
Assessment and Comparison of Digital Competences in Education for Selected European Countries

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Abstract:

Purpose: As part of the study, the authors assessed and compared the digital competences of teachers in selected European countries. The research was carried out as part of the project "Adult Social Inclusion in a Digital Environment (ASIDE) Strategic Partnerships for Adult Education - Cooperation for innovation and exchange of good practices" No. 2019-1-PL01-KA204-065689, between 01-09-2019 and 31-08-2021.

Approach/Methodology/Design: The value of each index has been determined based on answers to several questions (for details see the appendix). The variables analyzed in the study were defined based on a set of parameters assessed by the respondents on a scale from 1 to 5, where 1 - a low level and 5 - a high level. They were defined as the mean values of the answers to each question regarding a given index. Since the variables identified above are based on the answers to several questions, they were analyzed using Cronbach's alpha coefficients to verify their reliability.

Findings: The lowest value of all indexes can be observed in the case of teachers from Poland. This group also has the highest percentage of persons with the lowest values of the analyzed indexes. In the case of teachers from Spain and Turkey, the level of four of the indexes is similar. In the case of the last two indexes, the value indicated by teachers from Turkey is significantly the highest.

Practical Implications: The results are of key importance and should be used to formulate assumptions, regulations, and guidelines for the creation of policies, instruments, and tools to support educators in the use of digital technologies as part of the education process. The results can contribute to the achievement of the European goal of creating new operational curricula through active and responsible development of digital competences.

Keywords: Digital competences, management.

JEL classification: E01, F66, J2, O1.

Paper Type: Research study.

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1. Introduction

Competences are a concept commonly used in professional literature, in management practice, and everyday language. This contributes to the ambiguous and complex understanding and definition of the concept. Competences differ both in terms of terminology regarding key areas covered by the concept and the number of its elements. In subject literature, the phrase "*digital competences*" is defined as a set of skills, knowledge, and attitudes that enable achieving personal goals using digital technologies in various life contexts (Baartman and de Bruijn, 2011; Ferrari *et al.*, 2012). Digital competences have become an elementary requirement for active participation in society (Balsmeier and Woerter, 2019; McAfee and Brynjolfsson, 2017; Kurz and Riege, 2013; Adamczyk *et al.*, 2020; Skrzek-Lubasińska and Gródek-Szostak, 2019).

Dynamic technological development, increased availability of Information and Communication Technology (ICT) resources have changed the traditional learning and working environment and will continue to do so in the future (Siddiq and Scherer, 2019; Skryabin *et al.*, 2015; Hu *et al.*, 2018; Gródek-Szostak *et al.*, 2020a; Gródek-Szostak and Ochoa Siguencia, 2020). To meet the challenges posed by the transformation, many countries have introduced and implemented policies aimed at increasing access to ICT resources (Newrly and Veugelers, 2009), supporting teachers in integrating the use of information technology in their classrooms (Hynes and Shelton, 2018; Tondeur *et al.*, 2012) and promoting digital competences as part of national curricula (Claro *et al.*, 2012; Wang *et al.*, 2018).

Keywords used in discussing digital competences are digital skills, computer and information literacy, internet skills, ICT or 21st century skills (Ainley *et al.*, 2016; Chen *et al.*, 2018; Combes, 2009; Erstad, 2010; Ochoa Siguencia *et al.*, 2020; Rohatgia *et al.*, 2016; Senkbeil and Ihme, 2017; Gródek-Szostak *et al.*, 2020). Based on the available studies, four areas can be identified, common to all frameworks: collecting and working with data, digital production (knowledge), the need for responsible and ethical standards, as well as communication (Siddiq *et al.*, 2019).

The ongoing technological changes are a challenge for the teaching community (teachers) on two levels. First, it is developing own digital competences, and secondly, developing instructional activities that will equip all students with the competences needed to succeed in the digitized world (Hämäläinen *et al.*, 2021). In addition to supporting traditional literacy, teachers need to support literacy in a digital environment (Billett *et al.*, 2018; Harteis, 2019; Tsai and Chai, 2013). In terms of the digital literacy of teachers, there is a critical opinion in the literature that teachers seem to be more challenged in technology-rich environments, e.g., have lower problem-solving skills than adults working in other sectors (Hämäläinen *et al.*, 2019). Despite this critical approach (Hämäläinen *et al.*, 2021) demonstrated that technological skills of teachers differ from their teaching competence in a digital environment. The study

considered digital competences of teachers as a key premise which includes digital skills, attitudes and knowledge (Ferrari, 2012; Redecker, 2017; Spiteri and Rundgren, 2020).

