The Italian School Ecosystems two years after the pandemic in the perceptions of schools' principals and teachers – part 2 (a segmented analysis)

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Abstract. This article presents a detailed analysis of the influence of age and gender of the respondents (231 teachers and 153 principals), and, as well, of the geographical localization and level of the schools in which they operate, on the effects generated, two years later, by the *digital shock* undergone by the Italian school ecosystem at the beginning of March 2020 due to the pandemics. An overall positive perception of the introduction and use of technologies is confirmed, although it remains clearly distinct from that of the particularly critical period experienced. Inhomogeneities emerged among geographical areas and school levels. Among them, greater suffering of ICs (primary and middle schools) and, in general, of the schools in the South of Italy regarding infrastructures and connectivity was highlighted. Due to that and to a greater sense of unpreparedness also a greater sense of increased workload has been perceived in such area. In spite of this, and perhaps because of this, a greater enthusiasm by teachers to experiment, together with a more positive perception about the usefulness of technology (particularly in the female gender), was also observed, along with a demand for highly qualified continuous training. A gender gap was observed in the variation of the individual factor related to the teachers'/principals' wellbeing (lower for males) and in the judgment towards technologies. We detected also a greater difficulty with the teachers' age to become accustomed to technology, particularly in high schools. The text analysis of the answers given to open-ended questions made it possible to bring out the peculiarities of the technologies that allowed teachers to develop the mentioned positive perception, as well as to highlight the reasons why many technologies are shelved. The activities for which technologies are considered most useful also emerged, as well as future intentions of use and expectations about continuous training. Differences in expectations about the future integration and use of technologies among the respondents teaching at different school levels clearly emerged. Finally, future smart organization of the schools seems deemed necessary by all categories of teachers and principals.

Keywords: smart learning ecosystems, Italian schools, Covid-19 pandemic, school e-maturity, school teachers, school principals, technology innovation process, technology-enhanced learning, integrated learning, smart organization.

1 Introduction

As well known, in the spring of 2020 all learning ecosystems around the world – including the Italian schools on which we focus in this paper - underwent a severe lockdown as a non-pharmacological intervention to support the social distancing needed to contain the spread of COVID-19 pandemic [1]. The abrupt transition from face-to-face (f2f) classes to distance and online learning subjected the learning ecosystems to considerable stress that has been largely documented by grey literature, storytelling, reports [2], and scientific investigations [3] that showed both the lack of plans to cope with the emergency but, as well, the ability of the systems to react in a period of time varying between few days and 2-3 weeks depending on the level of IT infrastructures and of the digital skills available to the specific context.

In any case, such an abrupt transition to distance and online learning can be considered a *"digital shock"* and represented a unique opportunity to study the characteristics and the effects of a very peculiar innovation process [4,18] that developed over the past two years while the surrounding conditions changed continuously and substantially: from distance teaching to forms of integrated teaching - presence-distance and parallel blended learning - till a "*new normal*" characterized by large flexibility in the procedural customization of the teaching process, functional to the contingent situations determined by the various pandemic waves and, finally, to the return to an apparent "*full normality*".

During the two years period 2020-2022 we have followed the evolution of the process both in the school [4,5,18] and in the university [6-9] at our best. In particular, as far as the school, with the help of the teachers, who kindly took part in three surveys, and principals that also kindly took part in the third one, we were able to take snapshots of the first steady state after the emergency (two months after the lockdown [5]), one year later [4], and two years later [18] during a moment in which the system reached a *new steady state* that could be defined "*new normal"*. Such a three steps observational process of a national learning system, to our best knowledge, can be considered almost a unicum in the literature devoted to the study of the effects provoked by the pandemics on school ecosystems – also with respect to the reports dedicated to the Italian school system [19,20,28-30] - and allowed us to analyze the progress of the ongoing innovation process (its nature, identify the factors that can determine its development, stagnation, or retreat) and, finally, to make emerge a model capable of representing it: Model for Attitude to get Engaged in Technological Innovation (MAETI) [9,5]. It has been of great interest to take stock of the situation, verify the evolution of the perceptions, and identify the transformations induced by the "*digital shock*" both at the individual and systemic level, understand if there were any chance that they could stabilize over time and, finally, bring out useful elements for the development of future policies. In particular, with the third survey [18] besides monitoring the evolution of the teachers' perception with respect to the operational context, we have also collected the point of view of the schools' principals (that have been compared with that of teachers) and refined the understanding of the peculiarities of the forced innovation process undergone by the learning ecosystems.

In this paper, thus, as a follow-up of the analysis carried on in [18] on the data collected two years after the lockdown, we present: a) a segmented analysis of the numerical answers aimed at identifying possible dependencies on age, gender, school level (high, middle and primary school), geographical location; b) an analysis of the textual answers provided to 7 questions aimed at obtaining more detailed information on the participants' perception about the used technologies, the impact of the latter on the teaching activities and the respondents' future intentions of using technologies to support both the management of the school and the learning processes.

In the following we first summarize the experimental setting, then we present the outcomes of the analysis (segmented analysis of the numerical answers and analysis of the textual answers) and, to conclude, our final considerations.

2 The experimental setting

Although the models which served as the basis for the development of the study and the experimental setting have already been illustrated in [18], we provide here, anyway, a summary of them in order to facilitate the reader's understanding of the article.

2.1 Factors investigated by the survey

E-maturity. One of the working hypotheses of our survey is that the "*digital shock*" provoked by the pandemic may have induced an increase in the e-maturity of the schools which, before the lockdown, struggled to incorporate the learning technology into everyday practices and were characterized by a significant proportion of teachers who do not routinely use technology for learning [10, 31].

The e-maturity is a multilevel construct [11,12] that measures the digital maturity of a complex organizational context, such as a learning ecosystem, to evaluate the ability of the context to fully exploit the opportunities offered by the digital technologies and culture and to prepare, therefore, strategic plans for the development of the learning ecosystem.

In the past, there have been few attempts to elaborate models and methods to measure such construct, like the one developed by Sergis & Sampson in 2014 [13] and that presented in 2015 by the JRC-IPTS, known by the acronym DigCompOrg [14].

In both such frameworks, a rather large number of very specific indicators are taken into consideration (i.e. 74 in the case of the DiCompOrg [14]). The level of granularity for each of the considered dimensions is, thus, very high. A framework like DiCompOrg could be used to perform a detailed diagnostic survey at the school level by means of a tool like SELFIE [15] (to be carried out with the approval of the school's principal) but for sure, at present, cannot be used to carry out online surveys to investigate the e-maturity of a whole school ecosystem and/or additional construct like for example the wellbeing of the actors operating in the ecosystems (see next subsection).

To this end, we have identified a smaller number of factors that on the one hand cover all the dimensions considered in the two models described above and, on the other, allow us to explore also other aspects, while minimizing the fatiguing effects and the related drop out of the respondents. Our choice of factors (see Fig.1 and Table 1) allowed us to investigate the perceptions about the level of the available resources (technological setting and competencies), some organizational factors, and some aspects related to the learning processes.

