Monarch University, Apr. 30, 2020, [Online]. Available: https://lens.monash.edu/@education/2020/04/30/1380217/online-learning-rethinking-teachers-digital-competence-in-light-of-covid-19 (in English)

[26] K. Chen, E. Dorn, J. Sarakatsannis, and A.Wiesinger, "Teacher survey: Learning loss is global – and significant," *McKinsey & Company*, Mar. 1, 2021. [Online]. Available: https://www.mckinsey.com/industries/education/our-insights/teacher-survey-learning-loss-is-global-and-significant (in English)

[27] M. Jelińska, and M.B. Paradowski, "Teachers' perception of student coping with emergency remote instruction during the covid-19 pandemic: the relative impact of educator demographics and professional adaptation and adjustment," *Front. Psych.*, vol. 12, 2021, Art no. 648443, doi: 10.3389/fpsyg.2021.648443. (in English)

[28] G. Orhan, and O. Beyhan, "Teachers' perceptions and teaching experiences on distance education through synchronous video conferencing during covid-19 pandemic," *Soc. Sci. Ed. Res. Rev.*, vol. 7, no.1, pp. 8–44, Jul. 2020. [Online]. Available: https://ideas.repec.org/a/edt/jsserr/v7y2020i1p8-44.html (in English)

[29] R.P. Rahayu, and Y. Wirza, "Teachers' perception of online learning during pandemic covid-19," *J. Pen. Pend.*, vol. 20, no. 3, pp. 392–406, 2020. doi: https://doi.org/10.17509/jpp.v20i3.29226. (in English)

[30] R. Rasmitadila, R.R. Aliyyah, R. Rachmadtullah, E. Syaodih, and M. Nurtanto, "The perceptions of primary school teachers of online learning during the covid-19 pandemic period: A case study in Indonesia," *J. Eth. Cul. St.*, vol. 7, no. 2, pp. 90–109, 2020, doi: http://dx.doi.org/10.29333/ejecs/388. (in English)

[31] M.A. Khan, T. Kamal, A. Illiyan, and M. Asif, "School students' perception and challenges towards online classes during covid-19 pandemic in India: An econometric analysis," *Sust.*, vol. 13, no. 4786, pp. 1–15, 2021, doi: https://doi.org/10.3390/su13094786. (in English)

[32] "Learning loss definition," *The glossary of education reform*, Aug. 29, 2013. [Online]. Available: https://www.edglossary.org/learning-loss/ (in English)

[33] P. Engzell, A. Frey, and M. D. Verhagen, "Learning loss due to school closures during the COVID-19 pandemic," *PNAS*, vol. 118, no. 17, 2021. doi: https://doi.org/10.1073/pnas.2022376118. (in English)

[34] N., Dadey, W. Lorié, and Ch. Brandt, "Including missing data in the estimate of the impact of the pandemic on student learning," *The Center for Assessment*, 2021. [Online]. Available: https://www.nciea.org (in English)

[35] N.Yarrow, E. Masood, and R. Afkar, "Estimates of covid-19 impacts on learning and earning in Indonesia: How to turn the tide," *World Bank Group*, Washington, DC, 2020. [Online]. Available: https://openknowledge.worldbank.org/handle/10986/34378 (in English)

[36] "Kazakhstan estimate of covid-19 impact on learning loss," *World Bank Group*, 2020. [Online]. Available: https://thedocs.worldbank.org/en/doc/307511594086679993-0080022020/original/KazakhstanCOVID19ImpactonLearningLoss.pdf (in English)

[37] M. Kuhfeld, J. Soland, B. Tarasawa, A. Johnson, E. Ruzek, and J. Liu, "Projecting the potential impacts of COVID-19 school closures on academic achievement," *Ed. Res.*, Oct. 2020, doi: https://doi.org/10.3102/0013189X20965918. (in English)

[38] C. Li, and F. Lalani, "The COVID-19 pandemic has changed education forever," *World Economic Forum*, Apr. 29, 2020. [Online]. Available: https://www.weforum.org/agenda/2020/04/coronavirus-education-global-covid19-online-digital-learning/ (in English)

[39] L. Umaroh, "Different approach and method in teaching English during covid-19 pandemic," *Eng. Teach. J.*, vol. 1, no. 1, pp. 70–76, Mar. 2021, doi: 10.26877/eternal.v12i1.8304. (in English)