As part of the study, the authors undertook research to assess and compare the digital competences of teachers in selected European countries. The research was carried out as part of the project “*Adult Social Inclusion in a Digital Environment (ASIDE) Strategic Partnerships for Adult Education - Cooperation for innovation and exchange of good practices*” No. 2019-1-PL01-KA204-065689, between 01-09-2019 and 31-08-2021 (Ochoa Siguencia *et al.*, 2020b; Sanchez and Garcia, 2020; Bech and Gurgul, 2018). The ASIDE project aims to support inclusive education and digital skills, increasing competences in digital social inclusion of adult social educators and adult social volunteers. Our project concerns social inclusion by defining a portfolio of basic digital competences that are necessary for the development of social inclusion initiatives/services based on information and communication technologies. The goal of the project is:

- to support social integration by improving the competences of social educators and social volunteers involved in the design/implementation of initiatives/projects for social inclusion;
- to strengthen the support, participation, and educational activities of social educators and social volunteers involved in inclusive education and digital social practices;
- to enhance social inclusion through digital innovation practices, innovative ICT-based methods, and pedagogy as well as online participation models where appropriate.

The partners in the project are: the Institute for Research and Innovation in Education (Leader - Poland), Saricam Halk Egitimi Merkezi (Turkey), Fundación Universitat Jaume I - Empresa (Spain), and ITC International TEFL Certificate s.r.o. (Czech Republic). The research was conducted in Q1 2020 among teachers in public and private adult education centers, training centers, and vocational training centers. The teachers participating in the research came from Turkey (92 people), Poland (143 people), and Spain (61 people).

As part of the research, the main research hypothesis was formulated: The level of digital competences of teachers in the studied European countries is varied. This hypothesis was verified by comparing the results of the questionnaires for the six indexes specified in the following questions:

- 1) What is the level of professional commitment of teachers using digital technologies?
- 2) What is the role of teachers in creating digital resources?
- 3) What is the level of conscious learning and teaching digital resources?

- 4) What is the assessment of the digital technologies used by the educators?
- 5) What role does digital technology play in empowering learners?
- 6) At what level is the digital competence of learners facilitated?

2. Materials and Methods

As mentioned above, six main indexes were distinguished as part of the survey, to verify the level of digital competences of the respondents. professional commitment, digital resources, teaching and learning, assessment, student empowerment, and facilitating digital competences. The value of each index has been determined based on answers to several questions (for details see the appendix). The variables analyzed in the study were defined based on a set of parameters assessed by the respondents on a scale from 1 to 5, where 1 - a low level and 5 - a high level. They were defined as the mean values of the answers to each question regarding a given index.

Since the variables identified above are based on the answers to several questions, they were analyzed using Cronbach's alpha coefficients to verify their reliability. Table 1 offers information regarding the nature of individual variables along with the number of positions from which it was created and the value of the Cronbach's alpha coefficient for individual variables in the analyzed period.

Table 1. Description of the variables and analysis of their internal reliability

Variable	No.	Cronbach's alpha		
		Poland	Turkey	Spain
Professional commitment	4	0.809	0.891	0.836
Digital resources	3	0.651	0.842	0.764
Teaching and learning	4	0.790	0.912	0.893
Assessment	3	0.778	0.869	0.748
Student empowerment	3	0.874	0.890	0.737
Facilitating digital competences	5	0.922	0.934	0.875

Source: Own study.

Cronbach's alpha coefficients for five of the six indexes are above 0.7, which is a satisfactory combination of its subheadings. This indicates that the variables were internally consistent and applying to the same construct. The Cronbach's alpha coefficient solely for the "digital resources" index is lower, 0.651, which can also be acceptable for exploratory and social science research according to Hair *et al.* (2006).