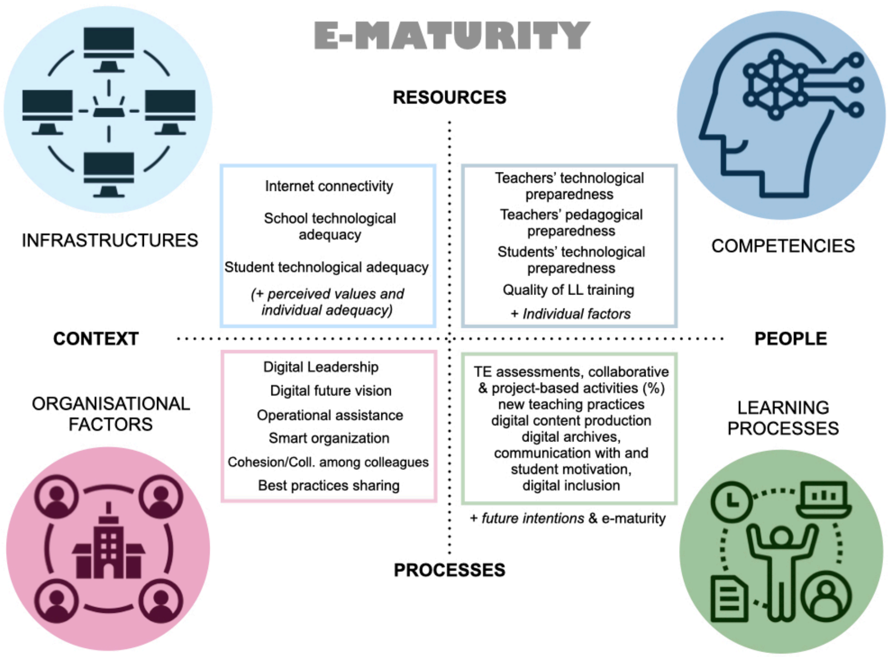

Fig. 1: schematic representation of the essential factors contributing to the determination of the e-maturity of a learning ecosystem

It is important to underline that with our surveys we did not intend to measure the e-maturity of a single school but that of the whole Italian school system thanks to the participation of a suitable sample of school teachers and principals.

Wellbeing. Also, very important for a learning ecosystem is the level of smartness achieved, that is the well-being of all the actors participating in the educational process. The augmentation of spaces, services, and activities determined by the integration of ICTs is only a way to amplify the smartness of a learning ecosystem [16,17] described by the ASLERD pyramid [22, 27], i.e. by a multidimensional construct obtained by integrating the Maslow's pyramid of needs [33] and the theory of flow [23]. The technologies, indeed, allow to improve and/or optimize many of the dimensions of the ASLERD pyramid (see fig. 2), but not all. The dimensions located higher in the pyramid, in fact, although supported by the improvements of the lower levels, open up important psychological and social implications.

Table 1: List of the main factors considered in the present study, organized by domains.

Factors domain	Factors considered in the present investigation
Learning Ecosystem: Technological resources	School Connectivity (SC); School Technological Adequacy (STA); Student Technological Adequacy (StTA)
Learning Ecosystem: Competences	Average Teachers' Technological Preparedness (ATTP) and its variation (dATTP); Average Teachers' Pedagogical Preparedness (ATPP) and its variation (dATPP); Average Students' Technological Preparedness (ASTP) and its variation (dASTP); Quality of Training (QT) and its variation (dQT);
Learning Ecosystem: Organizational factors and relationships	School Digital Leadership (SDL) and its variation (dSDL); School Digital Future Vision (SDFV) and its variation (dSDFV); Operational Assistance (OA) and its variation (dOA); Usage of Smart Organization (USO) and its variation (dUSO) Cohesion among colleagues (CC) and its variation (dCC); Best Practices Sharing (BPS) and its variation (dBPS)
Personal factors: competences	Individual Technological Preparedness (ITP) and its variation (dITP); Individual Pedagogical Preparedness (IPP) and its variation (dIPP);
Personal factors: wellbeing	variation in Self-Fulfillment (dSF); variation in Self-Esteem (dSE); variation in Esteem from Others (dEfO); variation in Autonomy Level (dAL); variation in the Involvement Level (dIL); variation in the Intrinsic Motivation (dIM); variation in the Extrinsic Motivation (dExM);
Personal factors: perceived changes (Individual and Process levels)	variation of Personal Time Management Capacity (PTMC); variation of Student Time Management Capacity (STMC); Workload Increase (WI); variation of the Interest in Digital Challenges (dIDC); variation in the Individual Innovation Propensity (dIIP); variation in the Individual Feeling with the Technologies (dIFT); variation in the Individual e-Maturity (dIeM)
Technology enhanced educational activities/processes and their variations	Technology Enhanced Collaborative Activities Percentage (TECAP); Technology Enhanced Design Activities Percentage (TEDAP); Technology Enhanced Evaluations Percentage (TEEP) and its variation (dTEE); Variation in the Production of Digital Resources (dPDR); Variation in the Generation of Digital Archives (dGDA); Variation in the Communication with Students (dCWS); Variation in the Ability to Motivate the Students (dAMS); Variation in the Digital Inclusion (dDI); Reproducibility of Classroom Dynamics (RCD);
Educational activities/processes and their variations	Collaborative Activities Percentage (CAP) and its variation (dCA); Design Activities Percentage (DAP) and its variation (dDA); Competence Based Learning Percentage (CBLP); Changes in Didactic Activities Percentage (CDAP); Variation in the Integration of New Didactic Activities (dINDA);
Perceived values of technologies	Usefulness of the Didactic Technologies (UDT) and its variation (dUDT); Easiness of Use of the Didactic Technologies (EUDT) and its variation (dEUDT); Efficacy/Efficiency of Integrated didactic (EEDT) and its variation (dEEDT);
Outcomes: Learning ecosystems	Degree of e-Maturity (SeM) and its variation (dSEM);
Outcomes: Learning processes	Sustainability of Technology Augmented Didactics (SoTAD) and its variation (dSoTAD); Sustainability of Integrated Didactic (SID) and its variation (dSID); Usefulness of Education on Learning Technologies (UELT) and its variation (dUELT); Extent to which School should Rely on Technology Augmented Didactic (SRTAD); School should Rely on Smart Organization (SRSO);
Outcomes: Individual intentions	Intention to attend Training in Learning Technologies (ITLT); Intention to Use Technology Augmented Didactics (IUTAD); Intention to Use Integrated Didactic (IUID);

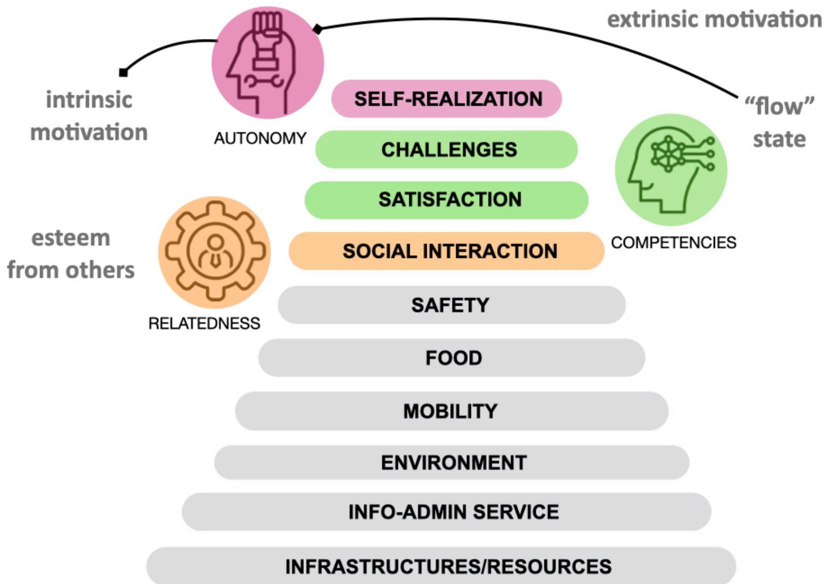

Fig. 2: The dimensions that contribute to defining the *smartness* of a large techno ecosystem (ASLERD pyramid [27]).

