FORMATION OF DIGITAL COMPETENCE OF TEACHERS IN THE CONDITIONS OF DISTANCE LEARNING

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INTRODUCTION
The Covid-2019 pandemic has led to the forced transition of educational institutions to distance learning. The absolute transition to digital pedagogy in educational institutions has necessitated the strengthening of digital competence, which causes difficulties for the most part for teachers of humanities. In a pandemic, the problems of distance education, which were present in educational institutions before the spread of the coronavirus, intensified (GEWERC, 2020; ZHANG, 2020). “After the emergence of the Coronavirus (Covid-19) and with its huge impact on the education industry, the concern about digital competence has reached a new height” (ZHAO, 2021a). For example, schools were not ready for an absolute transition to distance learning (ASIO, BAYUCCA, 2021). The need to adapt to the constant holding of distance lectures and seminars, communication with pupils and students is also a challenge for teachers (KÖNIG, 2020; FLORES, SWENEN, 2020). Among the difficulties of distance education are shortcomings in teaching digital skills to teachers, which leads to an increased burden on teachers and the emergence of negative emotions (Portillo, 2020); lack of direct contact with students, discomfort of students due to the inability to obtain knowledge directly from the teacher (DARAZHA, 2021); Internet connection, lack of funding, lack of preparation for transition, lack of competence and infrastructure (ASIO,
BAYUCCA, 2021); problems of teachers gaining access to digital literacy (LINDFORS, PETTERSSON, OLOFSSON, 2021).

Thus, in different countries the need to develop digital competence of teachers is exacerbated by the transition to absolute distance learning. Different countries have different problems in the development of digital competencies. However, there is little research in the field of digital competence of teachers. The purpose of the article is to identify the features and relationships between different stages of formation of digital competence of teachers in terms of distance learning. The main objectives of the study are:

1. To analyze the inclusion of ICT use courses in teacher training programs.
2. Identify features in the professional development and the need for professional development of teachers who have passed and have not taken courses in the use of ICT in the training process.

LITERATURE REVIEW
Trubavina (2019) based on the study of digital competencies of teachers of three higher education institutions found differences in the development of digital literacy: before quarantine in one university, 91% of teachers had skills in the digital environment, in the second - 84.2%, in the third - 60%. Cabero-Almenara (2021), based on the study of the level of digital teachers competence of Spanish universities (300 respondents), identified the basic and
intermediate level of skills. Zhao (2021a) identified a basic level of skills based on a systematic review of the literature on digital competencies of students and teachers for 2015-2021. Portillo (2020) identifies a lower level of digital competence at lower levels of education, which are most vulnerable to the challenges of distance education (4586 respondents in Spain). Work experience does not determine the level of digital competence, however, educators at a younger age are not confident enough about their own potential for introducing distance education in a pandemic (TRUBAVINA, 2019). Zhao (2021b) identifies a higher level of self-assessment of digital competence by teachers with less teaching experience than teachers do with more work experience. Instead, the age and previous professional training of teachers determine the level of digital competence in a pandemic (TRUBAVINA, 2019).

Portillo (2020) identifies a lower level of digital competence at lower levels of education, which are most vulnerable to distance education challenges (4586 respondents in Spain). Work experience does not determine the level of digital competence, but teachers at a younger age are not confident enough in their own potential for the introduction of distance education in a pandemic (TRUBAVINA, 2019). Zhao (2021b) identifies a higher level of self-assessment of digital competence by teachers with less teaching experience than teachers do with more work experience. Instead, the age and previous professional training of teachers determine the level of digital competence in a pandemic (TRUBAVINA, 2019). Portillo (2020) also found a gap in the digital competence of teachers depending on gender, age and educational institution. Accordingly, different skill levels lead to differences in the ability to adapt to online teaching and the potential for digital skills development (KÖNIG, 2020; FLORES, SWENNEN, 2020).