3. Results and Discussion

A comparative analysis of the level of digital competences and involvement in education based on digital tools for teachers from three countries was carried out in

two stages. In the first part, the basic statistics were compared, i.e., mean, median, standard deviation, as well as minimum and maximum values for each of the countries considered within all six indexes. The significance of median differences in the analyzed subgroups for Poland, Spain, and Turkey was verified by carrying out the non-parametric Kruskal-Wallis test (Józwiak and Podgórski, 2012) and the post-hoc Dunn test (Dinno 2015; Gurgul and Suder, 2018).

The analysis was supplemented with a comparison of the cumulative frequency distributions for each of the analyzed indexes, divided according to the quantiles into three groups: 'low' (for values not exceeding the 33% quantile), 'medium' (between 33% and 67%) and 'high' (above 67%). The relationship between the value of the index and the country in which it was assessed was verified based on the χ^2 independence test (Józwiak, Podgórski 2012). All calculations were carried out using the R environment. The summary of basic statistics for individual indexes per country and the relevant values for the test performed are included in Table 2.

Table 2. *Descriptive statistics and the results of the Kruskal-Wallis test for individual indexes*

Index	Country	Mean	Median	Standard deviation	Min	Max	Kruskal-Wallis	
							Statistic	P-value
Professional commitment	Poland	3.97	4.00	0.66	2.00	5.00	18.23	0.0001
	Spain	4.27	4.25	0.70	2.00	5.00		
	Turkey	4.27	4.50	0.73	2.00	5.00		
Digital resources	Poland	3.04	3.00	0.85	1.00	5.00	71.49	0.0000
	Spain	3.97	4.00	0.72	1.67	5.00		
	Turkey	3.97	4.00	0.80	1.33	5.00		
Teaching and learning	Poland	3.31	3.25	0.89	1.00	5.00	42.80	0.0000
	Spain	4.03	4.00	0.77	2.00	5.00		
	Turkey	4.04	4.13	0.80	1.75	5.00		
Rating	Poland	3.39	3.33	0.88	1.00	5.00	21.38	0.0000
	Spain	3.81	4.00	0.78	2.33	5.00		
	Turkey	3.93	4.00	0.84	1.67	5.00		
Student empowerment	Poland	3.31	3.33	0.98	1.00	5.00	23.48	0.0000
	Spain	3.63	3.67	0.83	1.67	5.00		
	Turkey	3.94	4.00	0.79	1.67	5.00		
Facilitating digital competences	Poland	3.45	3.40	0.92	1.00	5.00	21.01	0.0000
	Spain	3.62	3.60	0.89	1.20	5.00		
	Turkey	4.03	4.00	0.76	2.20	5.00		

Source: *Own study.*

Upon analyzing the obtained results, it can be noticed that for each of them, the result for Poland is the worst, both in terms of the mean and the median of their values. It is

also the only country for which five of the six indexes listed (except Professional commitment) have the lowest possible minimum value of 1.

However, upon comparing the values of indexes for Spain and Turkey, it can be observed that in the case of the first three, i.e., Professional commitment, Digital resources and Teaching and learning, their 'medium' values are almost identical. On the other hand, differences can be observed for the next three cases, i.e., Rating, Student empowerment, Facilitating digital competences, where Turkey ranks higher. Confirmation of these conclusions can be found in the results of the Kruskal-Wallis test presented in the last two columns of Table 2 (the Kruskal-Wallis test was used in the study due to the failure to meet the ANOVA assumptions). In the case of each of the tests performed for individual indexes against the three countries considered in the study, it can be observed that the p-value is significantly lower than 0.05. This allows a conclusion that at the 95% confidence level, in each case under consideration, there is at least one pair of median values of the indexes that are significantly different from each other. To find out which groups have such significant differences, a Dunn's post-hoc test was performed (Table 3), which unequivocally indicated that Poland has the lowest results, as compared to the other two countries. Compared to Turkey, the values recorded for Poland are significantly lower in each case (p-value <0.05), while compared to Spain, only for the Facilitating digital competences index, the values did not prove to be significantly lower (p-value = 0.11). The Dunn's test also allows a conclusion that significant differences between the median values for Turkey and Spain were shown only for Student empowerment and Facilitating digital competences, with an affinity toward the first country (p-value <0.05).

