Chapter

Remote Support through Technologies: A Research-Training on Teachers' 'Sophisticated Knowledge'

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Abstract

The COVID-19 pandemic accelerated the process of transforming teaching practices, such as remotely supporting students through innovative technological means. After a reflection on the impact of COVID-19 emergency on teachers' skills, on the basis of a series of professional resources made available to teachers in order to support remote participation and learning of students, the work presents methodologies and results of an intervention-research, which involved 108 teachers in service, aimed at develop the teachers' ability to integrate remote teaching technologies resources, with a view to personalizing interventions and effectiveness of learning content. The survey highlighted that relationship with students has been the teaching practice aspect most influenced by technologies/digital resources in the period of the pandemic. Such results offer support for didactic research to integrate the well-known explanatory model of TPACK (Technological Pedagogical Content Knowledge) with further aspects relating to 'sophisticated' knowledge, more linked to adaptation and *re-shaping* of knowledge to be taught with reference to the students needs.

Keywords: COVID19 emergency, teaching technologies, TPACK

1. Introduction - support of teachers as a COVID-19 emergency

The pandemic crisis has affected people's lifestyles by inducing countries to change the management of entire sectors of private and public life [1–3]. It is estimated that over 1.58 billion children and young people attending education-training courses - around 94% of students worldwide - in 200 countries no longer went to school in March 2020 [1, 4] and that countries have had to adopt various measures to continue students' learning during school closure.

Countries have used a variety of resources to ensure remote learning for students (radio and television); specifically, to ensure online education, recovered instructional resources [5], as online platforms with tools included - educational content for exploring, real-time lessons on virtual meeting platforms, online support services for parents and students, self-paced formalized lessons [6].

Such situation is inevitably leading to the reconfiguration of the entire education system and, above all, to the acceleration of change in teaching-learning processes [7]. The urgent implementation of new ways to deal with the crisis - use of remote teaching, flexibility of schedules and functions, etc. - indeed, made it possible to experiment with 'solutions previously considered difficult or impossible to implement' (p. 4) and to concentrate efforts to address training needs that have always been known but which the pandemic situation has in fact forced to solve - such as, among others[i], support for the teaching profession and the preparation of teachers.

The COVID-19 pandemic and such abrupt modification of teaching delivery accelerated the process of transforming teaching practices, such as remotely supporting students through innovative technological means [7, 8]; such situation asked teachers above all to face new challenges such as that of supporting students remotely through innovative technological means. Since the early pandemic teachers were tasked to implement teaching in distance learning modalities, "often without sufficient guidance, training, or resources" ([7], p. 14). They:

> *were largely unprepared to support continuity of learning and adapt to new teaching methodologies (…) Even in contexts with adequate infrastructure and connectivity, many educators lack the most basic ICT skills, meaning they will likely struggle with their own ongoing professional development, let alone with facilitating quality distance learning' ([7], p. 15).*

For this reason, the COVID-19 crisis has highlighted among the many things that in-service teacher training 'are in need of reform to better train teachers in new methods of education delivery' ([7], p. 15).

As already noted by Hattie and by Pitler et al. [9, 10], the current situation has finally made it clear that to support the teaching profession and the preparation of teachers it is not enough to provide them with: 'Technology alone cannot guarantee good learning outcomes. More important than training teachers in ICT skills, is ensuring that they have the assessment and pedagogical skills to meet students at their level and to implement the accelerated curricula and differentiated learning strategies' ([7], p. 23).

As suggested by Anderson [11, 12], in order to avoid the negative effects of the so-called *coronateaching* [13][1] - i.e. the poor quality of the training offer and the ineffectiveness of the production of skills, due to sudden transformation of frontal lessons in virtual mode without investing the curriculum or teaching methodology - the support offered to students by teachers and tutors becomes fundamental, especially through - upstream - the redesign of the course in terms of both the curriculum and strategies, – downstream - the monitoring of students' learning processes.

The specific limit of the emergency adaptation of courses in online mode, in fact, would not be so much in the lack of support offered by teachers to students - in terms of the 'teacher-student' relationship -, but rather in the lack of link between

[1] The neologism is taken from the UNESCO-IESCALC document 'COVID-19 and higher education' [13] in which it is defined as the tendency to 'transform present lessons in a virtual mode, without changing the curriculum or methodology (…) abrupt entry into a complex teaching modality, with multiple technological and pedagogical options and with a steep learning curve (which could involve) frustration and overwhelming adaptation to an educational modality never experienced before without the corresponding training' [13, p. 25].

pedagogical contents, of differentiated learning environments, by means of digital technologies and organization of learning experiences - in terms of the 'teacher-course' relationship -, which involves both the planning of the instructional design (ID) and the choice of learning design - LD [14–16].

As highlighted by UN ([7], p. 24) 'digital solutions need relevant content, adequate instructional models, effective teaching practices and a supportive learning environment'. It then becomes possible to dispel the *myth* of teaching 'with' technologies [17, 18] and put teaching strategies at the center.

2. (Useful) support to (real) needs of teachers

Already in 2019 the TALIS [19] survey revealed the strong need for teacher training in the use of information and communication technologies (ICT) - despite 60% of teachers received professional development in ICT, 18% in fact reported a higher need for development in this area. The preparation of teachers to support students' digital learning is not based only on ICT skills [5]: 'technology does not just change methods of teaching and learning, it can also elevate the role of teachers from imparting received knowledge towards working as co-creators of knowledge, as coaches, as mentors and as evaluators' ([5], p. 17).

Teacher training, in general and even more so in the current context, is effective if useful for build pedagogical and technical skills, for integrate digital tools into learning environment [5, 19, 20].

