Evaluating Italian School Learning Ecosystem Through an Integrated Lens: Assessing Smartness, Well-being and E-maturity with Teachers', Principals' and Parents' Perspectives

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Abstract. This contribution builds upon our previous work, in which we tested an integrated evaluation framework designed to assess smartness, well-being, and e-maturity in two high schools located in Rome. In the present study, we have extended the application of this framework to the entire Italian school ecosystem, involving a sample of principals, teachers, and parents in the evaluation process. The most significant outcome of this work is the development of a benchmark for learning ecosystems. This benchmark can serve as a reference for schools that wish to adopt the integrated framework in the future, enabling them to conduct self-assessments through a participatory evaluation process. The study also compared the perspectives of principals, teachers, and parents. The findings show relatively similar evaluations from parents and teachers, while principals tended to provide significantly more positive assessments. Using causal network analysis, we were able to identify the importance each respondent group assigned to the indicators used in evaluating the learning ecosystems. When combined with the insights gathered during the earlier high school evaluations—which also included student participation—these findings underscore the importance of involving all stakeholders in the educational process. Only through such inclusive, participatory evaluation can a truly meaningful assessment of a learning ecosystem be achieved, offering valuable guidance for its improvement.

Keywords: smart learning ecosystems evaluation, participatory evaluation, smartness, well-being, e-maturity, Italian schools' ecosystem

1   Introduction

In many countries, including Italy, school evaluation is primarily conducted through a self-assessment process. This may subsequently be reviewed on a sample basis by external commissions, with the aim of identifying necessary corrective actions to

meet expected performance standards. In Italy, a concrete example of this approach is the RAV (Self-Assessment Report) [1], an evaluation framework developed by the Ministry of Education. The RAV mandates schools to engage in a self-assessment and initiate an improvement process, primarily focused on enhancing performance related to European key competences [2] and standardized assessments, such as the INVALSI tests [3]. These tests are designed to enable cross-national comparisons based on students' basic skill acquisition [4]. However, tools like the RAV often tend to downplay—or entirely overlook—several crucial aspects that determine the smartness (see next section) of a school ecosystem. These include the school's engagement with families and the surrounding community, and the development of shared responsibility among all stakeholders in driving educational improvements. As a result, practices such as systematically collecting feedback from parents and local stakeholders remain rare. Moreover, the identification of causal relationships between contributing factors is typically neglected.

Clearly, there is a need for an evaluation framework that can complement top-down strategies while also incorporating a bottom-up approach that actively involves all stakeholders in the educational process.

Even the most well-established international evaluation models face certain limitations. These models have frequently been criticized for failing to capture all relevant dimensions of a learning ecosystem or for neglecting the broader impacts generated by specific projects or activities. Among the most well-known models developed since the 1980s are: CIRO (Context, Input, Reaction, Outcomes) [5], which evaluates context in terms of needs, culture, and objectives, with a focus on design, student expectations, and outcomes; Kirkpatrick's Model [6], which combines student perceptions with measurable changes in knowledge, skills, and organizational improvements; Phillips' Model [7], an extension of Kirkpatrick's that includes a return-on-investment (ROI) analysis; CIPP (Context, Input, Process, Product) [8], which, while similar to CIRO, is more systemic, linking objectives and outcomes to social acceptance, cultural context, and technological adequacy.

All these models—except perhaps the CIPP to some extent—fall short when it comes to assessing an educational context's ability to leverage digital technologies, i.e., its *digital maturity* or *e-maturity*. Relevant efforts to address this include the model developed by Sergis & Sampson [9] and the DigCompOrg framework [10], created by the European Commission's JRC-IPTS. The latter enables self-assessment of digital maturity at both the individual and institutional levels via the SELFIE online tool [11]. However, as noted in [12], SELFIE cannot assess broader regional or national ecosystems and does not provide benchmark data due to restrictions on access to aggregated results. These limitations led Giovannella et al. [12] to propose a new evaluation framework capable of assessing not only *e-maturity* but also the *smartness* and perceived *well-being* characterizing learning ecosystems.

The following section will briefly introduce this integrated evaluation framework, previously described in detail in [12,13] and piloted in two high schools in the Rome area [13].

The primary goal of the present study is to conduct a preliminary national-level application of the framework, evaluating the smartness, well-being, and e-maturity of

the Italian school system. Unlike the prior localized test—which involved only one principal per school—this study includes a broader sample of school principals, whose collective perceptions are crucial for large-scale evaluation. Details of the nationwide sample involved in the participatory evaluation are provided in Section 3. As we will explore in Section 4, the results will offer a national benchmark for schools interested in using this tool for self-assessment and will reveal differences in perception among the various stakeholder groups involved.

A second objective of this work is to perform a detailed analysis of the causal networks that emerge from the data collected from principals, teachers, and parents. This analysis aims to demonstrate the existence of priority causal links between evaluation factors and to highlight how each stakeholder group interprets the school context from its own perspective. These findings will also be discussed in Section 4.

Finally, Section 5 will present our conclusions, discuss the limitations of this study, and outline directions for future research.

2 A brief description of the integrated evaluation framework

As mentioned in the introduction, the integrated evaluation framework has already been described in detail in previous studies [12,13]. Therefore, in this section, we simply refer to Table 1 in the Appendix, which lists the factors considered in the participatory evaluation, organized by domain. Table 3 further illustrates how these factors contribute to the construction of the three indices: *e-maturity, smartness, and well-being*.

As shown in Table 3, the e-maturity index has been evaluated both as a whole and through four sub-dimensions: *Technological resources and infrastructures, Available competencies, Organizational factors and relationships, Technology-enhanced educational activities*.

The well-being index has been derived from three sub-dimensions*: Individual feelings, Individual competencies and development, Well-being at work*.