In institutions where before the pandemic there was a higher level of integration of distance learning due to the special needs of students, a higher level of implementation of distance learning methods was found (TRUBAVINA, 2019). All teachers received online training and trainings on digital and online education. In addition, a high level of independent professional digital training (80%), consultation with colleagues, online seminars and private lessons. Trubavina (2019) identified an urgent need to develop digital pedagogical competencies to ensure the success of distance education. The main factors in the development of digital competence of teachers in Ukraine are awareness of the need to develop digital skills, awareness of informal self-education, moral and psychological stimulation by university leaders, self-stimulation and self-motivation, financial incentives (maintaining wages through competence) (TRUBAVINA, 2019).

In contrast to Sánchez-Cruzado (2021), the results of a descriptive analysis of interviews with 4883 Spanish teachers revealed a generally low level of self-awareness of teachers about their digital skills, which increases the need to develop a curriculum for digital skills. Zhao (2021b) based on the study of digital competencies of 536 professors of Gansu Agricultural University in China in 2019-2020 showed a positive self-perception of information literacy (cooperation, communication through ICT, information security skills, solving digital problems), but needed to develop digital skills content. Cabero-Almenara (2021) based on a survey of 2180 university teachers from Andalusia (Spain) found an average level of digital competence for male and female teachers. In particular, men majoring in architecture, law and social sciences, younger and older than 40, have a higher level of competence compared to the digital skills of teachers in other fields. For women professors, the highest level of competence is identified by areas of knowledge of law and social sciences for different age categories, without a clear trend identified for other areas.

The need to develop a course for the development of digital skills is discussed in the work of Darazha (2021), which offers the following course structure: learning the basics of pedagogical design, learning outcomes, learning to work in a platform for collaboration, learning tools to create video lectures, learning to work in a platform for monitoring and information collection, formation of digital analysis skills and use of Internet resources of virtual laboratory works. Barragán-Sánchez (2020) argues for the need to develop plans to train teachers for the development of digital competence and its self-assessment. Novella-Garcia, Cloquell-Lozano (2021) identify the problem of lack of ethics in the development of digital competence of teachers in plans for the study and use of ICT in teaching.
Advanced training courses organized before the COVID-19 pandemic (their content, form) do not meet the needs of the real situation. New forms need to be sought to ensure that the content of refresher courses meets the needs of current general education teachers, including not only general skills that characterize digital competence, but also specific ones related to the level of education (age of students) and field of study. The purpose of the study: to identify the needs of general education teachers in the development of digital competence and to prepare proposals for performers of professional competence development courses. Research methods: online survey of 559 teachers, survey of 6 experts, quantitative data processing in the SPSS program, analysis of the content of qualitative data. The study concluded that teacher professional development courses should be practice-oriented, as close as possible to the technical capabilities of the institution, as well as taking into account the current needs of teachers, the field of subjects taught and the level of education they work in (USCA, 2021).

**METHODOLOGY**

This study used data from a structured interview of OECD educators (2018a) on the development of digital competences (Appendix 1). 38081 teachers from the following countries took part in the survey: Brazil (7.4%), Chinese Taipei (7.4%), Croatia (7%), Denmark (4.4%), Portugal (9.3%), Viet Nam (10.2%), Slovenia (5.8%), Sweden (7.7%), United Arab Emirates (16.1%), and Turkey (21.9%), Alberta (Canada) (2.9%) (Table 1). Among the respondents, 56.3% are female and 43.7% are male.

**RESULTS**

In formal education of teachers, the use of ICT for teaching was included in 63.1% of cases, while 34.4% of respondents noted the lack of formal courses on the development of ICT skills for use in further activities. Regarding the level of readiness to use ICT in education, 11.6% of teachers answered "not quite", 23.4% - "somewhat", 36.8% - "well prepared", 21.2% - "very well prepared" during teaching. Among teachers 12.7% have 1 year of work experience, 9.7% - 2 years, 8.1% - 3 years, 6.6% - 4 years, 6% - 5 years, 4.3% - 6 years, 4.3% - 7 years, 4.4% - 8 years, 3.3% - 9 years, 4.6% - 10 years. In fact, 66.4% of teachers have experience as a teacher at school from 1 to 10 years, and 33.6 - from 10 to 41 years. Among teachers 22.1% - teach reading, 17.4% - mathematics, 20.0% - science, 19.6% - social sciences, 12.3% - foreign
languages, 4.2% - study Latin, 14.6% - teach the use of technology, 9.6% - religion or ethics, 14.4% - practical skills, 8.3% - other subjects.