While in the early emergency the first generalized response was to provide tools[2] [4] that made it possible to set up a 'field' [21] distance learning, then it was possible to start thinking on the skills needed by the teacher to cope with this situation.

OECD [22] stressed in the second study that 'for educators, the COVID-19 pandemic is a quintessence of the adaptive and transformative challenge, for which there is no pre-configured playbook that can guide appropriate responses' ([22], p. 2) and provides a set of online educational resources to support continuity of teaching and learning:

1. *Curriculum resources* - as lectures, videos, interactive learning modules;

2. *Professional development resources* - resources to support teachers (or parents) in the ability to teach at a distance, to support learners, more independently at home rather than at school;

3. *Tools* - teaching and learning management tools, communication, creation or access to educational content.

The second one resources were assessed on the basis of a specific taxonomy for classifying the curriculum and professional development resources [23], see **Table 1**.

Regards resources for professional development suggested by OECD [8], the following table shows the professional skills activated as well as the related taxonomic category (see **Table 2**).

[2] Applications, platforms and educational resources for use by parents, teachers, school administrators to support student learning and offer assistance during school closing periods.

1. Cognitive Skills	2. Interpersonal skills	3. Intrapersonal skills
1.1. *Processing and cognitive strategies* - CT: Critical Thinking; PS: Problem Solving; A: Analysis; LR: Logical Reasoning; I: Interpretation; DM: Decision Making; EF: Executive Functioning 1.2. *Knowledge*: LC: Literacy and communication skills; AL: Active listening skills; KD: Knowledge of the disciplines; Ev: Ability to use evidence and assess biases in information; DL: Digital Literacy 1.3. *Creativity*: C: Creativity; In: Innovation	2.1. *Collaborative group skills* - Cm: Communication; Cl: Collaboration; TW: Team Work; Cp: Cooperation; Co: Coordination; EP: Empathy, Perspective Taking; Tr: Trust; SO: Service Orientation; CR: Conflict Resolution; Ne: Negotiation 2.2. *Leadership*: Le: Leadership; Re: Responsibility; AC: Assertive Communication SP: Self-Presentation; SI: Social Influence	3.1. *Intellectual Openness* - Fl: Flexibility; Ad: Adaptability; Ar: Artistic and Cultural Appreciation; PS: Personal and Social Responsibility; IC: Intercultural competency; AD: Appreciation for diversity; CL: Capacity for lifelong learning II: Intellectual interest and curiosity 3.2. *Work Ethic, Responsibility* - Ini: Initiative; SD: Self-direction; Res: Responsibility; Pe: Perseverance; Pr: Productivity; Pt: Persistence; SR: Self-Regulation; MT: Meta-cognitive skills, anticipate future, reflexive skills Pro: Professionalism; Eth: Ethics; Int: Integrity; Cit: Citizenship; WO: Work Orientation 3.3. *Self-efficacy* - SA: Self-regulation (self-monitoring and self-assessment); PMH: Physical and mental health

Table 1.
Taxonomy for the analysis of professional development resources ([22, 23], p. 5).

The OECD [22] analysis highlights that the resources available to teachers for their effective professional development in a pandemic situation are only partly related to technological skills but invest broader ability, such as redesign of programs, flexible adaptation of strategies, for the effective support for student learning. Such resources must not be limited only to 'technological' (T) skills but even extend beyond the 'techno-pedagogical' (TP) ones, introduced by Mishra & Koehler [24, 25] within the TPCK (Technological Pedagogical Content Knowledge) descriptive model. This is considered as the Shulman's explanatory model integration - 'Pedagogical Content Knowledge' (PCK) - since to the distinction between disciplinary and pedagogical knowledge it adds that of the technological area. Its basic components are: a. technological knowledge ('knowledge of the technologies and skills necessary to operate with them - TK); b. pedagogical knowledge ('teaching/learning processes and practices, methods and approaches' - PK); c. content knowledge ('teachers' understanding of the semantics and syntactic organization of a discipline').

On the other hand, techno-pedagogical (TP) skill - as 'knowing the pedagogical affordances and constraints of a range of technological tools as they relate to disciplinarily and developmentally appropriate pedagogical designs and strategies' ([25], p. 10) - describes relationships and interactions between technological tools and specific pedagogical practices, in other words 'the pedagogical awareness of resources and technological constraints' [26]; on the other hand, pedagogical-content (PC) skill describes relationships/interactions between pedagogical practices and specific learning objectives [27]; it is 'the ability to teach content from the students' point of view' [28].

Analyzing carefully, in the construct of 'techno-pedagogical' (TP) skill the relationship with the 'student's point of view' - recognized only in the 'pedagogical-content' - would appear to characterize the skills necessary for the teacher to carry out a teaching remote in the pandemic phase.

Resources	Professional skill	Taxonomic category*
Teachercpd.ie (website)	How effectively teach and learn online How to find good sources of educational content How to enable online communication and collaboration How to create and share your educational content online	1.1. Processing and cognitive strategies 1.2. Knowledge 2.1. Collaborative group skills 3.1. Intellectual Openness 3.2. Work Ethic, Responsibility 3.3. Self-efficacy
Teachfromanywhere.google (platform)	How to make home teaching decisions with videos, without videos How to make distance learning accessible to all How to keep students engaged How to keep in touch with other teachers	1.1. Processing and cognitive strategies 1.2. Knowledge 2.1. Collaborative group skills 3.1. Intellectual Openness
Learningpractice.org (website)	How to adapt online courses How to manage trauma situations How to practice inclusive education and socio-emotional distance learning	1.1. Processing and cognitive strategies 3.2. Work Ethic, Responsibility 3.3. Self-efficacy
Quipper.com (website)	How to find learning resources for students How to track student homework online How to use learning videos and worksheets within digital teaching practice	1.2. Knowledge 2.1. Collaborative group skills 3.2. Work Ethic, Responsibility
Knotion.com (platform)	How to redesign the teaching-learning path in terms of the pedagogical model and the curriculum	1.1. Processing and cognitive strategies 1.2. Knowledge 1.3. Creativity 2.1. Collaborative group skills 2.2. Leadership 3.1. Intellectual Openness 3.2. Work Ethic, Responsibility 3.3. Self-efficacy

Table 2.
Professional development resources: Skills and taxonomic categories ([22], p. 5).