Among the theories that have major implications for well-being is the Self-Determination Theory (SDT) which identifies three factors capable of generating well-being: autonomy, competence, and relatedness [21]. All are in strict relationships with the highest level of the ASLERD pyramid. In particular, relatedness maps the need for social relations (fourth last level) which is at the basis of both self-appreciation and public appreciation. As discussed in [22] the last levels of the pyramid are closely linked to the ability of the techno ecosystem to stimulate the state of flow [23], which is a state of engagement characterized also by a high level of satisfaction; to the latter contributes also the feeling to own adequate skills and competencies to address the challenges posed by the technological context. To maintain the state of flow with time, then, the level of the challenges must be increased to prevent the onset of a state of boredom and, at the same time, to foster the development of higher levels of competencies [23]; a mechanism that reminds the learning process stimulated by the encroachment in the proximal space of development [24]. Maintaining the flow state is therefore the main way towards self-fulfillment and self-realization of individuals and, as well, of the whole community. The engagement associated with the state of flow, generated by the adequacy of the challenges, also implies an adequate perception of autonomy and, most likely, fosters also an increase in extrinsic motivation. Although intrinsic motivations have a different and complex nature, they might also be reinforced by the achievement of an adequate degree of self-fulfillment.

Summarizing: the key assumption - related also to the ongoing innovation process - is that a higher level of well-being can be fostered in the actors taking part in the educational processes by the technologies adopted to augment the learning ecosystem.

With this in mind, we have used the survey also to investigate if these two years of experience have modified the perceived value of many individual factors related to personal well-being. In other words, in the present investigation (see Table 1), we have considered only the highest levels of the ASLERD pyramid, not the whole multidimensional construct describing the ecosystems' smartness.

Outcomes and future intentions. Finally, by means of the survey, we have investigated if the variation of the factors defining the e-maturity of the learning ecosystem and the individual perceived well-being - have been capable to influence the future intentions of the participants (teachers and principals in the present study), see Table 1.

2.2 The questionnaire used for the third survey and the participants

Following the elaboration of Table 1, as already described in [18], we have designed a six-sections questionnaire presenting a total of 81 items. Section I comprises seven socio-biographical background items (gender, age, role, school level, school curriculum and teaching subject [only teacher], geographical location). Section II (27 items) focuses on respondents' perceptions of the general operating conditions and the technological context. Section III (7 items) deals with the learning process and the didactic activities. Section IV (5 items) deals with more general operating conditions and with self-feeling. Section V (17 items) is dedicated to the feeling with technologies at the individual level. Section VI, finally (18 items), investigates mainly changes in teachers' expectations for the future. The complete questionnaire (in Italian) is available at [25]. Most of the items required a multiple choice or a numerical answer, and a limited number were open questions or requests for explanatory comments. Further details can be found in ref. [18]

As for the previous two surveys [4,5], the teachers were contacted mainly by means of announcements on social media and via emails. The principals were contacted through the newsletter distributed by the Principal National Association (ANP) [26] that promoted the investigation, together with ASLERD [27]. Since the goal was to investigate the evolution of the Italian school ecosystem in about two years since the lockdown (March 5th, 2020), the survey was open from March 17th, 2022 till April 19th, 2022.

The survey was completed by 231 teachers and 153 principals, overall 79,5% females and 20,5% males from all the Italian regions. Teachers are employed in kindergarten (14), primary (81), lower secondary (52), or upper secondary (84) schools. Principals are employed in *Instituto Comprensivo* (IC: primary and first secondary school level - 78) and in secondary schools (75). Additional details on the sample that, as checked ex post facto, is well representative of the entire population can be found in [18].

3 Results

In this second part of the data analysis (having reported the first one in [18]) we concentrated on a segmented study of the respondents and took into consideration either the numerical answers and the textual answers given by teachers and principals.

The numerical data were analyzed with the aim to highlight possible dependencies on four independent variables - age, gender, school level (high, middle, and primary schools), and geographical location (north, centre, south and islands) – and, as well, possible significative differences among groups belonging to the different categorical variables.

The textual answers were analyzed to highlight mainly the differences in perception among the exponents of the various school levels, except for the first and the last questions of table 6. In the latter case, since only the percentage of terms having a positive valence was assessed, also a comparison among different subgroups is provided (provided that the numerosity of the subgroups allowed for it).

3.1 Differences and Dependencies

The statistical analysis of the numerical responses was conducted first by using a linear regression model in which a potential multiple dependence on four independent variables was explored simultaneously: age, gender, school level (high, middle, and primary school), and geographical location (north, centre, south and islands). For the nominal variables were taken as references the female gender, the geographic location north, and kindergarten in the case of teachers while the IC (middle and primary school) in the case of the school principals. Then, possible significative differences among groups (e.g. among north, centre, south and islands; high, middle, and primary school; male and female genders) have been investigated by the Tukey multiple comparisons of means [32]. The possible relevance of the age for every single group and for every dependent variable has been also investigated.

The dependencies of the investigated factors on the independent variables, with their size effect, are reported in the rows with no background of Tables 2-5, devoted respectively to the set of factors describing: the *learning ecosystems* (infrastructures, competencies, organisational factors), the *educational processes*, *personal feelings* and *expectations for the future*.

In the rows with a grey background, we have reported for each factor differences among the means of the different groups that are statistically relevant, together with possible meaningful dependences on age.

A limitation of the analysis is that the values of the p factors, due to the explorative nature of the study, have not been corrected for multiple comparisons.

Table 2: *Learning Ecosystems Factors*: observed dependences for Principals and Teachers samples on age (age), school level (HS=high school, MS=Middle Schools, PM= Primary schools; IC = Middle+Primary schools), gender (M=male), geographical location (South= South&Islands, Center and North of Italy).