[40] S-Y. Wu, "How teachers conduct online teaching during the covid-19 pandemic: A case study of Taiwan," *Front. Ed.*, vol. 6, May. 2021, Art no. 675434, doi: 10.3389/feduc.2021.675434. (in English)

[41] R.C. Anderson, T. Bousselot, J. Katz-Buoincontro, and J. Todd, "Generating buoyancy in a sea of uncertainty: Teachers creativity and well-being during the COVID-19 pandemic," *Front. Psych.*, vol. 11, 2021, Art no. 614774, doi: 10.3389/fpsyg.2020.614774. (in English)

[42] S. Bubb, and M.-A. Jones, "Learning from the COVID-19 home-schooling experience: listening to pupils, parents/carers and teachers." *Impr. Sch.*, vol. 23, no. 3, pp. 209–222, 2020, doi:10.1177/1365480220958797. (in English)

[43] G. Spickler, B. Davis, and J. Patrick, "Educators' view: Students have been resilient and creative during COVID-19. Schools must be, too. Here's some of what our XQ schools have learned," *Crosstown High*, PSI High and Círculos, Mar. 30, 2021. [Online]. Available: https://www.the74million.org/ (in English)

[44] M. Devare, "Amalgamation of indirect gamification into development and operations (DevOps) course teaching," *Information Technologies and Learning Tools*, vol. 87, no.1, pp. 124–138, 2022, doi: https://doi.org/10.33407/itlt.v87i1.4619. (in English)

[45] C. Miranda, "Generation Z: Re-thinking teaching and learning strategies," *Faculty Focus*, Apr. 24, 2020. [Online]. Available: https://www.facultyfocus.com/articles/teaching-and-learning/generation-z-re-thinking-teaching-and-learning-strategies/(in English)

ТЕНДЕНЦІЇ ЦИФРОВОЇ АДАПТАЦІЇ ШКІЛ ПІД ЧАС ПАНДЕМІЇ COVID-19

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Анотація. Пандемія COVID-19 прискорила цифрову трансформацію шкіл із впровадженням освітніх інформаційних технологій у глобальному масштабі. Учителі та учні зіткнулися з проблемами адаптації до нового режиму – цифрового дистанційного викладання та навчання. З огляду на це виникає питання: як школи адаптувались до нового цифрового дистанційного навчання, успішно чи невдало. За цих обставин дослідження зосереджено на виявленні тенденцій цифрової адаптації та трансформації шкіл під час пандемії COVID-19 у світі. Завдання дослідження вирішується поєднанням різних підходів – якісного контент-аналізу документів, опублікованих у мережі у 2020-2021 роках, проведення опитувань та інтерв'ю учнів українських шкіл з грудня 2020 року по лютий 2021 року. Ці підходи дозволяють виявити позитивні й негативні тенденції цифрової трансформації шкіл на макро- та мікрорівнях з точки зору заходів, пов'язаних з пандемією, на міжнародному та національному рівнях, а також сприйняття учнями екстреного дистанційного навчання. Дослідження представляє рейтинги країн у відповідності до фінансової можливості та доступності освітніх інформаційних технологій, які були впроваджені в школах у кризовій ситуації. Крім того, у дослідженні обговорюються наступні питання: вплив пандемії COVID-19 на школи та відповідні карантинні заходи, пов'язані зі школами; впровадження освітніх технологій у навчання та цифровий перехід шкіл; цифровий розрив і нерівність в освіті; розрив між поколіннями; розрив у навчанні та навчальних досягненнях; креативність учителів і зміна методології. Зібрані дані підтверджують теоретичні висновки про тенденції в шкільній освіті під час пандемії. Результати дослідження полягають у тому, що екстрена інтеграція освітніх інформаційних технологій у шкільну освіту змінила традиційний спосіб викладання та навчання у світі. Впровадження освітніх інформаційних технологій заохочує вчителів забезпечувати творче навчання та розробляти нові підходи для задоволення потреб студентів покоління Інтернет у віртуальному освітньому середовищі. Результати дослідження можуть сприяти формуванню політики та розробці стратегії подальшої цифрової трансформації школи під час кризи.

Ключові слова: шкільна освіта; цифрова трансформація; дистанційне навчання; ставлення студентів; пандемія COVID-19.