3. Situation and a research-training in Italy

As noted by OECD ([29], p. 8), the Italian government already adopted in March, then renewed in May, measures to support distance learning (digital platforms for schools, tools for learning, digital devices for limited means students) and, mainly, a training plan for school staff on methodologies and techniques for distance learning - dl n. 18/2020, n. 34/2020.

In the 'School Plan 2020–2021' - decree no. 39 of 26 June 2020 - launched in June, in the paragraph on 'Training' for teachers, the 'use of new technologies in relation to the different tasks and professionalism' is encouraged, as regards innovative

teaching-learning methodologies, school inclusion, interdisciplinary teaching models, methods and tools for evaluation. The document also proposes an integrated digital teaching solution described in terms of needs analysis, objectives to be pursued, tools to be used, timetable and frequency of lessons, therefore inherent in the redesign of teaching activities, which takes into account the digital potential of the school community, with particular regard to the access and full participation of students with specific needs.

The ministerial note n. 388 of 17 March, formerly, had focused attention on the redesign of the entire teaching activity, on the reshaping of the educational objectives, on the provision of new learning resources and methods of interaction with all pupils, as well as - for students with Special Needs - explanation of new forms of interaction/fruition between student and class, between student and other teachers, between teachers and families, the supply of new personalized material, constant monitoring through periodic feedback based on the established objectives.

The previous National Digital School Plan [30] already favored the modernization of infrastructures and technologies from 2007 to 2015 - see LIM action (2008), Cl@ssi 2.0 action (2009–2011), Scuol@ 2.0 action, Wi-Fi action (2013) - as well as a deep rethinking of teaching based on innovative learning environments - see 'Future Labs' Training Centers Action (since 2015 for the digital training of school representatives) - and has allowed the Italian school not to be completely unprepared for the COVID-19 emergency.

As already noted elsewhere through the metaphor of the 'supply-chain' [30], the digital training of in-service teachers in Italy takes place through integrated governance (see Law no. 107/2015) which holds together the European framework DigCompEdu 2.0 [31, 32], the PNSD and the training needs of territorial 'polo' schools[3].

As known, the European Framework DigCompEdu aimed at describing in six different areas the digital competences of teachers ([31], pp. 33):

Area 1: Professional Engagement - Using digital technologies for communication, collaboration and professional development – i.e. professional interaction with colleagues, students, parents and other parties, for the collective good of the organization;

Area 2: Digital Resources - Sourcing, creating and sharing digital resources;

Area 3: Teaching and Learning - Managing and orchestrating the use of digital technologies in teaching and learning;

Area 4: Assessment - Using digital technologies and strategies to enhance assessment;

Area 5: Empowering Learners - Using digital technologies to enhance inclusion, personalization and learners' active engagement;

Area 6: Facilitating Learners' Digital Competence - Enabling learners to creatively and responsibly use digital technologies for information, communication, content creation, wellbeing and problem-solving.

It provides a general 'reference frame for developers of digital competence models' ([31], p. 9) and it is assumed as a guidance for the design of effective training courses involving teachers [17, 33].

Methodologies and results of a research-intervention, aimed at develop teachers' ability to integrate inclusively remote teaching technologies resources and inspired by the DigCompEdu Framework, are described below.

[3] Schools as territorial centers for teachers training of specific areas: technologies, inclusion etc. – see L. 107/2015.

Area 1: Professional Engagement	**Area 2: Digital Resources**	**Area 3: Teaching and Learning**		**Area 5: Empowering Learners**
1.1. Organizational communication	**2.3 Managing, protecting and sharing digital resources**	**3.1 Teaching**	**3.2 Guidance**	**5.1 Accessibility and inclusion**
To use digital technologies to enhance organizational communication with learners, parents and third parties. To contribute to collaboratively developing and improving organizational communication strategies.	To organize digital content and make it available to learners, parents and other educators. To effectively protect sensitive digital content. To respect and correctly apply privacy and copyright rules. To understand the use and creation of open licenses and open educational resources, including their proper attribution.	To plan for and implement digital devices and resources in the teaching process, so as to enhance the effectiveness of teaching interventions. To appropriately manage and orchestrate digital teaching strategies. To experiment with and develop new formats and pedagogical methods for instruction.	To use digital technologies and services to enhance the interaction with learners, individually and collectively, within and outside the learning session. To use digital technologies to offer timely and targeted guidance and assistance. To experiment with and develop new forms and formats for offering guidance and support.	To ensure accessibility to learning resources and activities, for all learners, including those with special needs. To consider and respond to learners' (digital) expectations, abilities, uses and misconceptions, as well as contextual, physical or cognitive constraints to their use of digital technologies.

Table 3.
DigCompEdu teachers' sub-skills - 'technologies for e-inclusion' ([31], p. 19–22]).

3.1 Technologies for e-inclusion: a research-intervention in the south of Italy

'Technologies for e-Inclusion' intervention-research [34, 35] has been carried out within the second COVID-semester - September–November 2020 - and aimed at developing DigCompEdu teachers' sub-skills (**Table 3**):

These are the sub-competences related to the area of design, rather than intervention towards the skills of the students. The intent was to investigate rather the 'introductory' relationship of the teacher with technologies, rather than the effect on the relationship between students and technologies. More specifically, as made explicit by Redecker ([31], pp. 16).