The following answers were received to the question about the training activities: 77.9% took personal courses and seminars, 39.4% - online courses and seminars, 56.1% attended scientific conferences, 20.5% - formal qualification programs, 29.9% - review visits to other schools, 31.1% - review visits to business schools, 43.9% - were coached by colleagues, 47.5% - participated in the networking of teachers, 75.5% - read professional literature, 39.4% - other measures.

61.5% of teachers passed professional development in the field of ICT development (information and communication technologies), 31.6% did not pass. Among the respondents, 19% noted that they do not need professional development of ICT skills for learning, 27.5% - noted a low level of need, 34.1% - noted a medium level of need and 16.8% - a high level of need. The most popular way to develop ICT skills is personal courses or trainings (57.51% of all teachers take personal courses) (Table 2), reading professional literature - 56.36%, educational conferences - 43.25%, participation in a network of teachers formed specifically for the professional development of teachers - 39.79%, peer and/or self-observation and coaching as part of a formal school arrangement - 36.10%, online courses or seminars - 32.99%, observation visits to other schools - 25.27%, observation visits to business premises, public organizations, or non-governmental organizations - 24.88%. At the same time, among those who pass various events, a fairly high proportion of teachers who develop ICT learning skills: 87% among those who have taken personal courses/seminars, 85% - among those who read professional literature, 65% - among those who attend educational conferences.

### Table 2. Professional development of ICT skills by teachers in terms of training activities

| Training Activity                                                                 | Number of respondents who professionally develop ICT skills, persons | Share among the total population, % | Proportion among those who pass the relevant event, % |
|----------------------------------------------------------------------------------|---------------------------------------------------------------------|-------------------------------------|-----------------------------------------------------|
| a) Courses/seminars attended in person                                           | 20335                                                               | 57.51%                              | 86.98%                                              |
| b) Online courses/seminars                                                       | 11632                                                               | 32.99%                              | 49.91%                                              |
| c) Education conferences where teachers and/or researchers present their research or discuss educational issues | 15267                                                               | 43.25%                              | 65.39%                                              |
| d) Formal qualification program (e.g. a degree program)                          | 6011                                                                | 17.03%                              | 25.75%                                              |
| e) Observation visits to other schools                                           | 8921                                                                | 25.27%                              | 38.21%                                              |
| f) Observation visits to business premises, public organizations, or nongovernmental organizations | 8777                                                                | 24.88%                              | 37.62%                                              |
| d) Peer and/or self-observation and coaching as part of a formal school arrangement | 12738                                                               | 36.10%                              | 54.60%                                              |
| h) Participation in a network of teachers formed specifically for the professional development of teachers | 14034                                                               | 39.79%                              | 60.16%                                              |
| i) Reading professional literature                                               | 19911                                                               | 56.36%                              | 85.21%                                              |
| j) Other                                                                          | 11166                                                               | 33.60%                              | 50.68%                                              |

**Source:** calculated by the author based on the OECD (2018b).

Support student learning using digital technology (e.g. computers, tablets, smart boards) can 35.2% of teachers in most cases, 35% of teachers in some cases, 23.8% to a certain level, 3.3% - cannot provide such support. Table 3 shows the average number of those who undergo professional development of ICT skills (22669) and those who do not (12069).
Table 3. Group statistics: Question 6. "Were the use of ICT (information and communication technology) for teaching included in your formal education, and to what extent did you feel prepared for each element in your teaching?" and "23. Were ICT (information and communication technology) skills for teaching included in your professional development activities during the last 12 months?" Please mark one choice in each row. 1 - Yes, 2 - No.

| Areas prof. dev. ICT skills for teaching | Elements in form. educ. Use of ICT for teaching | N  | Average value | Standard deviations | Average error |
|----------------------------------------|-----------------------------------------------|----|---------------|---------------------|--------------|
| Yes                                    |                                               | 22669 | 1.27 | .442               | .003         |
| No                                     |                                               | 12069 | 1.47 | .499               | .005         |

Source: calculated by the author based on the OECD (2018b).