Factors	Principals	Teachers
Learning ecosystem		
School Connectivity (SC)	South t= -2.174 p = 0.032 * η^2= 0.037 HS t= 4.166 p < 0.001 *** η^2= 0.110	South t= -2.323 p= 0.021 * η^2= 0.027
	Age HS 0.28 p = 0.089 .	(South-North = -0.69 p= 0.187)
School Technological Adequacy (STA)	M t= -2.125 0.036 * η^2= 0.038	-
	Age HS 0.28 p = 0.087 .	Age HS -0.21 p = 0.061 . HS-PS=0.80 p = 0.062 . η^2= 0.035
Student Technological Adequacy - BYOD (StTA)	HS t= 1.896 0.057 . η^2= 0.033	South t= -1.974 p= 0.0496 * η^2=0.017 HS t= 1.658 p= 0.0987 . η^2=0.039
		Age HS 0.21 p = 0.053 . (HS-PS=0.75 p = 0.072 .)
Average Teachers' Technological Preparedness (ATTP)	-	South t= -4.303 p <0.001*** η^2= 0.008 Centre t= -1.916 p= 0.0567 .
	-	South-North = -1.11 p< 0.001*** South-Centre=-0.70 p= 0.070 .
Average Teachers' Pedagogical Preparedness (ATPP)	-	South t= -4.146 p <0.001 *** η^2=0.074
	-	(Age MS -0.21 p = 0.130) South-North = -1.27 p< 0.001*** South-Centre=-0.09 p= 0.004**
Average Students' Technological Preparedness (ASTP)	HS t= 1.922 0.057 . η^2= 0.035	-
	-	(Age HS 0.18 p = 0.110) (Age MS 0.22 p = 0.116)
Individual Technological Preparedness (ITP)	-	Age t= -2.128 p= 0.034 * η^2=0.020 HS t= 1.819 p= 0.070 . η^2=0.019
	-	Age HS -0.24 p = 0.031 * (Age MS -0.21 p = 0.139) (M-F=0.36 p = 0.134 η^2=0.004) (South-North=0.46 p=0.146 η^2=0.008)
Individual Pedagogical Preparedness (IPP)	-	South t= 2.222 p= 0.027 * η^2=0.021 PS t= 2.426 p= 0.016 * η^2=0.028 HS t= 1.915 p= 0.057 .
	-	Age HS -0.24 p = 0.030 * South-North = 0.61 p= 0.004 **
Quality of Training (QT)	-	-
School Digital Leadership (SDL)	(HS t= 1.922 0.100 η^2= 0.025)	-
		Age HS -0.24 p = 0.027 * (Age PS 0.18 p = 0.116)
School Digital Future Vision (SDFV)	(HS t= 1.632 0.106 η^2= 0.024)	-
	Age HS 0.28 p = 0.083 .	Age HS -0.19 p = 0.090
Operational Assistance (OA)	HS t= 3.129 0.004 ** η^2= 0.076	-
Usage of Smart Organization	-	-

(USO)		
Cohesion and collaboration among colleagues (CC)	-	Age t= -2.073 p= 0.039 * η^2=0.018 HS t= -2.609 p= 0.0097 ** η^2=0.045
	Age IC (M&PS) -0.35 p = 0.031 *	
Best Practices Sharing (BPS)	-	PS t= -1.785 p= 0.076 . η^2=0.016

Learning Ecosystems. The survey shows that in the opinion of the principals, the technological environment has developed more favorably in the case of high schools (lyceum and technical schools) than in middle and primary schools (IC). The differences are particularly significant with regard to *network connectivity* and the *Operational Assistance* provided by the technical staff, but are also detectable with regard to *School Technological Adequacy*, *Student Technological Adequacy*, *Average Students' Technological Preparedness*, *School Digital Leadership,* and *School Digital Future Vision*.

As far as network connectivity is concerned, there is also a significant gap between the south and the centre-north areas of the country.

In the case of principals, however, a tendency towards a more positive evaluation of the technological environment with the age of the respondent is noted. While the opposite sign has the dependence on age as regards the judgment of the IC principals on the ability to collaborate among colleagues.

The opinions expressed by teachers are more articulated. In the respondents' perception, a disparity is confirmed between the south and the other areas of the country as regards network connectivity, but also as regards the average level of technological and pedagogical preparedness of teachers. A likely consequence of this perception is the higher evaluation of the *Individual Technological and Pedagogical Preparedness* of southern teachers. This effect seems to indicate the presence in this area of a higher unevenness in teacher preparation.

As far as age dependence is concerned - since teachers perform operational teaching functions - the picture is slightly different from that of the principals: there is a tendency with age to judge high schools as less technologically adequate and themselves as less technologically and pedagogically prepared; with age the level of *Digital Leadership* and *Future Vision* associated with high schools decreases, while the *Average Students' Technological Preparedness* is perceived as higher. All this data seems to indicate a greater difficulty for older high school teachers to absorb the digital shock.

As far as school levels are concerned, the significant differences detected are all to the advantage of high schools with the exception of the level of *Cohesion and collaboration among colleagues* that seems higher in Primary schools, despite a weaker ability to *share Best Practices*.

Gender differences are not statistically significant with the exception of the male principals who perceive a lower *School Technological Adequacy* and of the male teachers who perceive a higher *Individual Technological Preparedness*. Pieces of evidence that could be the consequence of the still existing gender gap in the familiarity with digital technologies.

Table 3: *Educational Process Factors*: observed dependences for Principals and Teachers samples on age (age), school level (HS=high school, MS=Middle Schools, PM= Primary schools; IC = Middle+Primary schools), gender (M=male), geographical location (South= South&Islands, Center and North of Italy).

Factors	Principals	Teachers
Technology enhanced education		
Collaborative Activities Percentage (CAP) %	(only teachers)	-
Competence Based Learning Percentage (CBLP) %	(only teachers)	-
Changes in Didactic Activities Percentage (CDAP) %	(only teachers)	South t= 2.872 p= 0.005 ** η^2=0.036 M t= -2.604 p= 0.0099 ** η^2=0.030
		M-F=11% p = 0.010* South-North=12% p= 0.0098** (South-Centre=9% p= 0.185)
Variation in the Integration of New Didactic Activities (dINDA) (-5, 5 scale)	(only teachers)	M t= -2.026 p= 0.044 * η^2=0.019
		Age HS -0.26 p = 0.018 *
Technology Enhanced Collaborative Activities Percentage (TECAP) %	(only teachers)	(South t= 1.634 p= 0.104 η^2=0.016)
		(South-North=10% p= 0.154) (South-Centre=11% p= 0.173)
Technology Enhanced Design Activities Percentage (TEDAP) %	(only teachers)	-
Technology Enhanced Evaluations Percentage (TEEP) %	(only teachers)	-
Variation in the Production of Digital Resources (dPDR); (-5, 5 scale)	(only teachers)	-
		Age HS -0.20 p = 0.065 .
Variation in the Generation of Digital Archives (dGDA); (-5, 5 scale)	(only teachers)	-
		(Age HS -0.18 p = 0.102)
Variation in the Communication with Students (dCWS); (-5, 5 scale)	(only teachers)	M t= -2.591 p= 0.010 * η^2=0.030
Variation in the Ability to Motivate the Students (dAMS); (-5, 5 scale)	(only teachers)	M t= -2.497 p= 0.013 * η^2=0.029
Variation in the Digital Inclusion (dDI); (-5, 5 scale)	(only teachers)	(M t= -1.584 p= 0.154 η^2=0.012)
Reproducibility of Classroom Dynamics (RCD)	(only teachers)	South t= 2.429 p= 0.016 * η^2=0.029 M t= -1.741 p= 0.083 . η^2=0.013
		(Age HS -0.18 p = 0.107) South-North=1.09 p= 0.041 * (South-Centre=5.77 p= 0.106)
Usefulness of the Learning Technologies (ULT)	-	South t= 2.536 p= 0.012 * η^2=0.039 Age t= -1.746 p= 0.082 . η^2=0.013
	-	Age HS -0.20 p = 0.065 . South-North=0.84 p= 0.035 * South-Centre=1.14 p= 0.015 *
Easiness of Use of the Learning Technologies (EULT)	-	-
	-	Age HS -0.22 p = 0.044 * (South-North=0.68 p= 0.100) South-Centre=0.89 p= 0.072 .
Efficacy/Efficiency of Learning Technologies (EELT)	-	South t= 2.366 p= 0.019 * η^2=0.032 M t= -2.372 p= 0.019 * η^2=0.012
	-	Age HS -0.22 p = 0.040 *

		South-North=0.78 p= 0.059 . South-Centre=1.03 p= 0.037 *

Educational processes and technology-enhanced education. The evaluation of the effects on teaching processes was, for obvious reasons, carried out almost exclusively on the answers provided by the teachers.