> *'The core of the DigCompEdu framework is defined by Areas 2-5. Together these areas explain educators' digital pedagogic competence, i.e. the digital competences educators need to foster efficient, inclusive and innovative teaching and learning*

strategies. Areas 1, 2 and 3 are anchored in the stages characteristic of any teaching process, whether supported by technologies or not'.

The competences listed in the Areas 2 and 3 detail how to make efficient and innovative use of digital technologies when planning and implementing teaching and learning. Instead, the competences listed in the Area 5 concern the potential of digital technologies for learner-centered teaching and learning strategies.

3.1.1 Context and population

The survey was carried out at two High School – A. 'Marone', Vico del Gargano, Puglia and B. 'Alberti', Benevento, Campania - having the following characteristics (**Table 4**):

The survey involved 108 teachers with the following characteristics (**Table 5**):

3.1.2 Methodology: object and question of investigation

Data was collected by administering an 'ad hoc' questionnaire divided into three areas: sociometric-professional data, technological knowledge/skills, inclusive knowledge/skills. The tool wanted to know the perceptions of the teachers involved with respect to the technological tools for distance learning, the devices for setting up e-learning learning environments and the strategies useful for accessing and participating in the teaching process online learning.

This chapter focuses on the question no. 12 - Which aspect of your teaching has been most influenced by digital technologies/resources? - related to the perceptions

High school	Target	n. teachers	n. students	Type of school
'Marone', Vico del Gargano, Foggia (Puglia)	High – school referents for inclusion	59	477	Grammar and scientific high school – Vocational Institute for Agriculture Polo School for Inclusion
'Alberti', Benevento (Campania)	Basic - basic knowledge on distance learning	49	585	Scientific and Technical high school

Table 4.
Characteristics of the schools involved.

School	n. teachers	Age	Qualification	Seniority of service	Professional Development training	Middle-management assignment
A.	59	Over 50 years (57,6%)	Bachelor degree (47,5%)	Over 10 years (86,4%)	Technological-digital (44,1%)	Digital innovation team member (35,6%)
B.	49	Over 50 years (73,5%)	Bachelor degree (73,5%)	Over 10 years (75,5%)	Technological-digital (36,7%)	Digital innovation team member (63,3%)
Tot.	108	64,8%	59,3%	81,5%	40,7%	48,1%

Table 5.
Characteristics of the teachers involved.

of teachers on the aspect of their teaching practice most influenced by technologies during the COVI19 emergency.

The aim is to infer useful information to describe areas of possible overlap between technological, pedagogical and disciplinary knowledge and thus reflect on the usefulness of the descriptive models of teachers' technological knowledge/skills.

3.1.3 Data analysis

Data were analyzed at two levels:

- synthesis of sociometric-professional data (see 'Sample representativeness') - aimed at describing the sample and its representativeness with respect to the reference population - see Tabb. 2 and 6;

- correlation (see 'Correlation') between answer no. 12 and four factors - qualification, seniority of service, previous professional development training and middle-management assignment - aimed at inferring information about the weight of these factors on the ability to choose and effectively use technologies in inclusion, in an emergency situation such as that determined by the COVID19 pandemic.

3.1.4 Sample representativeness

The group of teachers involved has an high average age (64,8%, over 50 years), a bachelor degree (59,3%), over 10 years of teaching experience (81,5%), previous training in the technological-digital area (40,7%) - as well as in the technologies (39,8%) and design of learning environments (19,4%) - and experience in middle management, specifically as digital innovation team member (48,15)[4] (**Figure 1**).

The following table shows the characteristics of the teachers involved – number and age - in relation to the ones of regional population, i.e. secondary school teachers from southern Italy, retrieved from MIUR (2020) and OCSE (2019). The total number of teachers in Italy is 836,496 for an age of over 50, at 59% - the older population of teachers in the world and in Europe [29] (**Table 6**).

The group of teachers of course A represents 0.097% of the Apulian colleagues with an average age of the rest of the region; the teachers of course B are 0.052% of the Campania colleagues, far beyond the 50-years average.

3.1.5 Correlation

Question no. 12 - Which aspect of your teaching has been most influenced by digital technologies/resources? - presented 6 response alternatives (**Table 8**): content clarification, content facilitation, simplification of learning materials, communication effectiveness, class participation, student participation. It sought to investigate in what relationship the teacher places technologies with respect to his teaching practice. The six alternative responses indicated three aspects of teaching practice that would be favored by the use of technologies, specifically:

[4] Assignment without direct responsibility, unlike the digital animator (A. 3.4%; B. 22.4%) - coordinator of technological inclusion interventions and support of the school principal - and the 'instrumental function' in the technologies area (A. 0.0%; B. 14.3%) - guarantor of operational intervention actions. It should be noted that 61% of the teachers of the A. course declared that they had not held any of the professional positions in the technology area.