Table 3. Results of Dunn's post-hoc test

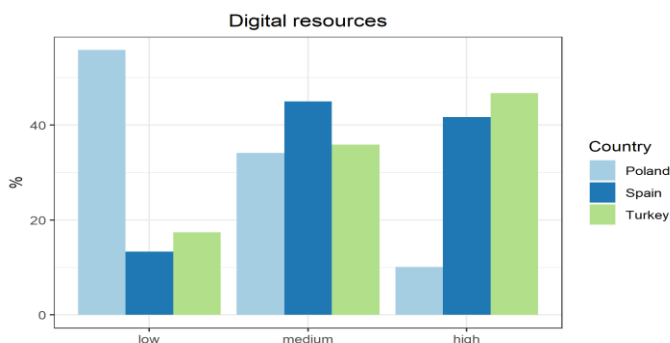
Index	Spain-Poland		Spain-Turkey		Poland-Turkey	
	Statistic	p-value	Statistic	p-value	Statistic	p-value
Professional commitment	3.17	0.0008	-0.15	0.4403	-3.82	0.0001
Digital resources	6.45	0.0000	-0.04	0.4840	-7.44	0.0000
Teaching and learning	4.95	0.0000	-0.09	0.4634	-5.78	0.0000
Rating	2.87	0.0021	-0.94	0.1746	-4.42	0.0000
Student empowerment	2.13	0.0167	-1.97	0.0245	-4.83	0.0000
Facilitating digital competences	1.20	0.1142	-2.61	0.0045	-4.56	0.0000

Source: Own study.

Moreover, the values of the indexes were divided into three groups in terms of quantile affiliation: 'low' (for values not exceeding the 33% quantile), 'medium' (between 33%

and 67%), and 'high' (above 67%). The frequencies of the cumulative values for each group in relation to individual indexes are presented in the following Figures (1-6).

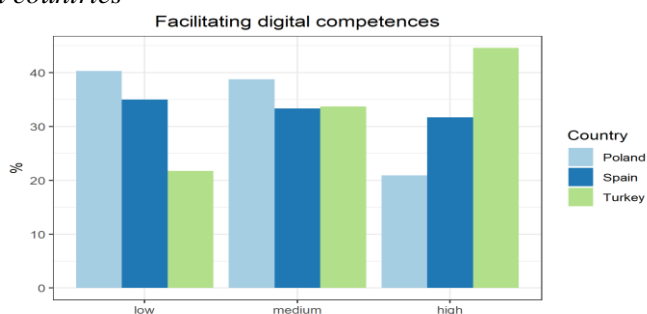
Figure 1. Cumulative frequencies of the Digital resources index divided into categories and countries



Source: Own study.

In the case of the Digital resources index (Figure 1), a downward trend should be noted in its value for Poland. Over 50% of the respondents indicated values included in the lowest group and only 10% in the highest group. This is contrary to Turkey, where the lowest values were indicated by less than 20% of respondents, and the highest by more than 45%. For Spain, the most numerous group are the respondents assessing the components of the Digital resources index at the 'medium' level (approx. 45% of respondents), slightly fewer respondents assessed it at the 'high' level (slightly over 40%). 'Low' indications were the least numerous group for this country.

Figure 1. Cumulative frequencies of the Facilitating digital competences divided into categories and countries

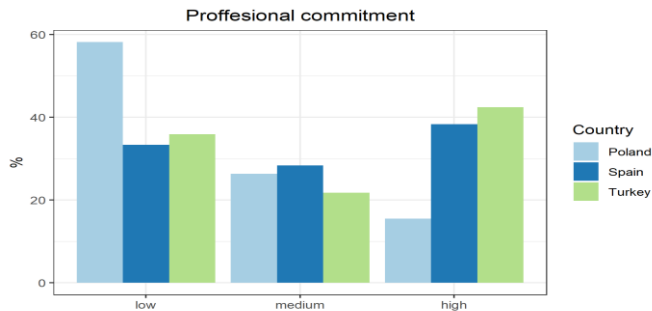


Source: Own study.

Similarly to the index above, in relation to the three analyzed values for Poland, the percentage division of responses for the Facilitating digital competences index is characterized by a downward trend, and for Turkey - by an increasing trend (Figure

2). In this case, the distributions are not characterized by such a great disproportion. The difference between the cumulative frequencies for the 'low' and 'medium' groups is approx. 3 percentage points (approx. 40% and 37%, respectively), and for the 'high' group, this percentage is slightly over 20%. For Turkey, these values are respectively: slightly above 20%, less than 35%, and nearly 50%. The data for Spain show the most similar distribution, where all three groups oscillate between 30-35%.