As far as the *propensity to change* is concerned, the data highlight a greater willingness to experiment in the south area both in the methodological redefinition and in the integration of technologies, a willingness that, in the end, seems to have induced also higher perceived values of the *Usefulness, Easiness of use* and *Efficacy/Efficiency of the Learning Technologies*.

Quite evident also is a gender difference that indicates the female as the gender more inclined to change and experiment with new didactic approaches and new technologies. Females are also more inclined to get engaged in the production of digital resources and to test new modalities to motivate and communicate with the students. Probably also because of this, we observed a higher perceived *Usefulness and Efficacy/Efficiency of the Learning Technologies* by the female gender.

Table 4: Factors describing *personal feelings*: observed dependences for Principals and Teachers samples on age (age), school level (HS=high school, MS=Middle Schools, PM= Primary schools, IC = Middle+Primary schools), gender (M=male), geographical location (South= South&Islands, Center and North of Italy).

Factors	Principals	Teachers
Personal factors		
Personal Time Management Capacity (PTMC); (-5, 5 scale)	-	-
Student Time Management Capacity (STMC); (-5, 5 scale)	-	M t= -2.606 p= 0.0098 ** η^2=0.029
Workload Increase WI %	(South t= 1.533 p= 0.128 η^2=0.022)	South t= 2.976 p= 0.003 ** η^2=0.036 M t= -3.172 p= 0.002 ** η^2=0.041
		Age MS 0.23 p = 0.098 . South-North=15% p= 0.004 **
variation of the Interest in Digital Challenges (dIDC); (-5, 5 scale)	Centre t= 2.853 p= 0.005 ** η^2=0.077	South t= 2.222 p= 0.027 * η^2=0.022
	Center-North= 1.02 p=0.014*	Age PS 0.21 p = 0.063 .
variation in the Individual Feeling with the Technologies (dIFT); (-5, 5 scale)	Centre t= 1.893 0.061 . η^2=0.034	-
	(Age HS 0.28 p = 0.104)	Age PS 0.22 p = 0.049 *
variation in the Individual Innovation Propensity (dIIP); (-5, 5 scale)	(Center t= 1.551 p= 0.124 η^2=0.026)	South t= 1.997 p= 0.047 * η^2=0.018
	-	Age PS 0.25 p = 0.029 *
variation in the Individual e-Maturity (dIeM); (-5, 5 scale)	-	-
	-	Age HS -0.23 p = 0.034*
variation in Self-Fulfillment (dSF); (-5, 5 scale)	-	-
	Age M&PS -0.24 p = 0.049 *	
variation in Self-Esteem (dSE);	Age t= -1.664 p= 0.099 . η^2=0.029	-

(-5, 5 scale)		
	Age M&PS -0.25 p = 0.042 *	
variation in Esteem by Others (dEfO); (-5, 5 scale)	-	-
	Age M&PS -0.21 p = 0.079 .	Age HS -0.28 p = 0.011 *
variation in the Intrinsic Motivation (dIM); (-5, 5 scale)	Centre t= 1.840 p= 0.0689 . η^2=0.044	M t= -1.920 p= 0.056 . η^2=0.017
	Age M&PS -0.25 p = 0.037 *	
variation in the Extrinsic Motivation (dExM); (-5, 5 scale)	Centre t= 1.943 p= 0.055 .	-
	-	Age PS 0.20 p = 0.070 . (HS-PS=0.88 p = 0.119)
variation in the Involvement Level (dIL); (-5, 5 scale)	(only teachers)	South t= 1.663 p= 0.098 . η^2=0.012 M t= -2.040 p= 0.043 * η^2=0.018
	-	(Age PS 0.18 p = 0.105) HS-PS=-0.94 p = 0.069 .
variation in Autonomy Level (dAL); (-5, 5 scale)	Age t= -1.725 p= 0.088 . η^2=0.029	-
	Age M&PS -0.23 p = 0.054 .	-

Personal factors. With regard to personal factors, the answers of the principals show less positive values with increasing age for changes in *Self-Esteem* and in *Autonomy Level*. The perceived *increase in workload* is greater in the southern Italian regions.

It emerges also a greater variation, induced by the digital shock, in the *Interest in digital challenges* and in the *Individual's feeling for technology*, as well as a greater increase in *motivation* (both intrinsic and extrinsic) and *Esteem by others* in the principals of the schools located in Central Italy.

Very clear appears the gender difference in the case of teachers, with the male gender showing less positive variation in some individual factors related to personal well-being. Most likely, such less positive feelings also generate a less positive perception of the *Student's time management* skills.

Age seems to be correlated with a more positive perception of the variation of personal factors in primary schools, while the opposite happens in high schools.
Interestingly the *increase in workload* was strongly perceived in the South and by the female gender. In parallel, always in the South, we observed a corresponding larger variation in the *Interest in digital challenges*, in the *Individual's propensity for innovation,* and in the level of *Personal Involvement*.

Table 5: *Expectations for the future* (Outcomes Factors): observed dependences for Principals and Teachers samples on age (age), school level (HS=high school, MS=Middle Schools, PM= Primary schools; IC = Middle+Primary schools), gender (M=male), geographical location (South= South&Islands, Center and North of Italy).

Factors	Principals	Teachers
	Outcomes	
Sustainability of Technology	-	South t= 2.127 0.0346 * η^2=0.031

Augmented Didactics (SoTAD)		
		South-North=0.93 p= 0.040 * South-Centre=1.16 p= 0.032 *
Sustainability of Integrated Didactic (SID)	-	-
	-	South-North=1.03 p= 0.094 . η^2=0.021 South-Centre=1.29 p= 0.077 .
Usefulness of Education on Learning Technologies (UELT)	-	Centre t= -1.901 p= 0.059 . η^2=0.037
	-	South-Centre=1.31 p= 0.015 *
Extent to which School should Rely on Augmented Didactic (SRTAD) %	-	South t= 2.484 p= 0.014 * η^2=0.029 M t= -2.749 p= 0.006 ** η^2=0.034
		South-North=16% p=0.003 **
School should Rely on Smart Organization (SRSO)	Centre t= 1.912 0.059 . η^2=0.034	South t= 1.708 p= 0.089 . η^2=0.014
		Age MS 0.27 p = 0.082
Intention to attend Training in Learning Technologies (ITLT)	(only teachers)	South t= 2.719 p= 0.007 ** η^2=0.048 M t= -1.666 p= 0.097 . η^2=0.013
		South-North=1.32 p= 0.013 * South-Centre=1.74 p= 0.006 **
Intention to Use Technology Augmented Didactics (IUTAD) %	(only teachers)	South t= 1.894 p= 0.060 . η^2=0.023 M t= -1.661 p= 0.098 . η^2=0.013 HS t= 1.830 p= 0.069 . η^2=0.022
		South-North=13% p= 0.024* South-Centre=13% p= 0.092.
Degree of e-Maturity (SeM)	-	M t= -2.356 p= 0.019 * η^2=0.026
	South-Center=-0.62 p=0.067. η^2=0.045	

Outcomes and future expectations. The opinions of the principals appear very homogeneous and confirm the very positive conditions that have been determined by the digital shock - as emerged in [18] - and that might lead to a permanent use of technologies in many sub-processes. The only detectable difference concerns, in accordance with the previous subsection, the greater propensity of the principals of the schools located in the centre of Italy toward the implementation of a *Smart Organisation*, combined with the perception of a higher level of *e-maturity* of their schools.