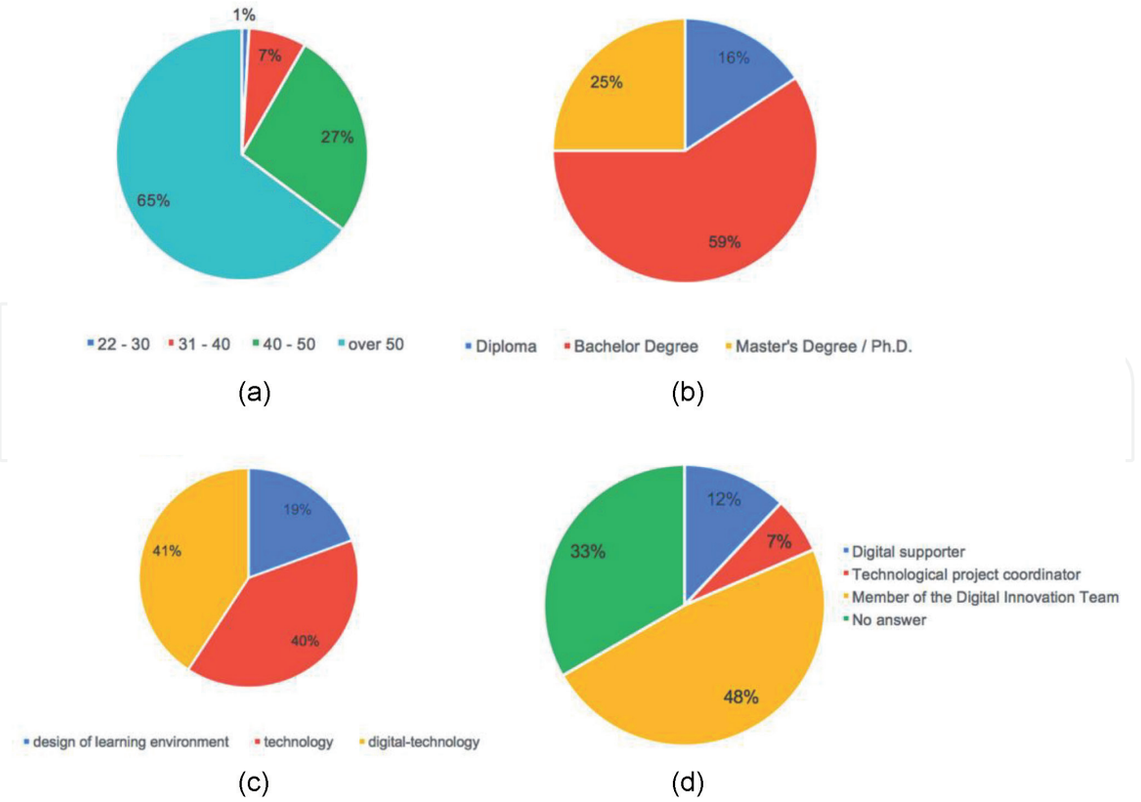

Figure 1.
(a) Age. (b) % of qualification. (c) % of PD training. (d) % middle-management assignment.

n. teachers				Age – over 50 years			
A.	**Puglia**	**B.**	**Campania**	**A.**	**Puglia**	**B.**	**Campania**
59 (0,097%)	61.094	49 (0,052%)	94.472	57,6% (−0,4%)	58%	73,5% (+14,2%)	59,3%

Table 6.
Sample representativeness.

- *what* - 'content clarification' and 'content facilitation' - focuses attention on learning content and tends to highlight the teacher's relationship with his/her discipline - see construct of 'relationship to knowledge';
- *how* - 'simplification of learning materials' and 'communicative effectiveness' - instead focuses attention on mediation and tends to highlight the teacher's relationship with the properly instructive dimension of his/her practice;
- *to whom* - 'class participation' and 'student participation' - shifts the focus, on the other hand, to the relational aspect of teaching, that is, the teacher's relationship with students and their participation.

These three aspects - *what*, *how* and *to whom* - were assumed as criteria for aggregating the data in the analysis process (see **Table 7**, **Figure 2**): they make it possible to better highlight where teachers' opinions and representations tend towards technologies: on aspects of content (*what*), of method (*how*) or with respect to students (*to whom*).

The following table shows absolute and percentages values of the six response alternatives (**Table 7**).

	A		B		Tot.	
	n.	**%**	**n.**	**%**	**n.**	**%**
To whom	31	52,5%	27	55,1%	58	53,7%
How	20	33,9%	12	24,5%	32	29,6%
What	8	13,6%	7	14,3%	15	13,9%
No answer	0	0,0%	3	6,1%	3	2,8%
Tot.	59	100,0%	49	100,0%	108	100,0%

Table 7.
Type of answers to question no. 12 in %.

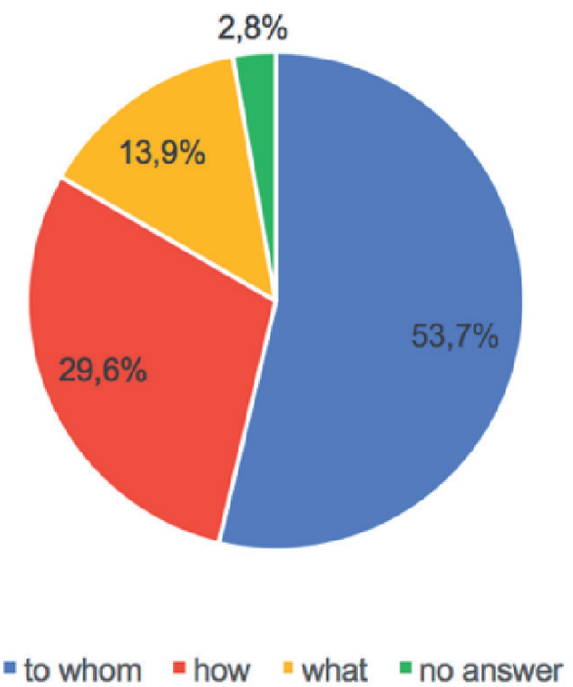

Figure 2.
Aspects of teaching influenced by technologies.

	A		B		Tot.	
Response alternatives	**n.**	**%**	**n.**	**%**	**n.**	**%**
Student participation	21	35,6%	18	36,7%	39	36,1%
Communication effectiveness	19	32,2%	11	22,4%	30	27,8%
Class participation	10	16,9%	9	18,4%	19	17,6%
Content clarification	8	13,6	7	14,3%	15	13,9%
No answer	0	0%	3	6,1%	3	2,8%
Simplification of learning materials	1	1,7%	1	2,0%	2	1,9%
Content facilitation	0	0%	0	0%	0	0,0%
Tot.	59	100%	49	100%	108	100%

Table 8.
Answers to question no. 12.