Table 4 shows the results of the Leven test, which draws conclusions about the similarity of the variance of those who undergo professional development of ICT skills, and those who do not pass during formal education. Since the value of the F-test is 3290.71 with a significance of 1%, the hypothesis of equality of variances was rejected, so to identify differences between groups, the second line of the test was used. The value of the t-test is -38,651 with a significance of 1%, so there are differences between those who took the course of using ICT for learning in formal education and those who did not. In particular, those who have taken ICT courses in formal education are, on average, less involved in the professional development of ICT skills during their professional activities (average difference -0.209).

Table 4. Independent samples t-test (Question 6 and Question 23)

| Criterion of equality of Livin’s variances | t-test for equality of means |
|------------------------------------------|--------------------------------|
| F | St. | Mean square error of difference |  |
| Equal variances are assumed | -40,119 | 34736 | -209 | .005 |
| Equal variances are not assumed | -38,651 | 22168 | -209 | .005 |

Source: calculated by the author based on the OECD (2018b).

Table 5 shows the average level of need for the development of ICT skills for training for those who took a course on the use of ICT in formal education (23,570 people) and those who did not (12,756). On average, the response of those who have taken a course in the use of ICT during training (2.44) requires less development of ICT in professional activities (2.61).

Table 5. Group statistics: Question 6 and Question 27

| Elements in form. educ. Use of ICT for teaching | N  | Average value | Standard deviations | Average error |
|-----------------------------------------------|----|---------------|---------------------|--------------|
| Yes                                           | 23570 | 2.44           | 1,008               | .007         |
| No                                            | 12756 | 2.61           | .951                | .008         |

Source: calculated by the author based on the OECD (2018b).

Table 6 shows the results of independent samples t-test. Since the value of F is 163,608 with a significance of 1%, we can reject the hypothesis of equality of variances. The value of t-test is -15.825 with a significance of 1% and indicates a rejection of the hypothesis of equality in the need for professional development between those who took a course of formal use of ICT in education and those who did not.
Table 6. Independent samples t-test Question 6 and Question 27

| Criterion of equality of Livin’s variances | t-test for equality of means |
|-------------------------------------------|-----------------------------|
|                                           | F   | Mea ning | t    | St   | Meaning (2-sided) | The difference is average | Mean square error of difference |
| Equal variances are assumed                | 163,608 | 0.00 | -15,551 | 36324 | 0.00 | 0.169 | 0.011 |
| Equal variances are not assumed           | -15,825 | 27493 | 0.00 | 0.169 | 0.011 |

Source: calculated by the author based on the OECD (2018b).

This means that teachers who do not take the ICT skills development course need more professional development in the process of professional activity. Teachers need the development of ICT skills. Table 7 shows the correlation between variables: ICT use courses during formal education, professional development of ICT skills, the need for professional development of ICT skills, student support during ICT training. With a significance level of 1%, we state the presence of: 1) a low level of direct linear connection between the courses of ICT use in the course of formal education and the professional development of ICT skills (correlation 0.21); 2) low inverse linear relationship between ICT use courses during formal education and the need for professional development of ICT skills (correlation -0.153); 3) low inverse linear relationship between the professional development of ICT skills and the level of support for students during training by ICT (-0.164); 4) low inverse linear relationship between the need for professional development of ICT skills and the level of student support during learning by means of ICT (-0.185). This means that formal education courses in the use of ICT in teaching, professional development and teachers’ awareness of the need for development affect the teacher’s potential to support students through ICT.