With reference to the teachers' perceptions, consistently with what has been observed for the other factors, emerged clearly a greater propensity of the teachers from south Italy - in particular female and high school teachers - towards the future *use of technology-enhanced* teaching, together with a more positive perception about its sustainability and a strong desire for more and better-qualified *training* about learning technologies. Such teachers seem also to desire a *smarter organization* of the school processes.

3.2 Text analysis

As described in the introduction, the questionnaire included also some open questions aimed at obtaining more detailed indications of the perceptions of the participants. Table 6 shows the questions asked to teachers and principals, questions which, as can be easily deduced, aim: to ascertain the sign (positive/negative) of the participants' perceptions about the technologies used; identify the barrier against the adoption of new technology; the impact of the used technologies on teaching activities; the future intentions/expectations of the respondents about technology-supported activities and continuous training. Finally, to complete the survey, an attempt was made to understand how technologies might also impact the organization of school processes and to ascertain, as well, the extent to which the positive perception about technologies might be affected by the perception of the past two years school experience, as a whole.

Table 6: Open questions answered by teachers and principals.

Open questions
• **Three words to define the technologies used during the last two years**
• **Reasons for not adopting tested teaching technologies** (only teachers)
• **For which activities do you find educational technologies most useful?**
• **Intentions of use: technology-supported activities** (only teachers)
• **Continuous training: in which topics would you be more interested in?** (only teachers)
• **Smart Organization: for which activities do you find technologies most useful?**
• **Three words to define the last two years period (with reference to the schools' activities)**

Perception about technologies. The terms used by the teachers were separated between those with positive valence and those with negative valence. The percentages are largely in favor of the former at all school levels. Where permitted by the numerosity of the data, an analysis was also carried out according to gender and geographical location, which showed a more positive attitude in the south of Italy with respect to the centre, see table 7.

The analysis of the terms used by the teachers made emerge as a positive aspect the innovation potential associated with the technologies that have been used, perceived as challenging, motivating, and capable of pushing towards research and experimentation. The efficiency, usefulness, speed, amplifying effect on communication, support to sharing, and collaboration (both among colleagues and between students and teachers), were also recognized as positive characteristics of the technologies, in addition to their 'salvific' effect in emergency conditions. On the other hand, among the negative aspects, the intrusiveness, but also coldness/distance, and the feeling of fatigue caused by their use were emphasized. The latter, in part, seems to be determined by a sense of unpreparedness capable of developing frustration together with a feeling of uselessness or, more precisely, of non-exhaustiveness of the technologies.

Table 7: Percentage of terms carrying a positive valence among those used by (a) teachers and (b) principals in describing the technologies used during the last two years

a) Teachers

Three words to define the technologies used during the last two years

High Schools	Middle Schools	Primary Schools
86% (+) 85% F | 90% M 88% N | 76% C | 95% S	81% (+)	80% (+)

b) Principals

Three words to define the technologies used during the last two years	
High Schools	Middle and Primary Schools (IC)
85% (+) 79% F | 90% M 75% N | 88% C | 100% S	89% (+) 88% N | 84% C | 91% S

The positive teachers' perceptions are substantially confirmed by those of the principals, except for the tendency towards an even more positive perception in middle and primary schools, a greater gender gap, and a more sensitive difference between the south and the north of Italy. The terms used by the principals are also very similar to that of the teachers, although we observed a tendency to emphasize even more the simplification, time-saving, and indispensability of the technologies.

Table 8: Most relevant topics contained in the answers provided by teachers to the question reported in the first row of the table.

Teachers

Reasons for not adopting tested teaching technologies		
High Schools	Middle Schools	Primary Schools
Poor intuitiveness. Complicated sharing. Poor adaptability to disciplines. Too many offers/opportunities. Huge amount of time required for break-in/use. Insecurity/unpreparedness. Easiness to cheat. Poor teaching effectiveness. Return to presence. Expensive Inadequate technological availability (school or students)	Huge amount of time required for break-in/use. Too many offers/opportunities. Low teaching effectiveness. Unsuitable for assessments. Limited student skills. Return to presence. Expensive.	Too complicated. Huge amount of time required for break-in/use. Too many offers/opportunities. Inadequate technology availability (school or students). Unusable in f2f activities. Low teaching effectiveness. Parental complaints. Return to presence. Better in presence.

Reasons not to adopt technologies. Despite the very positive perception of the technologies used, in the end, many of the technologies that the teachers came into contact with and experimented with were not adopted. Table 8 explains the reasons for this. Apart from the conviction of some teachers that f2f activities should be considered as an alternative to both online and technology-enhanced activities (which understandably manifests itself more in primary school), there emerges a certain orientation difficulty due to: the wide range of applications that functionally overlap; the little time available for experimenting and comparing technologies, as well as for becoming an expert in their use (for which some teachers feel unprepared); and in using them with an adequate continuity when they require a lot of preparation time; the impression of lack of effectiveness or adaptability to specific disciplines; as well as problems related to the obsolescence of the technological equipment of schools and students (particularly in high schools), and, finally, the costs associated with both hardware and applications (many of which are no longer free of charge after the pandemic).

Table 9: Most relevant topics contained in the answers provided by teachers (a) and principals (b) to the question reported in the first row of the table.

a) Teachers

For which activities do you find educational technologies most useful?		
High Schools	Middle Schools	Primary Schools
Presentations. Finding/sharing materials. Writing/storytelling. Visualisations/simulations. Prerequisite tests. Flipped Classroom. Collaborative teaching. Absentees inclusion. Greater proximity-listening activities. Didactic organisation	Presentations. Research and Insights. Material sharing. Use of multimedia materials. Collaboration and group work. Playful exercises/games. Science simulations/support to lab activities. Reinforcement/Consolidation. Absentees and DSA inclusion.	Presentations. Research and Insights. Use/realisation of multimedia materials. Sharing materials/maps. Quizzes/tests. Exercises (including games) Group activities. Maths. Language development/Storytelling. Inclusion absentees. BES and DSA support.

b) Principals

For which activities do you find educational technologies most useful?	
High Schools	Middle and Primary Schools (IC)
Material retrieval/sharing/archiving. Problem solving. Reality tasks. Metacognitive process documentation. Collaborative teaching. Laboratory activities Inclusion absent. Consolidation/enhancement. Planning and organisation Traceability. Meetings. Synchronous training.	Presentations. Finding/organising/sharing materials. Exercises and tests. Collective problem solving. Educational integrations. Innovate Teaching. Workshops/Simulations. Inclusion. Student involvement. Networking/Twinning projects Adult collaboration and interaction Communication Organisation and meetings. Administrative processes.