Table 7 shows the same answers grouped by type (**Figure 2**):

The prevalence of responses relating to the student-area (*to whom*) is highlighted, followed by the intervention methodologies/strategies (*how*) and teaching content (*what*) ones. The previous data are now correlated with the characteristics of the group of teachers involved (see **Table 2**):

	22–30 years	31–40 years	40–50 years	over 50 years	Total
To whom	1,7%	10,3%	19,0%	69,0%	53,7%
How	0,0%	6,3%	40,6%	53,1%	29,6%
What	0,0%	0,0%	33,3%	66,7%	13,9%
No answer	0,0%	0,0%	0,0%	100,0%	2,8%
Tot.	0,9%	7,4%	26,9%	64,8%	100,0%

Table 9.
Impact of technologies/age.

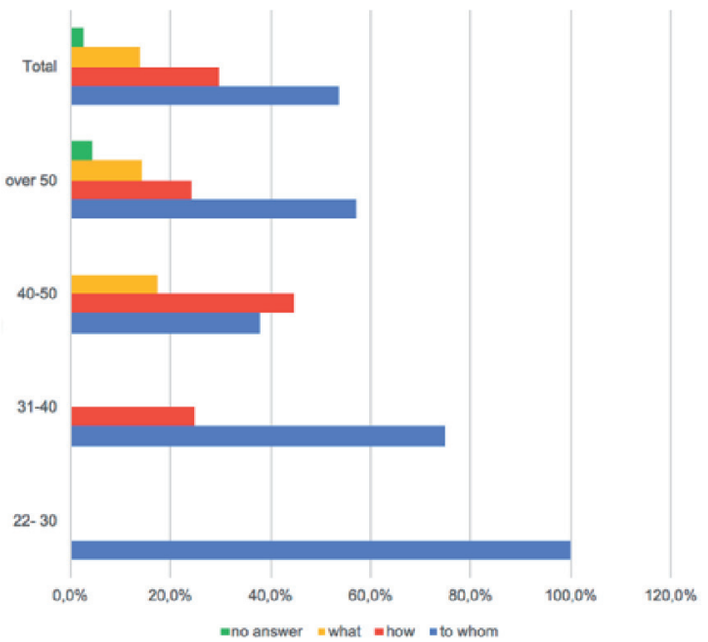

Figure 3.
Impact of technologies/age.

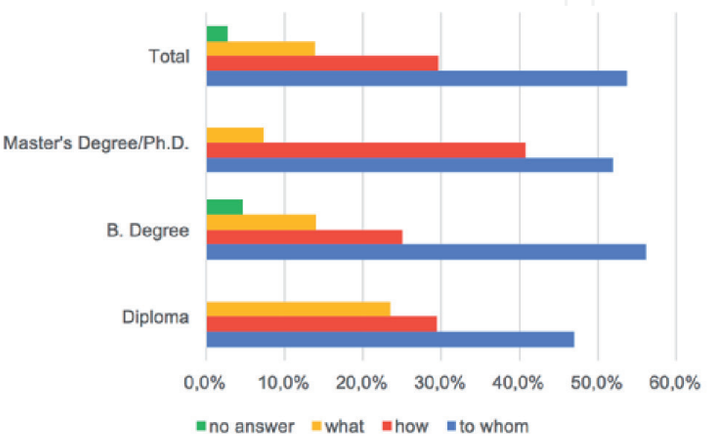

Figure 4.
Impact of technologies/qualification.

3.1.6 Impact of technologies and age

In all age groups, consideration of the impact of technologies on students prevails, with the exception of the 40–50 range where the influence on teaching methods is higher. It should be noted that within the younger classes - 22-30 years; 31–40 years - there is a complete lack of references to content - cf. **Table 9** - **Figures 3** and **4**.

3.1.7 Impact of technologies and qualification

Influence of technologies on students (*to whom*) prevails in all qualification grades (see **Table 10** - **Figure 5**). A slight increase compared to the methodologies (*how*) is found in the higher level of qualification.

3.1.8 Impact of technologies and seniority

Influence of technologies on students (*to whom*) prevails also within the seniority of service clusters (see **Table 11** – **Figure 6**). It peaks in the younger age group.

3.1.9 Impact of technologies and previous PD training

Influence of technologies on students (*to whom*) prevails also within the previous PD training clusters (see **Table 12** – **Figure 6**). It peaks in the 'design of learning environment', while it stabilizes for 'technology' and 'digital-technology'.

3.1.10 Impact of technologies and MM assignment

Same result for what concerns the characteristic of middle-management assignment (see **Table 13** - **Figure 7**). Influence of technologies on students (*to whom*)

	Diploma	B. Degree	Master's Degree/Ph.D.	Total
To whom	47,1%	56,3%	51,9%	53,7%
How	29,4%	25,0%	40,7%	29,6%
What	23,5%	14,1%	7,4%	13,9%
No answer	0,0%	4,7%	0,0%	2,8%
Tot.	100,0%	100,0%	100,0%	100,0%

Table 10.
Impact of technologies/qualification.