The structure of the smartness index, on the other hand, is more complex. It is based on the ASLERD pyramid [14,15], which integrates Maslow's hierarchy of needs [16] with the concept of flow [17]. The smartness index encompasses nine dimensions: *Infrastructures/Resources & Competences, Organization–Communication–Services, Learning Process, Environment, Mobility, Food, Safety, Socialization, Challenges and Flow*

Table 3 clearly illustrates that each of the three indices — *e-maturity, well-being,* and *smartness* — can be assessed independently. However, the strength of the integrated framework lies in its capacity to evaluate the learning ecosystem holistically. It allows for the simultaneous consideration of the well-being generated by the educational context for all actors and stakeholders, the well-being perceived at the individual level, and the positive contributions stemming from the ecosystem's achieved level of e-maturity [12,13].

3   The participatory evaluation of the Italian school ecosystem

The integrated evaluation framework was tested through a participatory evaluation of the Italian school ecosystem, involving a nearly equivalent number of principals (139), teachers (142), and parents (129).

A customized questionnaire was developed for each participant group, containing a different number of questions tailored to the relevance of the factors for each category: 85 questions for parents, 115 for principals, and 145 for teachers. Most of the questions used a 10-point Likert scale, requiring respondents to assign a numerical value from 1 to 10. Only these scaled responses will be considered in the analyses presented in the following subsections.

3.1   Socio-biographical background

The average age of the principals who participated in the evaluation—93 females and 45 males—is 57.3 years [56.2–58.3]. Among them, 76 come from northern Italy, 33 from the central region, and 29 from southern Italy and the islands. Seventy-one serve as principals of comprehensive schools (primary and K-14 schools), 64 lead high schools, and 4 are in charge of CPIAs (provincial centers for adult education).

The average age of the teachers—112 females and 29 males—is 52.3 years [50.9–53.7]. Ninety-six are from northern Italy, 32 from the center, and 14 from southern Italy and the islands. Forty-nine teachers work at comprehensive institutes (primary and K-14 schools), 86 at high schools, and the remainder in other types of schools.

The average age of the parents—106 females and 19 males—is 45.9 years [44.4–47.3]. Eighty-five are from northern Italy, 43 from the center, and only one from southern Italy and the islands. In 58.9% of cases, their children attend high school; 17.1% attend secondary school (K-14); and 16.3% attend primary school.

Overall, the sample is sufficiently balanced but not highly representative of southern Italy and the islands. Consequently, the values obtained for *smartness, well-being*, and *e-maturity* should be considered an upper limit, as schools in northern and central Italy are generally regarded as being of "*higher quality*" than those in the south and islands.

There is a clear imbalance favoring female participation, which reflects not just the sample but also the predominance of women among the teaching and managerial staff of Italian schools. This also mirrors the distribution of family responsibilities, where women are predominantly responsible for maintaining contact with schools and teachers.

3.2   PCA analysis

Table 2 in the Appendix presents the mean values of the indicators segmented by participant category, while Table 3 shows the aggregated values averaged across all categories. As mentioned in the previous subsection, Table 1 is also provided to illustrate how the various factors contribute to the construction of the individual indices. This is intended to help the reader understand the methodology behind the index cal-

culation, which forms the basis for the PCA (Principal Component Analysis) and the subsequent comparison between participant categories.

The visualizations in Figure 1 were produced using the following indices: *Infrastructure and Resources, Environment, Safety, Organisation, Communication and Services, Educational Processes, Socialisation, Challenges,* and *Flow*. As expected, these indices are not entirely independent, as confirmed by their correlation matrix. Therefore, a base transformation was necessary to generate a space with orthogonal axes—achieved through Principal Component Analysis [18–19]. In such an orthogonal space, the first two principal components (PC1 and PC2) are typically considered, as they capture the majority of the variance in the data.
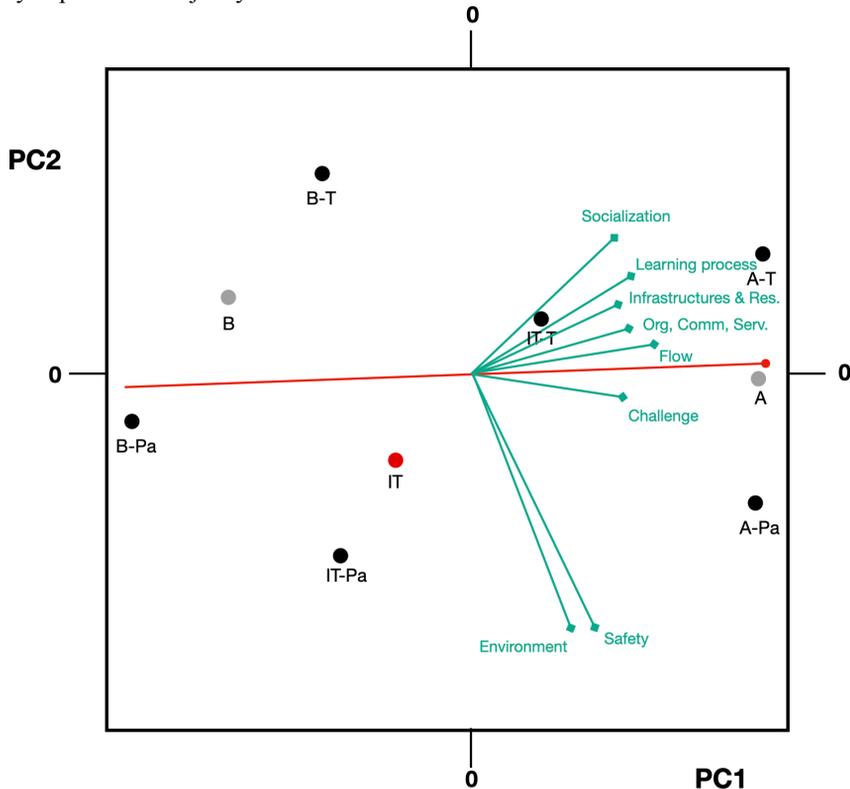

Fig. 1 - representation of the first two main components of the *smartness* of the whole Italian school system (IT – red dot) and of the two high schools (A & B – grey dots) involved in the first tryout of the integrated evaluation framework; the differences between the perceptions expressed by teachers (T -black dots) and parents (Pa – black dots) are also shown.