Usefulness of educational technologies. The difficulties highlighted in table 8 could be among the reasons that lead to a relatively limited use and perceived usefulness of the adopted technologies (see table 9). The main purposes include the retrieval of materials and information in multimedia format, the preparation and delivery of presentations, carrying out various types of tests, and group and collaborative activities. For the lower age groups (primary schools), there is a greater tendency to use playful approaches, while as age increases, the technologies have been used as an aid to deal with scientific subjects: from support to the explanation of mathematical concepts, to support for laboratory activities, to their use to carry out simulations. Highly appreciated by all is the ability of technologies to foster greater proximity with students and to include them (particularly in the case of absent students), as well as the support they can provide for BES (special educational needs) and DSA (specific learning disorders) students. There aren't many methodological indications associated with technologies (apart from the 'flipped classroom' approach and the aforementioned collaborative teaching). In high schools, reference also emerges to the capacity of technologies to facilitate didactic organization.

The didactic and organizational spheres are, on the other hand, precisely those on which the principals' perception of usefulness is most focused. Very relevant for many of principals is the reference to the organization and holding of meetings of various types, also for project and collaboration purposes. The optimization of administrative processes and the support to traceability are also mentioned.

As far as teaching processes are concerned, support for inclusion is mentioned at all levels together with, as far as high schools, the possibility to support consolidation and reinforcement. From both categories of principals (High schools and ICs), technologies are recognized as being able to support collaborative approaches and problem-solving as well as being useful in laboratory and simulation practices. In high schools, the possible drive for reality tasks and metacognitive process documentation is also emphasized. More obvious are the references to the retrieval, sharing and archiving of didactic materials, and to the aid to deliver multimedia presentations.

Table 10: Most relevant topics contained in the answers provided by teachers to the question reported in the first row of the table.

Teachers

Intentions of use: technology-supported activities		
High Schools	Middle Schools	Primary Schools
Materials sharing. Production of multimedia materials (teachers and students). Dematerialization. Methodological innovation (flipped classroom, on-line inquiry, active teaching, tutoring, cooperative learning). Skills enhancement. Improved and more efficient learning processes. Interdisciplinary. Evaluation. Inclusion. Improving student interaction and involvement. Improve relations with families and colleagues.	Support students motivation. Skills development. Socials and tech usage education Interactive teaching. Methodological innovation (flipped classroom, reality tasks, peer education, collaborative learning). Disciplinary teaching improvement (maps). Reinforcement/Consolidation. Game based learning. Assessment and self-assessment. Inclusion.	Research and insights.

Intentions about future technology-supported activities. The range of technology-supported teaching activities that teachers intend to implement in the future (i.e. not due to the restrictions imposed by Covid) grows and differs in going from the primary to the high schools. In primary schools, the intention of the teachers seems to return to traditional practices, even in presence, despite the recognized usefulness of technologies, evidently, considered as such only in case of critical situations. The only function of technologies that they do not seem to want to give up, in the return to the "full normality", is the carrying out of research and retrieval of additional materials, given the practically unlimited offer provided by the web. In practice, technologies and connectivity would be used as substitutes for encyclopedias.

Moving up to the middle schools, the landscape changes and the tendency seems toward building on the experience done in these last two years and reintroducing, even potentially, the activities for which technologies were perceived as useful during the pandemic period. In addition to the support to the strengthening of the methodological framework, technologies are also recognized to own an intrinsic educational value in relation to the acquisition of new technological and social skills. The respondents are convinced that the use of technology can be more motivating, which also explains the interest in more playful didactic approaches. Also confirmed is the interest in technological support for assessment and self-assessment processes.

The panorama regarding high schools is similar to that of middle schools, but enriched with further details and extensions to all aspects of the teaching process, including the improvement of interaction and its efficiency. Also a reference to the support for more multidisciplinary didactics has been added.

Table 11: Most relevant topics contained in the answers provided by teachers to the question reported in the first row of the table.

Teachers

Continuous training: in which topics would you be more interested in?		
High Schools	Middle Schools	Primary Schools
Realisation of multimedia materials (video). Virtual spaces, robotics. Assessment (including competences). Use of socials/distance communication. Multidisciplinary didactics. Technologies for disciplinary didactics Collaborative working platforms (cloud). Best practices sharing Planning/process management.	Realisation of multimedia materials (video). Maps creation. Coding, educational robotics, AR. Technologies for disciplinary didactics. Gamification.	Flipped classroom. Assessment and evaluation. Sharing tools. Collaboration tools Communication tools. Inclusion. Disability. Platforms and websites management. Games. Coding.

Continuous training. Given for granted the central value acknowledged to continuous training by all categories of teachers [18], what is reported in table 11 provides a picture fully coherent with the content of the previous tables. The expectations of primary school teachers turn out to be very generic apart from the specific requests concerning the management of teaching platforms and websites, the use of games, and the development of coding activities.

As one might have expected, these requests become more specialized at the middle schools level: along with the generic reference to coding we also find the reference to educational robotics and AR (augmented reality); the reference to games becomes a reference to gamification (which as well known is a more complex topic that involves processes); technologies are expected to support disciplinary didactics; and, finally, courses on how to master the production of multimedia materials and videos are also expected.

Going further up to the high schools, further specializations emerge such as: the competence assessment; the support to the design and management of processes; the sharing of good practices, as well the use of working and sharing environments in the cloud (a topic with broad facets and huge potentialities).

Table 12: Most relevant topics contained in the answers provided by teachers (a) and principals (b) to the question reported in the first row of the table.

a) Teachers

Smart Organization: for which activities do you find technologies most useful?		
High Schools	Middle Schools	Primary Schools
Organisation Streamlining bureaucracy. Time optimisation. Best practice sharing. Meetings (collegial bodies). Teachers' collaboration. Boards and scrutiny. Relations with families. PCTO/Orientation Administrative processes and practices (document delivery, interaction) Training.	Organisation Time optimisation. Planning/Scheduling Communication Meetings (collegial bodies). Relations with families. Administrative processes and practices Training	Organizzazione Organisation Time optimisation. Streamlined bureaucracy. Optimised communication (internal and external). Meetings (collegial bodies). Relations with families. Processes and practices Administrative processes and practices. Training.

b) Principals

Smart Organization: for which activities do you find technologies most useful?	
High Schools	Middle and Primary Schools (IC)
Documents archiving and sorting Documents sharing Services Simplification and efficiency. Process efficiency. Monitoring of learning offer planning (PTOF). External communication. Meetings. Final evaluations (discussions). Training. Relations with families.	Productivity increase. Services simplification and efficiency. Time optimisation. Tracking and monitoring. Administrative processes and practices. Organisational activities. Meetings. More effective communication. Document transmission. Collaborative activities (including evaluation). Process sharing. Planning and programming. Teacher training. Relations with families. Work/life balance.