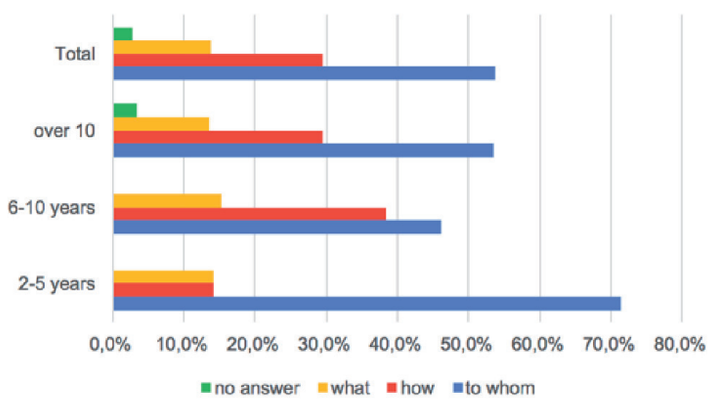

Figure 5.
Impact of technologies/seniority.

	2–5	6–10	over 10	Total
To whom	71,4%	46,2%	53,4%	53,7%
How	14,3%	38,5%	29,5%	29,6%
What	14,3%	15,4%	13,6%	13,9%
No answer	0,0%	0,0%	3,4%	2,8%
Tot.	100,0%	100,0%	100,0%	100,0%

Table 11.
Aspects of teaching/seniority.

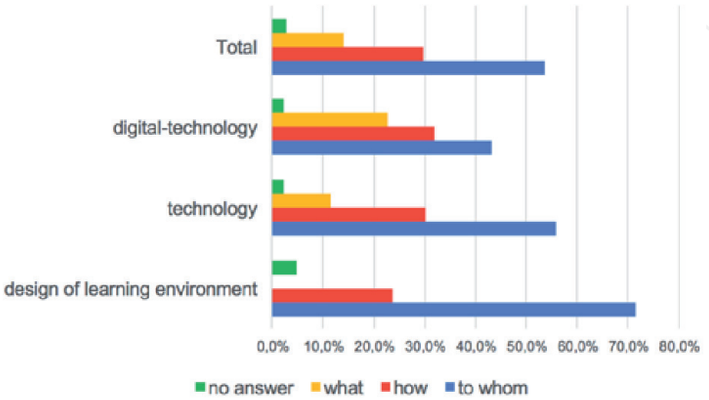

Figure 6.
Impact of technologies/PD training.

	Design of learning environment	Technology	Digital-technology	Total
To whom	71,4%	55,8%	43,2%	53,7%
How	23,8%	30,2%	31,8%	29,6%
What	0,0%	11,6%	22,7%	13,9%
No answer	4,8%	2,3%	2,3%	2,8%
Tot.	100,0%	100,0%	100,0%	100,0%

Table 12.
Impact of technologies/previous PD training.

	Digital animator	Instrumental function	Digital innovation team member	no answer	Total
To whom	53,8%	42,9%	55,8%	52,8%	53,7%
How	30,8%	42,9%	26,9%	30,6%	29,6%
What	0,0%	14,3%	15,4%	16,7%	13,9%
No answer	15,4%	0,0%	1,9%	0,0%	2,8%
Tot.	100,0%	100,0%	100,0%	100,0%	100,0%

Table 13.
Impact of technologies/MM assignment.

prevails in each of the three functions. It should be noted that for the Instrumental function the data of the participation of the tools (*to whom*) and the adaptation of strategies (*how*) are equivalent.

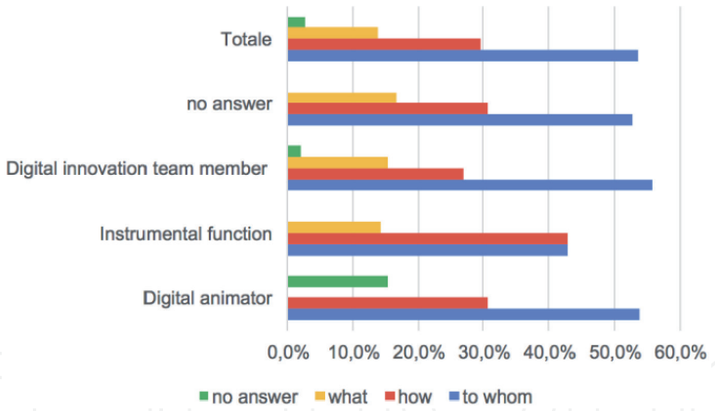

Figure 7.
Impact of technologies/MM assignment.

4. Results

The survey highlighted that the relationship with students has been the teaching practice aspect most influenced by technologies/digital resources in the period of the pandemic, according to the teachers involved.

The greatest urgency of the teachers was felt regarding the participation of single student and of class as well as regarding the communicative effectiveness - in terms of strategies - while teachers seem not to have bothered to facilitate the learning contents – **Tables 7** and **8**.

The group of teachers involved in the survey has stable and prevalent characteristics: on average elderly, with many years of experience and sufficient professional training on technologies.

Although the perception of the importance of the relationship with students does not seem to be affected, in general, by the characteristics of group – age, qualification, seniority, training, assignment - it nevertheless describes a different trend in them: it gradually increases with age (**Table 9**), it is higher in high qualification (**Table 10**), peaks in novices and then stabilizes in veterans (**Table 11**), prevails in those who have received more complex technological training (the design of learning environments - **Table 12**), is stable in every type of function (**Table 13**).

The trend of perceptions regarding teaching strategies (*how*) should also be considered: although it has a weight equal to half the participation of students (**Table 7**), it grows considerably with age (**Table 9**), it is quite high among teachers with high qualifications (**Table 10**) and with assignment as instrumental function (**Table 13**).

Unlike the professional assignment - which does not seem to affect the perception of the importance of the impact of technologies on the relationship with the student - the data of complex technology training should be compared with further investigations.

5. Conclusion. Rethinking the descriptive models of teaching

Support for students' learning processes should by now be taken as the focal point of the ability to teach, not secondary to disciplinary knowledge [36]. If valid in general, this assumption is even more valid in emergency conditions, when concentrate efforts on reducing potential exclusions is so necessary, as stated by supranational bodies [2, 5, 7] and confirmed by our survey.