In the two-dimensional PC1–PC2 plane (see Figure 1), we have plotted the positions of the overall Italian learning ecosystems (IT), along with those of the two high schools that participated in the trial phase of the integrated evaluation framework (Schools A and B). The analysis also includes a comparison of the perceptions expressed by teachers (T) and parents (Pa), which are likewise illustrated in Figure 1.

To incorporate the perceptions of principals (Pr) into the comparison, it was necessary to conduct a separate PCA, excluding the *Challenge* dimension, as this factor was not assessed by the principals. Figure 2 displays the results of this adjusted analysis and also includes the perceptions of students (S) who took part in the trial at the two high schools [12,13].
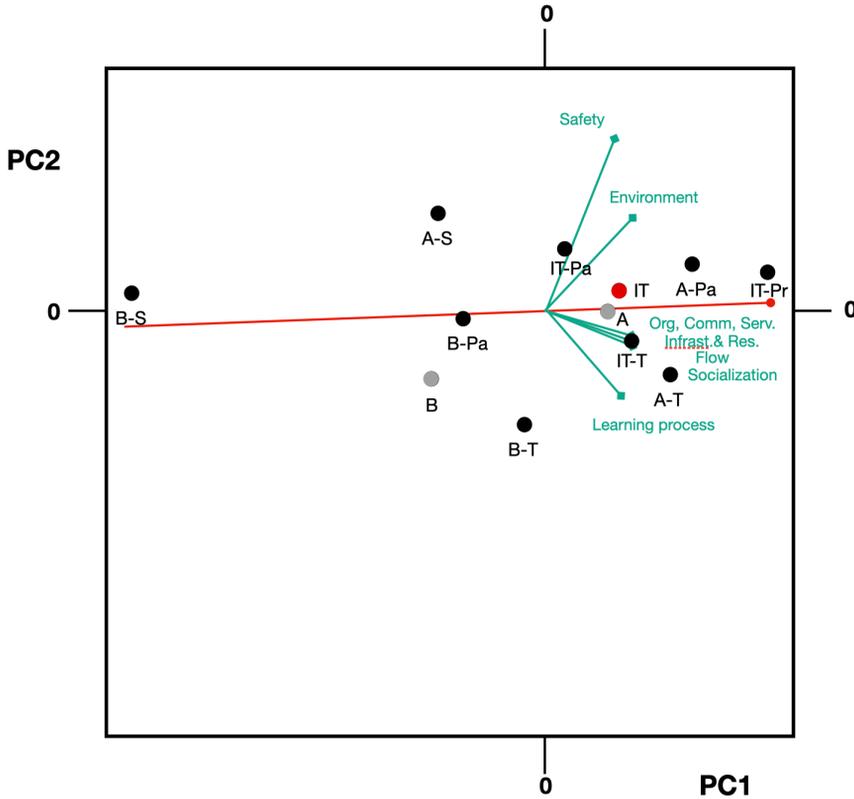

Fig. 2 - representation of the first two main components of the *smartness (with the challenge dimension dropped)* of the whole Italian school system (IT – red dot) and of the two high schools (A & B – grey dots) involved in the first tryout of the integrated evaluation framework; the differences between the perceptions expressed by teachers (T – black dots), parents (Pa – black dots), principals (Pr – black dots) and students (S – only for the high schools involved in the tryout, black dots) are also shown.

As shown—and consistent with findings reported in references [12,13]—most of the factors contribute significantly to the PC1 component. Only the *Safety* and *Environment* dimensions contribute primarily to the PC2 component. The main difference observed compared to [12,13] is the stronger contribution of the *Environment* dimension to PC2. Minor variations can also be noted in the contributions of the other dimensions to the two principal components. Overall, however, the framework demonstrates high stability and robustness.

The substantial contribution of most factors to PC1 indicates that higher PC1 values correspond to greater school smartness. A red line can be added as a visual aid to indicate the direction of increasing smartness. Furthermore, as previously noted in [12,13], the fact that all dimensions significantly influence PC1 supports the validity of the model and underscores the importance of considering each of the indices used to define the smartness of the educational ecosystem.
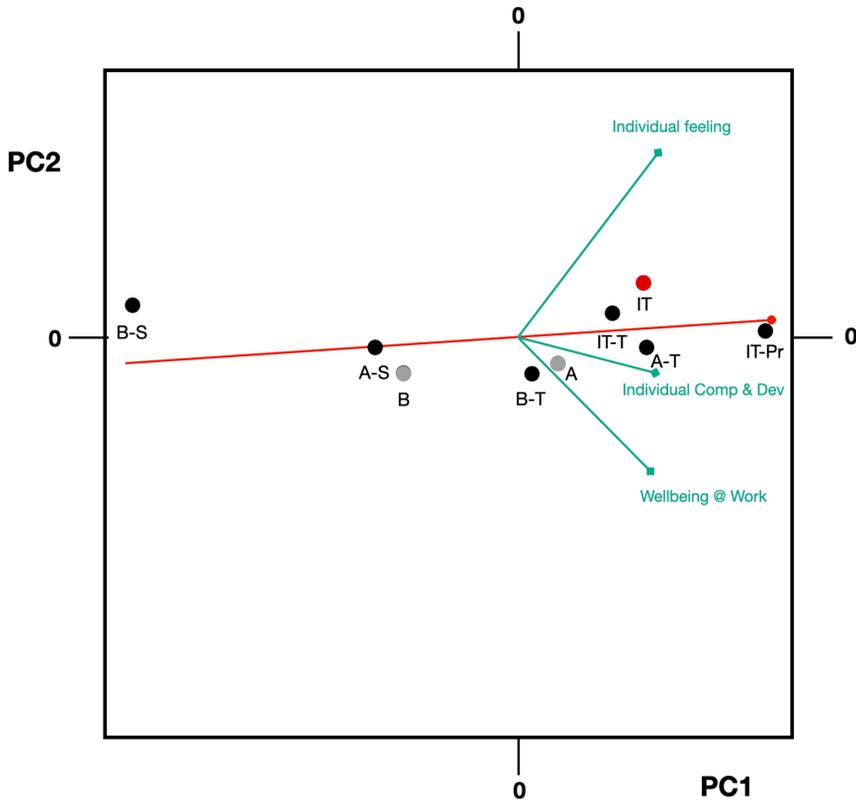

Fig. 3. Representation of the first two main components of the level of *personal well-being* perceived in Italian school system (red dot) and in the two high schools (A & B – grey dots) involved in the first tryout of the integrated evaluation framework; the differences between the perceptions expressed by teachers (T – black dots), principals (Pr – black dots) and students (S – only for the high schools involved in the tryout, black dots) are also shown.