Smart organization. It is evident from table 12 that at every level the benefits of technology in terms of streamlining and optimizing organizational and bureaucratic processes have been understood and intaken, probably to a much greater extent than for teaching processes and activities. In addition to this, the indispensability of technologies for optimizing and improving quality in internal and external communication processes, including the management of relations with students' families, seems to be well established. In general, all activities and processes that do not involve students, that would not require the presence of teachers in a classroom, and that are expected to take place beyond school hours are expected to become "smart". These activities also include teacher continuous training for which the use of distance learning has become dominant in the past years. The only exception is PCTO - the pathways for the development of transversal competencies and orientation - for which the use of activities carried out online with students is considered useful, and most likely profitable.

Perfectly aligned with those of the teachers are the opinions of the principals. The description of the sub-processes becomes somewhat more detailed but does not change in substance. The only noteworthy element to stress is the mention of the use of smart organization to help work/life balance. This highlights a positive outcome of the organizational and time optimization of school processes that goes well beyond the school practices pointing to the well-being of the key actors of the educational processes.

Table 13: Percentage of terms carrying a positive valence among those used by (a) teachers and (b) principals in describing the last two years period

a) Teachers

Three words to define the last two years period (with reference to the schools' activities)		
High Schools	Middle Schools	Primary Schools
55% (+) 60% F | 39% M 47% N | 58% C | 68% S	54% (+) 58% F | 40% M 49% N | 58% C | 59% S	39% (+)

b) Principals

Three words to define the last two years period (with reference to the schools' activities)	
High Schools	Middle and Primary Schools (IC)
52% (+) 50% F | 58% M 47% N | 58% C | 62% S	63% (+) 63% N | 81% C | 50% S

Perception about the last two years period. The terms chosen by teachers and principals to describe the period during which the school was subject to the *digital shock* (table 13) provide a picture that is much less positive than the description given of the technologies that have been used during such period (see table 7). This difference can be considered as evidence of the ability of the respondents to distinguish the judgment on technologies, the context of application, and the process outcomes. The judgment of teachers and principals is fairly uniform in the case of the high schools with the exception of the gender difference, which in the case of teachers indicates less criticality for female teachers and male principals. Evident is the greater distress perceived in the north compared to the centre and, even more, to the south. The results for middle schools are aligned, while the judgment given by the teachers of the primary schools is decidedly more negative. On the other hand, the principals of the ICs seem to have a more positive perception with respect to the high school principals.

The positive terms used to describe the period are very similar to those used to describe the technologies and are mainly centred on the themes of innovation and transformation. Aspects that, most likely, in the primary schools, were perceived as very impactful in a positive sense by the principals and in a more negative one by the teachers (an outcome that is fully consistent with the contents of the other tables discussed above). As far as the negative aspects are concerned, beyond the confirmation of the perceived increase in workload already found for the description of the technologies, very clearly emerge also terms referring to distance, isolation, lack of empathy, dispersiveness, and danger of reduced learning, together with - in the case of the teachers - a veiled sense of limited recognition of the efforts made to keep the schools going.

4 Final considerations and conclusions

Even though the effects of the *digital shock* caused by the pandemic on the school ecosystem were in general - as already discussed in [18] and confirmed by the analysis of the terms used to describe the technologies - rather positive, the detailed analysis carried out in this study highlights also the existence of critical aspects and the persistence of inhomogeneities with respect to the general trend. On such criticalities it would be advisable to focus in the near future, both with structural interventions and with special training courses and practical simulations, which can easily be conducted also remotely by means of adequate technologies.

The first very general critical issue concerns the clear difference that emerges between the full acceptance of the use of the technologies in the optimization of all organizational, managerial, communicative processes, etc. - i.e. in aspects that do not imply classroom activities with students - compared the to the level of penetration and integration of the technologies to support didactic activities.

With regard to the latter, as far as teachers are concerned, we have observed a disparity between schools' levels that emerges very clearly from the analysis of the answers concerning the future intention to implement technology-enhanced teaching activities and those about the desirable contents of future continuous training. Although these disparities may be justified by the different ages and needs of the students, they would nonetheless seem to reveal also a quite limited technological culture weakly focused on real needs. An impression that is also confirmed by the difficulty experienced by teachers in orientating themselves within the technological offer.

Alongside the orientation difficulties, we should also highlight the difficulties encountered by teachers in the use and experimentation of technologies which, if in part can be determined, upstream, by an insufficient preparation for the profession (at least regarding the learning technologies), to a great extent can be ascribed to the lack of maturity that characterizes a large part of the didactic applications. Too often, indeed, developers do not seem to apply the basic rules of human-computer interactions that might have generated the teachers' references to the difficulty in sharing materials and practices, to very time-consuming operations, partially to fatiguing effects, etc. Most likely the more in-depth intake of *smart working* with respect to the *technology-enhanced learning* activities is also due to the large use of well-consolidated and easy-to-use applications for collaborative work, material sharing, and video interaction that, by the way, have highly contributed also to the simplification of school processes.

All the above considerations about technologies - positive aspects and criticalities - should not be put in relation to the opinion of the respondents about the particularly critical period experienced over the last two years: in fact, from the content of tables 7 and 13 it is clear that teachers and principals are able to make a clear distinction between the judgment on technologies and the judgment on the complex operational context that they have experienced and in which they have operated.

Moving to the numerical evaluations provided by the participants, we can observe, in a very general way, how those of the principals appear much more homogeneous - and therefore less sensitive to the independent variables considered in this study - than those provided by the teachers.

Regarding the learning ecosystems, it is quite evident how network connectivity still represents a problem for middle and primary schools and more generally for schools located in southern Italy. Very minor but not entirely absent is the problem of Schools' and Students' Technological Adequacy which potentially could generate forms of digital divide.

Probably because of this, the results seem to highlight a lower digital leadership in the case of the principals of middle and primary schools, partly amplified by the lack of technical support, perceived also by the teachers.

A disparity also emerges between the south and the rest of the country, which also extends to technological and pedagogical skills. A possible relevant heterogeneity in the preparation of teachers in the south of Italy also emerged, highlighted by the greater disparity between the average evaluation of colleagues' competencies and their own.

In spite of these problems in the south, the teachers who answered the questionnaire seem to show a greater propensity for innovation and a stronger interest in the challenges posed by digital technologies, with a consequent greater openness to updating teaching methods. Such positive feelings, however, do not prevent them to show a certain approximation in the definition of the topics of interest for their continuous training.

Another significant element that emerged from the survey is the greater difficulty of teachers in adapting, with increasing age, to the consequences of the *digital shock*. This evidence seems to suggest that the full exploitation of the potential of digital technologies can only be achieved as a result of a generational change that in part will be achieved in 5-10 years from now (of course provided that the new teachers will be adequately trained).

In any case, the picture described in this article deserves to be constantly monitored in its evolution and this is why in the future we intend to follow up the survey, integrating the study of the digital maturity level with that of the "smartness" of the school ecosystem (to include all levels of the ASLERD pyramid), also for the purpose of verifying the effects that might be induced by programs sustained by European funds (such as "Scuola 4.0", which for the first time looks at schools as ecosystems). For this reason, where possible, we also intend to carry out surveys that highlight how changes may reverberate on the territorial communities of reference of the school ecosystems.

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