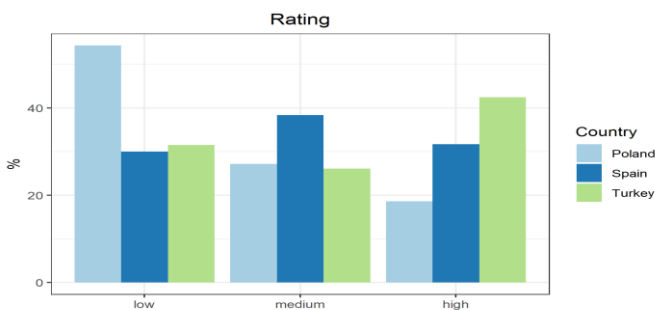
Figure 2. Cumulative frequencies of the Professional commitment index divided into categories and countries



Source: Own study.

The cumulative frequency distribution of the Professional Commitment index (Figure 3) for Spain and Turkey is very similar. The most numerous groups are values classified as high, oscillating at 40% of all observations for both countries. The indications of 'low' values were slightly less numerous (approx. 35%, in both cases), while the 'medium' values turned out to be the least numerous group. As for the previous indexes, Poland is characterized by the largest group of observations classified as 'low' (almost 60%) and the least numerous (approx. 15%) group of 'high' observations.

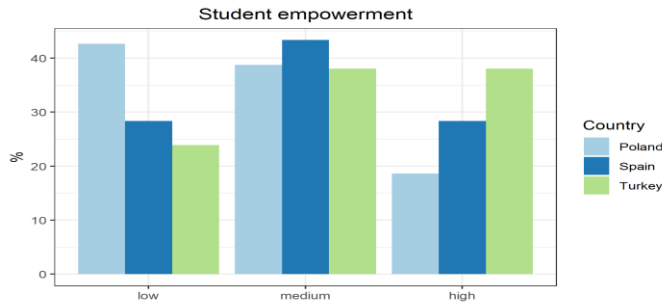
Figure 3. Cumulative frequencies of the Rating index divided into categories and countries



Source: Own study.

The Rating classification allows a repeated conclusion that Spaniards most often rate this index at the 'medium' level, while the other two groups are indicated equally often (Figure 4). Again, the highest percentage of respondents in Turkey (slightly over 40%) indicated the highest possible factor values within this index, while in Poland it was assessed most often as the lowest (over 50% of observations).

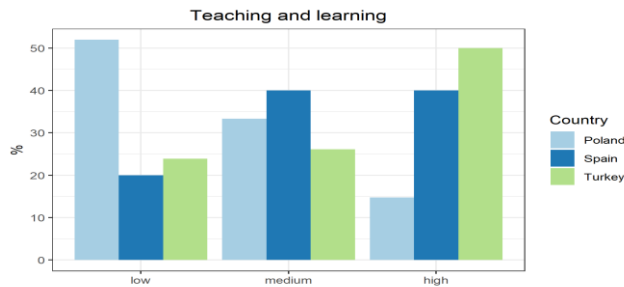
Figure 5. Cumulative frequencies of the Student empowerment index divided into categories and countries



Source: Own study.

The cumulative frequency distribution of the Student empowerment index in Spain is almost symmetrical (Figure 5). Again, the most numerous group for this country are the values between the 33rd and 67th quantile - almost 45% of responses. The other two demonstrate results above 25%. In the case of Turkey, the respondents classified the factors within this index as 'medium' and 'high' almost equally (around 37%), and 'low' values were indicated much less frequently (less than 25%). For Poland, the assessment of this index is similar to Facilitating digital competences. There is a slight difference between the indications of the 'low' and 'medium' groups (oscillating approx. 40%), while the group of 'high' values (less than 20%) is much less numerous in this case.

Figure 4. Cumulative frequencies of the Teaching and learning index divided into categories and countries



Source: Own study.

The Teaching and learning index has an inverse distribution for Poland and Turkey (Figure 6). As with Digital resources, the distributions are decreasing and increasing, respectively. In Poland, over 50% of the observations were classified as 'low' values, while in Turkey almost as many were assessed as 'high' values. Spain, on the other hand, is characterized by an even distribution between the values assessed as 'medium' and 'high' (approx 40%). Half of the observations (20%) were 'low'.