Figures 1 and 2 illustrate that the level of smartness perceived and attributed to the Italian school system by teachers and parents lies approximately midway between the two-case study high schools involved in the trial. The observed difference from Case B is mainly driven by the *Environment* and *Safety* dimensions, which tend to present greater challenges in urban contexts. Overall, teachers' perceptions are slightly more

positive than those of parents—except in the areas of *Environment, Safety,* and *Challenge*, where parents tend to rate the system more favorably.

The perceptions of principals and students differ notably from those of teachers and parents. Principals tend to have a significantly more positive view, while students' perceptions are substantially lower. As students were not included in the current participatory evaluation, their absence effectively raises the relative positioning of the Italian school system compared to the trial case studies, as reflected in Figure 2.
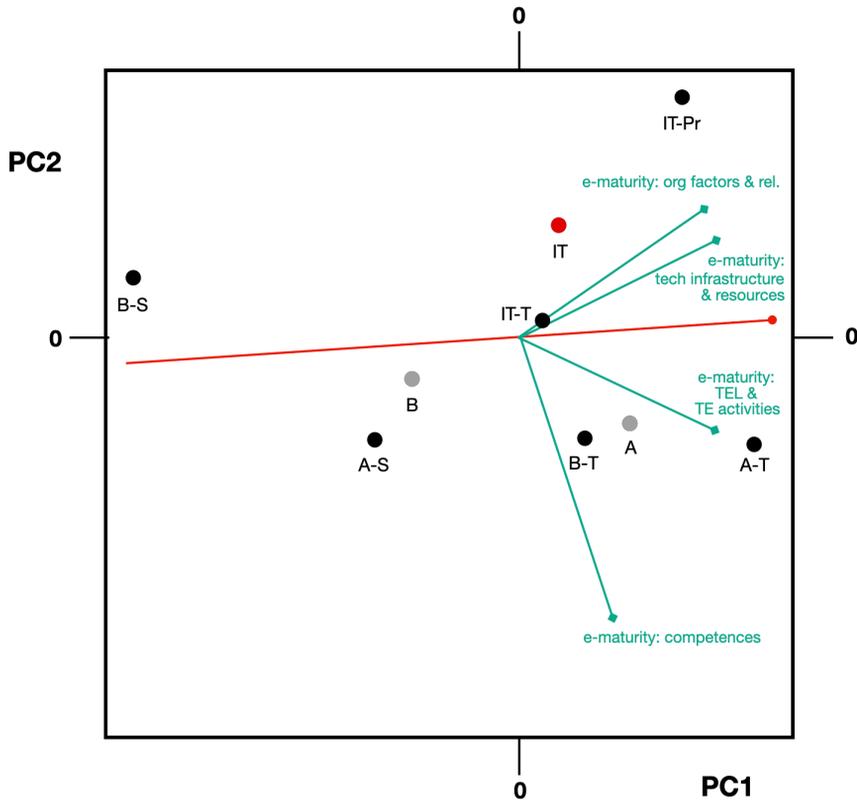

Fig. 4. Representation of the first two main components of the perceived *e-maturity* of the Italian school ecosystems and for the two high schools (A & B – grey dots) involved in the first tryout of the integrated evaluation framework; the differences between the perceptions expressed by teachers (T – black dots), principals (Pr – black dots) and students (S – only for the high schools involved in the tryout, black dots) are also shown.

To assess the level of perceived wellbeing, the following indices were considered: *Wellbeing at Work, perceptions of Individual Competence and Development, and perceptions of Personal Wellbeing (Individual Feeling).* The results of the principal component analysis (PCA) are shown in Figure 3. Parents were not included in this analysis, as they were asked to evaluate only a limited subset of the factors relevant to wellbeing.

All three dimensions contribute to the PC1 component, while Wellbeing at Work and Individual Feeling also contribute to PC2—though with opposite signs. The representation in Figure 3 differs somewhat from that reported in references [12,13], where principals were not included. In the current analysis, an increase in PC1 still appears to correspond to higher perceived overall wellbeing. PC2, by contrast, seems to reflect the tension between personal and professional aspects: the former associated with individual emotional wellbeing, the latter with professional development and work context. Overall, these two dimensions appear relatively balanced across the entities represented in Figure 3, though the level of perceived wellbeing varies significantly across participant categories. As was the case with smartness, principals report the highest levels of perceived wellbeing, while students report the lowest.

Regarding digital maturity, the following indices were considered: *Technological Infrastructures and Resources, Digital Competencies, Organisational Factors and Relationships, and Learning Processes and Activities Augmented by Technologies*. The outcomes of the PCA for these dimensions are presented in Figure 4. Again, parents were excluded from this analysis, as they provided feedback on only a limited portion of the relevant dimensions.

Figure 4 highlights the pivotal role of principals, not only in determining the overall perceived value of digital maturity in the Italian school system, but also—likely—in shaping the structure of the principal component space itself. While all dimensions contribute to PC1, the PC2 component is defined by the contrasting influence of two pairs: (*Technological Infrastructures and Resources + Organisational Factors and Relationships*) versus (*Digital Competencies + Learning Processes and Activities Augmented by Technologies)*. The first pair encompasses areas for which principals feel especially responsible. Unsurprisingly, their evaluations for these dimensions are higher, consistent with findings from previous studies. This results in an upward shift in the position of the Italian school system (IT) in Figure 4, partially moderated by the more conservative assessments from teachers. As with the other indices, students' perceived level of digital maturity is significantly lower than that of both teachers and principals.

Notably, for all participant categories involved in the participatory evaluation, the overall e-maturity score—calculated from its sub-dimensions—closely matches the value derived from direct assessments of digital maturity (SeM), averaged across all groups. This consistency indicates a high level of coherence in the evaluations provided by the sample.