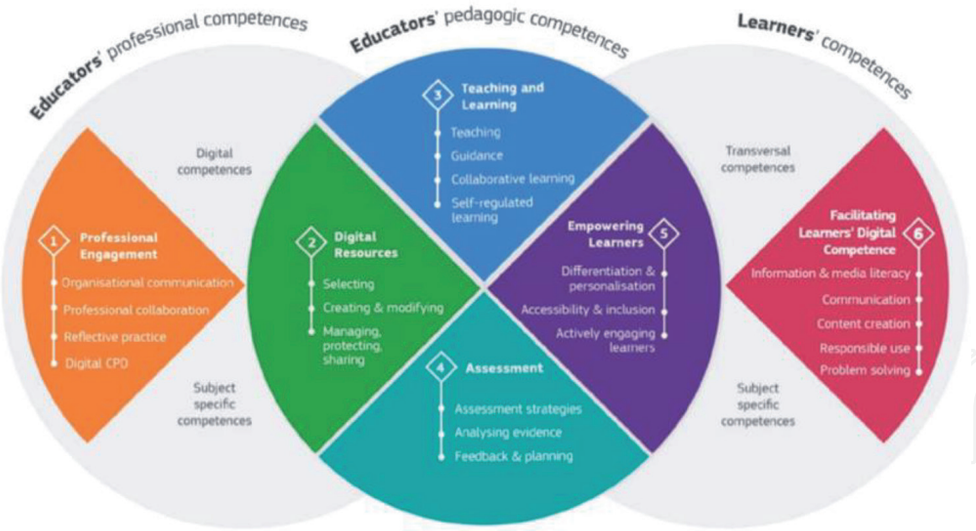

Figure 8.
The DigCompEdu areas and scope ([31], p. 15).

Place the student at the center of the teaching intervention - even more student with special needs - is the recommendation of Europe which, not by chance, adopted an articulated model of educators' technological [31] - **Figure 8**: to the 'characteristic phases of any teaching process, supported or not by technologies' (see area 1, 2, 3, 4) it adds the transversal area 5 of 'Empowering learners', which 'recognizes the potential of digital technologies for teaching strategies and learner-centered learning' ([31], p. 16).

In the traditional explanatory models of 'teacher's thinking' by Shulman and Koehler and Mishra [24, 25] the main components of the teacher's practical knowledge - 'learning contents' and 'intervention strategies' - are theoretically placed at the center, though they are not so relevant in the representations of the teachers involved in the survey and who are committed to addressing the problems related to 'emergency' distance learning during the COVID19 pandemic.

Traditional models of "teacher's thinking" [37, 38], mainly focused on disciplinary-knowledge, recognize other component of teaching didactic practice – elsewhere defined 'holistic', 'contextual' or 'relational' [39–41] - as "student participation" and "support to learning processes", as highlighted in the survey – but not specific weight.

The weakness of the TPCK construct would be the underlying logic of the 'overlap-separation' between the technological, pedagogical and disciplinary area. Although the authors state that 'the effective use of technologies in teaching is possible only when the teacher is able to integrate these three different cognitive components' ([25], p. 78), they should better clarify whether such integration takes place in actual practice, in the different procedures of teaching, or 'in the teacher's mind' as actual knowledge, then made into practice - as Shulman's thinking model seems to suggests [38]. Although, as stated by Koehler and Mishra ([25], p. 65), 'the TPCK framework for teacher knowledge is described in detail, as a complex interaction between three bodies of knowledge: content, pedagogy and technology'; albeit this framework seems to be useful to describe the dynamic/transactional relationship [27] between content, pedagogy and technology, it seems to be not sufficient to describe the actual complexity of the teacher's skills, given it underestimates the component of the 'student's point of view' [27]. Also for this, PCK and TPCK models are useful to describe the teacher's knowledge, as reasoning and procedures followed, but not sufficient to explain the stakes of the teaching practice [42–44], mainly in the *corona teaching* phase.

As noted elsewhere [17, 45], 'in other words, teacher should develop' the ability to teach content from the students 'point of view' (Ben-Peretz 2011, p. 4), making

the most of the possibilities offered by the e-learning environment. An extension of the TPACK, more "sophisticated" [17, 45] would be necessary to describe the knowledge of the teacher, which would concern not only the choice and delivery of effective digital content, from an organizational point of view, but also adaptation and *re-shaping* of knowledge to be taught on the basis of the characteristics of the students - as American experiences suggest (see *ICritical Thinking* of Educational Testing Service at the University of Princeton) and the DigCompEdu model - given that they take the perspective from the point of view of learning outcomes.

The current emergency scenario clarified the need to 'integrate' each components of teaching - planning, intervention, reporting, monitoring, etc. – in order to support student participation and learning: 'downstream', at the instructional level, and 'upstream', at the design level. On both levels, e-learning technologies can offer concrete support as long as teachers are adequately trained. The teachers involved perceive the learning needs of students as urgent, those who have received more complex training in technologies - not only at the instrumental level but also in learning environments - have felt this urgency even more. As noted by the OECD study ([22] – **Table 2**), among the skills underlying the professional development support of teachers there are disciplinary knowledge, support for 'processing and cognitive strategies' and 'collaborative group skills'.

The data should be compared with other similar studies (in terms of technological training of teachers) or different (with a larger population), to be taken as evidence and to allow a possible generalization of the results. The study presented was carried out in a population with stable and geographically similar socio-professional characteristics and highlighted that as age, length of service and level of training increase the importance given to the 'students' factor increases. 'in the relationship with technologies. Although it is extremely interesting to verify whether this trend would reappear in a population with diversified characteristics.

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Conflict of interest

The authors declare no conflict of interest.

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