The analysis of all distributions of indexes with the division into three groups allows an assumption that there are significant relationships between the country and the value of the assessment of a given index. These assumptions were verified by the independence test χ^2 . Its results (p-value <0.05 for each of the indexes included in Table 4 confirm the existence of significant relationships between the assessment given by individual respondents and their country of origin. In Turkey, there is a tendency to rate each of the considered factor classes much higher than in the other two countries. On the other hand, Poles assigned much lower scores than other respondents. The most evenly distributed scores are that for Spain, where the 'medium' scores were the most numerous group for almost every index.

Table 4. The χ^2 test results for each of the indexes divided into groups: low, medium, high

Index	Statistic	p-value
Professional commitment	24.58	0.0001
Digital resources	63.66	0.0000
Teaching and learning	42.13	0.0000
Rating	21.94	0.0002
Student empowerment	14.06	0.0071
Facilitating digital competences	15.91	0.0031

Source: Own study.

4. Conclusions and Limitations

In summary, it can be stated that definitely, the lowest value of all indexes is observable in the case of teachers from Poland. This group also has the highest percentage of persons with the lowest values of the analyzed indexes. In the case of teachers from Spain and Turkey, the level of four of the indexes is similar. In the case of the last two indexes, the value indicated by teachers from Turkey is significantly the highest.

The results are of key importance and should be used to formulate assumptions, regulations and guidelines for the creation of policies, instruments, and tools to support educators in the use of digital technologies as part of the education process. The results can contribute to the achievement of the European goal of creating new

operational curricula through active and responsible development of digital competences.

Among the limitations of the conducted research, the authors point to the following:

- the survey was conducted before the outbreak of the COVID-SARS-19 pandemic. The authors realize that the pandemic has forced many educators to use digital methods. Therefore, a repeated survey of the same respondents is planned, to compare the results;
- the list lacks questions regarding the effectiveness of this form of education. In subsequent studies, the authors plan to supplement the content of the survey with questions verifying the effectiveness of the methods used.

As further directions of research, the authors plan to conduct an identical survey on the same group of teachers to assess the impact of the pandemic on the competence level in the studied groups. Additionally, the authors plan to perform a comparative analysis, taking into account such factors as age, gender, and education.

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Appendix 1.

Measures and items used in questionnaire

(scale from 1 to 5; 1 = very low and 5 = very high)

- I. Professional commitment
 - a. I use digital technologies to improve organizational communication
 - b. I use digital technologies to leverage my knowledge and experience
 - c. I individually consider, critically evaluate and actively develop my own digital teaching practice and my learning community
 - d. I use digital sources and resources for continuous professional development
- II. Digital resources
 - a. I identify, evaluate and select digital resources for teaching and learning
 - b. I create or co-create new digital educational resources
 - c. I organize and share digital content
- III. Teaching and learning
 - a. I plan and implement digital devices and resources in the teaching process to increase the effectiveness of teaching interventions
 - b. I use digital technologies to provide timely and targeted guidance and assistance
 - c. I use digital technologies to support and improve student collaboration
 - d. I use digital technologies to support self-regulating learning processes, i.e. to enable students to plan, monitor and reflect on their own learning process
- IV. Assessment
 - a. I use digital technology for formative and summary assessment
 - b. I generate, select, critically analyze and interpret digital evidence of learner activity, performance, and progress to inform them about the teaching process
 - c. I use digital technologies to provide targeted and timely feedback to my students
- V. Student empowerment
 - a. I provide access to educational resources and activities to all learners, including those with special needs
 - b. I use digital technologies to meet diverse learning needs of students, enabling them to advance at different levels and speeds, following individual learning paths and goals.
 - c. I use digital technologies to support the active and creative involvement of my students
- VI. Facilitating digital competences of learners
 - a. I include learning activities, assignments and grades that require students to express their information needs
 - b. I include learning activities, assignments and assessments that require students to use digital technologies effectively and responsibly for communication,
 - c. I include learning activities and activities that require students to express themselves through digital means
 - d. I take measures to ensure students' physical, mental and social well-being when using digital technologies
 - e. I include learning and assessment activities that require students to identify and solve technical problems or to creatively transfer them