3.3   Causal relationship between indicators

Having established a benchmark for learning ecosystems that may wish to self-evaluate using our proposed integrated framework in the future, the next step is to identify the factors considered most relevant by each stakeholder group involved in the evaluation process. These factors should be the primary targets for interventions aimed at enhancing the smartness, wellbeing, and e-maturity of the school system.

 To achieve this, we analyzed the network of relationships among these factors and attempted to infer the direction of causality within these associations. Specifically, we

applied the PC algorithm [18, 19] to determine causal directions in the graphs shown in Figures 5-7, which correspond to parents, principals, and teachers, respectively.

Due to the relatively small number of survey participants, the causal network included some orphans—individual factors or small clusters not connected to the main network. These orphans were removed and are not depicted in Figures 5-7. Additionally, for some links, the algorithm could not definitively determine the direction of causality. Despite these limitations, valuable insights can still be drawn, as outlined below.
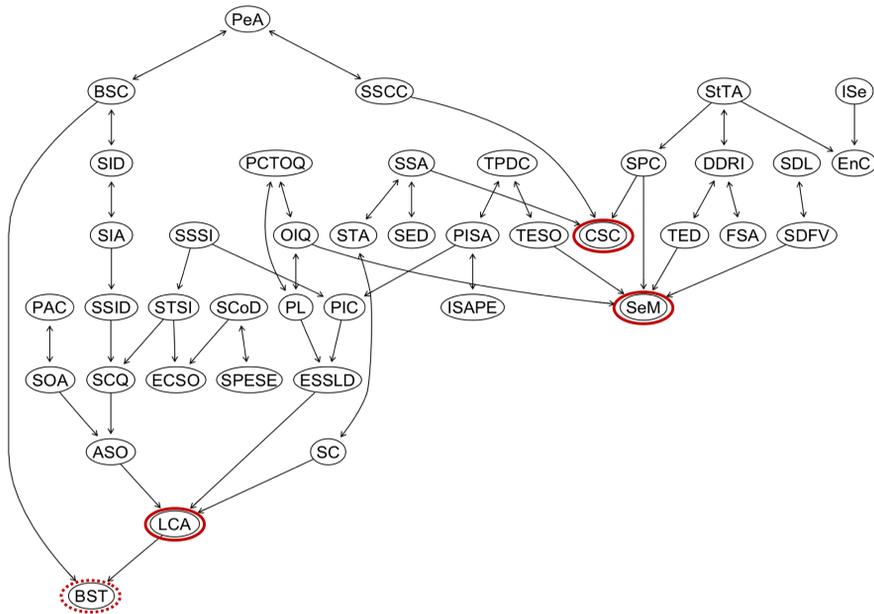

Fig. 5. Case study A: causal network linking the indicators assessed by the parents. (note that orphan factors are not included).

Parents. Figure 5 presents the causal network derived from parents' perceptions. Several factors stand out as terminal points in this network (highlighted in red): SeM (e-maturity), CSC (classroom social climate), and LCA (Learning Continuity Assurance), with LCA influencing BST (sense of belonging to the school territory).

E-maturity is a key factor valued by parents. They perceive that its quality is primarily influenced by: the smart organization of the school (TESO), which relates to the quality of digital communication between teachers and parents (PSDC/STDC); technology-enhanced didactics (TED), connected to efforts aimed at reducing the digital divide (DDRI) and improving student technology adequacy (StTA); the school's digital future vision (SDFV), linked to school digital leadership (SDL); as well as the availability of adequate professional skills (SDC) and the quality of guidance for the future (OIQ).

The second terminal factor, classroom social climate (CSC), is seen by parents as mainly shaped by student social and civic competences (SSCC), which are related to the perceived affinity among school community members (PeA/PRQ), the adequacy of school spaces (SSA), and the availability of professional skills (SDC).

The third semi-terminal factor, Learning Continuity Assurance (LCA), is influenced by three main aspects:

(a) an infrastructural pathway starting from SSA, passing through school technology adequacy, and leading to the quality of school connectivity (SC);

(b) support for students with difficulties (ESSLD) and personalization of the teaching process (PL), which connect to the quality of guidance (OIQ) and school-work alternation schemes;

(c) the sharing of school goals (ASO), which depends on appreciation of the school's organization (SOA), the school's ability to listen to parents' opinions, foster inclusion (SIA/SID), support social interaction (SSSI/SSTI), promote personal development (SSID), and offer appropriate challenges (SCQ).

Overall, this reflects a clear parental perspective focused on supporting the development of their children's personalities and potential within a welcoming, inclusive social context that fosters a positive classroom climate and ensures educational continuity, while also recognizing the importance of e-maturity. Such an environment helps cultivate a sense of belonging both to the educational institution and the broader community.

It is also noteworthy that perceived affinity toward peers within the school and student technology adequacy are positioned upstream in the causal chain—parents see these as foundational for effective social interaction and the development of e-maturity.

Principals. Figure 6 displays the principals' causal network without orphans. As expected, their viewpoint appears more institutional, strongly linked to school governance and its desired outcomes. At the upstream end of the network, we find Best Practice Sharing (BPS) and a well-organized distribution of responsibilities and workloads (RWLSA).

The terminal factors in the principals' causal network can be divided into two groups:

(i) Those related to digital technologies, focusing on Technology Enhanced Didactics (TED), which must be supported by efforts to reduce the digital divide (DDRI) and ensure adequate Average Students' Digital Competences (ASDC);

(ii) Those related to broader educational and governance goals, including promoting interdisciplinarity (ISS/IS), developing a territorial community around the school (UTCD), and fostering good relationships with school personnel (IATA).

Regarding the first subset, e-maturity is not viewed as a terminal factor but rather as one that, together with other elements—such as the school's technological adequacy (STA), level of connectivity (SC), smart organization (TESO), future digital vision (SDFV), and teachers' digital skills (ATDC)—contributes to Technology Enhanced Didactics (TED).