Table 7. Correlation between variables

| Elements in form. educ. Use of ICT for teaching | Areas prof. dev. ICT skills for teaching | Prof. dev. needs ICT skills for teaching | What ext. you can do Support student learning via the use of digital technology |
|-------------------------------------------------|----------------------------------------|----------------------------------------|--------------------------------------------------|
| Pearson’s correlation                           | 1                                      | .210 **                                | .081 **                                            |
| Meaning (bilateral)                             | .000                                   | .000                                   | .000                                              |
| N                                               | 37116                                  | 34738                                  | 36326                                             |
| Areas prof. dev. ICT skills for teaching        | Pearson’s correlation                  | .210 **                                | .003                                              |
| Meaning (bilateral)                             | .000                                   | .629                                   | .000                                              |
| N                                               | 34738                                  | 35454                                  | 35008                                             |
| Prof. dev needs ICT skills for teaching         | Pearson’s correlation                  | .081 **                                | .003                                              |
| Meaning (bilateral)                             | .000                                   | .629                                   | .000                                              |
| N                                               | 36326                                  | 35008                                  | 37075                                             |
| What ext. you can do Support student learning   | Pearson’s correlation                  | -.153 **                               | -.185 **                                          |
| via the use of digital technology               | Meaning (bilateral)                   | .000                                   | .000                                              |
| N                                               | 36277                                  | 34973                                  | 36711                                             |

** The correlation is significant at the level of 0.01 (bilateral).

Source: calculated by the author based on the OECD (2018b).

Thus, the formation of digital competence should take place within the programs of educational training of teachers, because courses on the use of ICT in education determine the further need for professional development, the level of support for teachers by students through ICT.
DISCUSSION
This study partly explains the problem of unpreparedness of most educational institutions for the absolute transition to distance learning and other problems that existed in the education system related to the development of digital competencies of teachers. According to our research, digital skills are formed in the process of professional training. 64% of teachers noted taking courses in the use of ICT in education. 36% of those who did not pass are more likely to undergo professional ICT skills development activities. Therefore, in the context of a complete transition to online education, the problems of digital pedagogy have deepened. According to Trubavina (2019), in institutions where before the pandemic there was a higher level of integration of distance learning due to the special needs of students, a higher level of implementation of distance learning methods was found. As both ICT courses in teaching and professional development activities are linked to the level of student support through ICT, digital skills of teachers need constant development.

This study also found a high level of passing various activities to develop ICT skills before the transition to distance learning. Similar conclusions are made by Trubavina (2019), who also notes the 100% level of online education and training for teachers in digital and online education, independent digital training, consultation with colleagues, online seminars and private lessons. However, if this study identified 46.5% of teachers who do not require professional development of ICT or almost do not need, then Trubavina (2019) found an urgent need for the development of pedagogical digital competencies to ensure the success of distance education. Other studies also note the urgency of this need (GEWERC, 2020; ZHANG, 2020; ZHAO, 2021A; ASIO & BAYUCCA, 2021; KÖNIG, 2020; FLORES, SWENNEN, 2020). This indicates a high level of subjectivity in teachers' assessments of their own level of digital skills.

CONCLUSION
The study reveals the following main features of the formation of digital competence of teachers. In the formal education of teachers in the use of ICT for teaching were included in 63.1% of cases. 58% of teachers are well prepared for the use of ICT in education, while 42% of teachers answered poorly prepared for the use of ICT in education. 61.5% of teachers underwent professional development in the field of ICT development (information and communication technologies). 50.9% of teachers noted the need for professional development of ICT skills, while 49.1 do not need or do not need to increase the level of ICT competence. The most popular way to develop ICT skills - personal courses or training (57.51% of all teachers take personal courses), reading professional literature - 56.36%, educational conferences - 43.25%, Support student learning through the use of digital technology (e.g. computers, tablets, smart boards) can 35.2% of teachers in most cases, 35% of teachers in some cases, 23.8% to a certain level, 3.3% - cannot provide such support.

The study also found differences between teachers who take ICT courses during training and those who do not: the first group requires less professional development of ICT skills compared to the second group. Further research should be aimed at identifying the features of the formation of digital competencies by country: assessment of the differentiation of the level of ICT skills, professional development of ICT skills in different countries.