Similarly, teachers' digital and pedagogical skills, combined with operational technical assistance, support the achievement of adequate Average Students' Digital Competences (ASDC). However, this cannot be separated from ensuring sufficient technological resources are available to students. Unsurprisingly, actions to reduce the digital divide (DDRI) are closely connected to the development of a digital resource repository (DAD). Yet, reducing the digital divide is seen as a challenge requiring broader contextual support, highlighting the importance of relationships with other schools and easy external access to the description of clearly defined goals to be achieved.

The territorial context also serves as a reference point for developing an expanded community—potentially through a territorial pact [20]—which should be fostered through codesign, coworking, and proper valorization of internal school resources (HRV), supported by technology.

Another key objective identified by principals is interdisciplinary teaching, which should be underpinned by a vision of competency-based learning (CBL), shared objectives and actions (ShOA), coworking, and interaction with territorial stakeholders and other schools. These connections are often established through networking actions, including international ones, such as those formed via European projects.
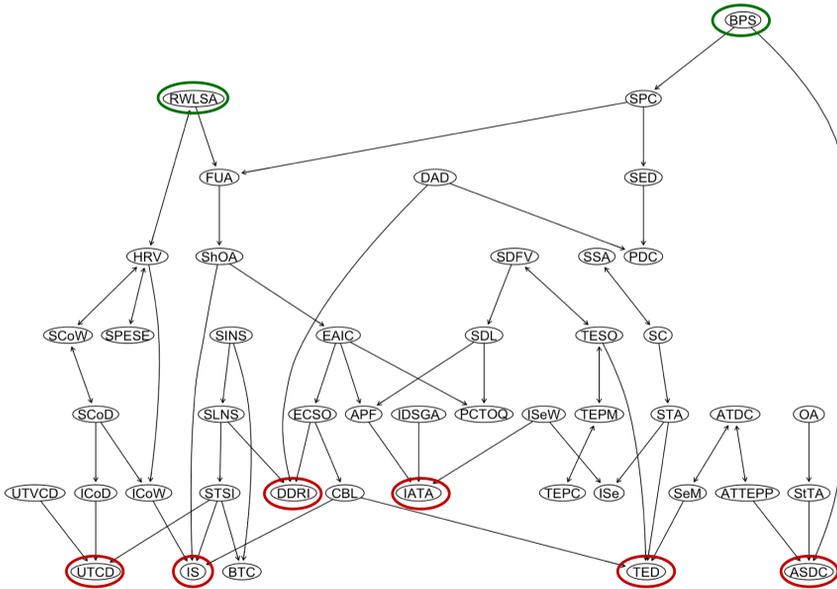

Fig. 6. Case study A: causal network linking the indicators assessed by the principals (note that orphan factors are not included).

Teachers. Figure 7 shows a different perspective from the teachers, with the causal network—also without orphans—reflecting their unique viewpoint.

The terminal factors emphasize a focus on personal well-being (Self-Fulfillment Increase - SFI) and professional growth (Average Teacher Digital Competences - ATDC). Additionally, the importance of the school community (Belonging to School Community - BSC) emerges, which depends on strong relationships between teachers and parents. A focus on personalization of the teaching process completes this view.
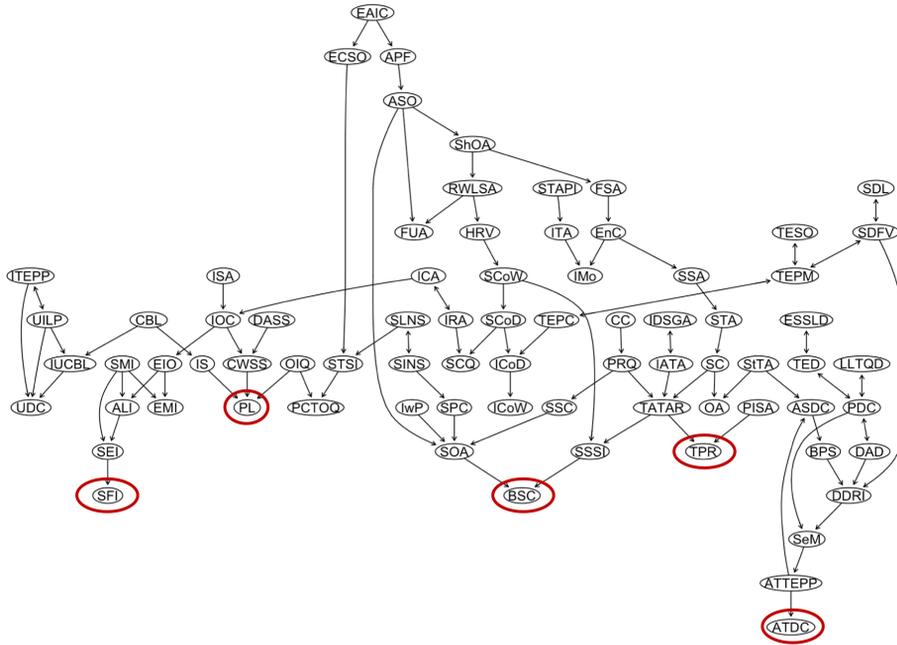

Fig. 7. Case study A: causal network linking the indicators assessed by the teachers.

The first focus—personal well-being—is influenced by numerous factors that shape individual well-being within the working environment. These include Individual Opinions Consideration (IOC), Involvement in School Activities (ISA), and Individual Competences Appreciation (ICA).

Individual growth in digital and related pedagogical skills is linked to e-maturity and also depends on efforts to reduce the digital divide, the creation of learning materials and digital archives, and, ultimately, students' technological availability and digital competencies.

The sense of belonging to the school community is supported by appreciation for the school organization (SOA), networking capacity, availability of professional skills (SPC), and a positive relationship with the principal. In other words, this reflects a vision of a school community fostered by an efficient and motivating work environment. Complementing this is another part of the causal chain, also related to SOA, which influences School Climate Quality (SSC), Peer Relationships Quality (PRQ), and collaborative ability (CC).

Supporting the development of this sense of belonging involves:

a) Support for Student Social Interaction (SSSI), which is itself supported upstream by coworking, skills enhancement, proper distribution of responsibilities and workload, and further up, the sharing of objectives and easy access to information (EAIC);

b) Strong relationships between teachers and technical-administrative staff;

c) Active parental involvement in school activities (PISA), which is important for maintaining good teacher-parent relationships (TPR).

Within this framework, the most overlooked aspects relate to the didactic process. Personalization of the learning process (PL) is identified as a terminal factor, nurtured by the encouragement of interdisciplinarity (IS)—based on competency-based learning (CBL)—support for collaborative work (CWSS) and codesign (DASS). These, however, require attention to individual opinions (IOC) and are ultimately sustained by the quality of guidance (OIQ).

4   Summary, final remarks, limitations and future perspectives

With this work, we successfully applied the integrated evaluation framework for learning ecosystems at a national level in Italy, providing a benchmark for ecosystems wishing to self-evaluate using this framework in the future. We offered a comparative example through two high schools involved in the initial trial. Our participants' responses revealed notable differences in perceptions among teachers, parents, and principals, with principals generally holding a more positive view than the other two groups. Although we could not engage a national sample of students in the participatory evaluation, comparisons with the student groups involved in the high school trials confirm prior observations that students tend to have a less positive perception than other categories [21].

These perceptual differences were further explored through causal networks, which helped identify causal relationships among factors and, importantly, highlighted how each group evaluates the learning ecosystem from distinct perspectives.

Parents' perspective centers on the development of their children's personalities and potentials, alongside expectations for a welcoming and inclusive social context. For parents, e-maturity is a key goal that unlocks valuable opportunities.

Principals' perspective is more institutional, emphasizing good governance and goal achievement: fostering a positive climate and relationships among staff, building a territorial community, enhancing students' digital skills while reducing the digital divide, and advancing technology-enhanced teaching and learning. In this view, digital technology factors are prominent, but e-maturity is seen not as an end in itself, but as a means to other educational goals.

Teachers' perspective primarily focuses on their own well-being and professional growth. They also value a school community characterized by a stimulating, collaborative work environment, including strong relationships among colleagues, technical-administrative staff, and families. The teaching process itself is less prominent, mainly focusing—similarly to principals—on personalizing learning through interdisciplinarity, competency-based learning, peer collaboration, and codesign.

These perspectives are understandable given each group's role and expectations in the learning process. Their integration reveals a shared priority: fostering a serene and collaborative environment, seen as essential to achieving the various goals important to each group.

It is important to note that the perspectives depicted in Figures 5-7 represent an average derived from participants across the country. In evaluations of individual learning ecosystems, slightly different perspectives may emerge, shaped by local context. For instance, in the high school try-out (case study A), while parents' causal network shared key terminal factors with the national model, additional factors such as the quality of challenges offered and appreciation of the school organization also emerged. Furthermore, the causal chains differed somewhat between the two cases.

All perspectives arising from these causal networks—whether at the national or individual ecosystem level—are situated within the "factor space" defined by the integrated evaluation framework. While no additional factors outside this framework have yet emerged, it remains possible that relevant factors, varying by category, exist but have not been captured. This is a potential limitation of the study.

Another limitation is the lack of specificity regarding study fields and curricula, teaching subjects, gender, and other factors. Future research should address these by involving larger samples to allow segmented analysis.

Future work also aims to include a larger nationwide sample of high school students, as current insights into students' views come only from the limited trials described in [12-13]. For example, the students' causal network from case study A, though not highly developed, highlights terminal factors such as self-actualization, consideration of student opinions, appreciation by teachers, care for excellence, quality of guidance, and school e-maturity—mainly reflecting students' personal needs and well-being.

Finally, this work underscores the limitations of evaluation processes based solely on self-assessment by small groups of mostly school personnel. Even when conducted fairly, such evaluations likely reflect a single perspective on the learning ecosystem. Our findings reaffirm that learning ecosystems are complex systems requiring the integration and balance of multiple perspectives from diverse stakeholders involved in the learning process.

CRediT author statement.
Carlo Giovannella: Conceptualization, Methodology, Formal Analysis, Investigation, Writing – original draft, Writing – review and editing, Visualization, Supervision. **Licia Cianfriglia:** Methodology, Writing – review and editing. **Antonello Giannelli:** Writing – review and editing.

References

1. https://www.miur.gov.it/documents/20182/2467413/Le+linee+guida.pdf/4e4bb411-1f90-

9502-f01e-d8841a949429?version=1.0&t =1593201965918 , retrieved on 07 April 2025 (in Italian)

2. Key Competences for Lifelong Learning in the European Schools. https://www.eursc.eu/BasicTexts/2018-09-D-69-en-2.pdf retrieved on 07 April 2025

3. https://invalsi-areaprove.cineca.it/index.php?get=static&pag=rapporti_invalsi retrieved on 07 April 2025 (in Italian)

4. https://invalsi-areaprove.cineca.it/index.php?get=static&pag=home_ocse retrieved on 07April 2025 (in Italian)

5. Warr P., Bird M., Rackham, N.: Evaluation of management training. London: Gower Press (1970)

6. Kirkpatrick D.L.: Evaluation of training. New York: McGraw-Hill (1967)

7. Phillips J.: Accountability in Human Resource Management, Butterworth- Heinemann, Oxford (1996)

8. Stufflebeam D.L., Zhang G.: The CIPP Evaluation Model: How to Evaluate for Improvement
and Accountability, New York, Guilford Publications (2017)

9. Sergis S., Zervas P., Sampson D. G.: A Holistic Approach for Managing School ICT Competence Profiles towards Supporting School ICT Uptake, International Journal of Digital Literacy and Digital Competence 5(4) pp. 33-46 (2014) https://doi.org/10.4018/ijdldc.2014100103

10. Promoting Effective Digital-Age Learning: A European Framework for Digitally-Competent
Educational Organisations, Commissione Europea, Joint Research Centre © European Union
(2015) DOI:10.2791/54070 ISBN 978-92-79-54005-9
https://publications.jrc.ec.europa.eu/repository/bitstream/JRC98209/jrc98209_r_digcompor g_final.pdf

11. https:/publications.jrc.ec.europa.eu/repository/search?query=selfie, retrieved on 07 April 2025