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# ANNEX 1

## Questionnaire for a structured interview of teachers

| Question                                                                 | Answer options |
|-------------------------------------------------------------------------|----------------|
| 1. Are you female or male? Please mark one option.                      | 1 Female  
2 Male |
| 2. How old are you? Please write a number.                              | Years |
| 3. What is the highest level of formal education you have completed?    | 1 Below ISCED 2011 level 3 
2 ISCED 2011 level 3 
3 ISCED 2011 level 4 
4 ISCED 2011 level 5 
5 ISCED 2011 level 6 
6 ISCED 2011 level 7 
7 ISCED 2011 level 8 |
| 6. Were the following elements included in your formal, and to what extent did you feel prepared for each element in your teaching? | (A) Inclusion in education or training (1 - Yes, 2 - No). (B) Preparedness (1 - Not at all, 2 - Somewhat, 3 - Well, 4 - Very well) |
| 11. How many years of work experience do you have, regardless of whether you worked full time or part-time? Do not include any extended periods of leave such as maternity / paternity leave. Please write a number in each row. Write 0 (zero) if none. Please round up to completely years. | a) Year(s) working as a teacher at this school  
b) Year(s) working as a teacher in total  
c) Year(s) working in other education roles, not as a teacher (e.g. as a university lecturer, nurse)  
d) Year(s) working in other non-education roles |
| 15. Were the following subject categories included in your formal, and do you teach them during the current school year to any (15-year-old) students in this school? Please mark as many choices as appropriate in each row (Included in my formal, I teach it to ISCED level X/15-year-old) students this year. | a) Reading, writing and literature  
b) Mathematics  
c) Science  
d) Social studies  
e) Modern foreign languages  
f) Ancient Greek and/or Latin  
g) Technology  
h) Arts  
i) Physical education  
j) Religion and/or ethics  
k) Practical and vocational skills  
l) Other |
| 22. During the last 12 months, did you participate in any of the following professional development activities? Please mark one choice in each row. | 1 - Yes, 2 - No |
| 23. Were any of the topics listed below included in your professional development activities during the last 12 months? Please mark one choice in each row. | 1 - Yes, 2 - No |
| 27. For each of the areas listed below, please indicate the extent to which you currently need professional development. Please mark one choice in each row. | 1 - Not at all, 2 - Somewhat, 3 - Well, 4 - Very well |
| 34. In your teaching, to what extent can you do the following? Please mark one choice in each row. | 1 - Not at all, 2 - Somewhat, 3 - Well, 4 - Very well |
| m) Support student learning using digital technology (e.g. computers, tablets, smart boards). | |
Formation of digital competence of teachers in the conditions of distance learning

Resumo
O objetivo deste artigo foi identificar as características e as relações entre diferentes estágios de formação de competência digital dos professores em termos de ensino a distância. A metodologia da pesquisa baseia-se em uma análise estatística de dados de um levantamento de 38081 professores por meio de uma entrevista estruturada da OCDE (2018a) sobre o desenvolvimento de competências digitais. O estudo constatou que os cursos sobre o uso de TIC para o ensino foram incluídos na formação formal de professores em 63,1% dos casos. 58% dos professores estão bem preparados para o uso de TIC na educação, enquanto 42% dos professores responderam a um baixo nível de preparação para o uso de TIC na educação. O valor prático do estudo reside na identificação das características da formação da competência digital: a importância de programas de treinamento para o desenvolvimento de habilidades digitais.

Keywords: Digital competence. Digital skills. Distance learning. Online education.

Abstract
The purpose of this article was to identify the features and relationships between different stages of formation of digital competence of teachers in terms of distance learning. The research methodology is based on a statistical analysis of data from a survey of 38081 teachers using a structured OECD interview (2018a) on the development of digital competencies. The study found that courses on the use of ICT for teaching were included in the formal education of teachers in 63,1% of cases. 58% of teachers are well prepared for the use of ICT in education, while 42% of teachers answered a low level of preparation for the use of ICT in education. The practical value of the study lies in identifying the features of the formation of digital competence: the importance of training programs for the development of digital skills.

Keywords: Digital competence. Digital skills. Distance learning. Online education.

Palavras-chave: Competência digital. Habilidades digitais. Educação à distância. Educação online.

Palabras-clave: Competencia digital. Competencias digitales. Enseñanza a distancia. Educación en línea.