12. Giovannella C., Cianfriglia L., Giannelli A.: A due anni dal lockdown: la percezione di insegnanti e dirigenti scolastici circa gli effetti provocati dallo shock digitale sul sistema, Bricks N.5, pp. 109-131 (2022)

13. Giovannella C.: An integrated evaluation framework – smartness, well-being, e-maturity – for participatory evaluation of learning ecosystems: first application to two Italian high schools., Interaction Design & Architecture(s) – IxD&A Journal, N.62, 2024, pp. 98–122, https://doi.org/10.55612/s-5002-062-007

14. Giovannella C.: The ASLERD Pyramid of Smartness: A Study on the Stability of Indices and Indicators in Schools in Project and Design Literacy as Cornerstones of Smart Education, Springer, pp. 81-91 (2020) https://doi.org/10.1007/978-981-13-9652-6

15. Giovannella C.: From simplex to complex: designing for wellbeing at scale, Interaction Design & Architecture(s) – IxD&A Journal, N.55, 2022, pp. 123–138, DOI: https://doi.org/10.55612/s-5002-055-006

16. Maslow A.H.: A theory of human motivation, Psychological Review, 50 (4) pp. 370–396. (1943) https://doi.org/10.1037/h0054346

17. Czisikszentmihalyi M.: Flow - The Psychology of Optimal Experience. Harper & Row (1990)

18. Jolliffe, I.T.: Principal Component Analysis, Springer Series in Statistics, 2nd ed., Springer, NY (2002)

19. Hotelling, H.. Analysis of a complex of statistical variables into principal components. Journal of Educational Psychology, 24, 417–441, and 498–520 (1933) https://doi.org/10.1037/h0070888

20. Giovannella C., Autiero M.: The school as a place learning ecosystem – Participatory evaluation of the boundary conditions: the case of the IIS Amaldi., Interaction Design & Architecture(s) – IxD&A Journal, N.60, 2023, pp. 59–84, DOI: https://doi.org/10.55612/s-5002-060-002

21. Giovannella C.: Participatory bottom-up self-evaluation of schools' smartness: an Italian case study, Interaction Design & Architecture(s) – IxD&A Journal, N.31 pp. 9 – 18 (2016) https://doi.org/10.55612/s-5002-031-001

APPENDIX

Table 1 - Factors making up the integrated evaluation framework *smarteness/well-being/e-maturity* grouped by domains. In brackets the acronyms that were used to identify the various factors/indicators in the analysis and in the representation of the results.

Domains	Factors/Indicators
Learning Ecosystem e-maturity: Technological resources and infrastructures Infrastructures	School Connectivity (SC); School Technological Adequacy (STA); Student Technological Adequacy (StTA) Individual Technological Adequacy (ITA) School Spaces Adequacy (SSA)
Learning Ecosystem e-maturity: Competences Other competences	Average Teachers' Digital Competences (ATDC); Average Teachers' Technology Enhanced Pedagogical Preparedness (ATTEPP); Average Students' Digital Competences (ASDC); Quality of Life Long Training (QLLT); Impact of Life Long Training (ILLT) School professional competences (SPC); Student Social & Civic Competences (SSCC)
Learning Ecosystem e-maturity: Organizational factors and relationships Other Organizational factors	School Digital Leadership (SDL); School Digital Future Vision (SDFV); Operational Assistance (OA); Enhanced Process Management (Smart Organization) (TESO); Technology Enhanced Process Management (TEPM); Technology Enhanced Peer Collaboration (TEPC); Easiness to Access Information and Communication (EAIC); Administrative Practices Friendliness (APF); Agreement on School Objectives (ASO); Sharing of Objectives and Actions (ShOA); Funds Usage Adequacy (FUA); Responsibilities and Working Load Sharing Adequacy (RWLSA); Human Resources Valorization (HRV); Support to Co-Working (SCoW); Impact of Co-Working (ICoW); Support to Co-Design (SCoD); Support to Participatory Evaluation and Self-Evaluation (PESE) -> SPESE; Cohesion among colleagues (CC); Best Practices Sharing (BPS) School Challenge Quality (SCQ); School Organization Appreciation (SOA); Parents Involvement in School Activities (PISA); External Communication of School Objectives (ECSO); Interaction with Principal (IwP); Interaction with DSGA (IDSGA); Interaction with ATA (IATA)
Personal factors: competences	Individual Digital Competences (IDC) + IDC1-5; Individual Technology Enhanced Pedagogical Preparedness (ITEPP)
Personal factors: well-being	Self-Fulfillment Increase (SFI); Self-Esteem (SEI); Esteem from Others (EfO); Autonomy Level Increase (ALI); variation in the Involvement Level (dIL); Self-Motivation Increase (SMI);
Personal factors: (Individual and Process levels)	Individual Competences Appreciation (ICA); Individual Results Valorization (IRA); Individual Opinions Consideration (IOC); School Support to Individual Development (SSID) Personal Time Management (PTM);

Technology enhanced educational e-maturity: activities	Technology Enhanced Didactics (TED); Technology Enhanced Collaborative Activities (TECA); Technology Enhanced Design Activities (TEDA); Technology Enhanced Evaluations (TEE); Technology Enhanced Personalized Learning (TEPL); Technology Enhanced Reinforcement (TER); Usage of Digital Content (UDC); Communication with Students -Teachers Digital Communication (STDC); Parents-School Digital Communication (PSDC); Digital divide reduction initiative (DDRI);
Educational activities/processes	Collaborative Work Support & Stimulation (CWSS); Design Activities Support & Stimulation (DASS); Competence Ba Learning (CBL); Individual usage of CBL (IUCBL); Usage of Innovative Learning Practices (UILP); Interdisciplinary Stimulation (IS) PCTO Satisfaction/Quality (PCTOQ); PCTO Management (PCTOM); PCTO Relevance (PCTOR); Orientation Initiative Quality (OIQ); Personalized Learning (PL); Support to Excellence Development (SED); Efficacy of Support to Students with Learning Difficulties (ESSLD); Learning Continuity Assurance (LCA)
Outcomes e-maturity: Learning ecosystems	Degree of e-Maturity (SeM)
Smartness	
Smartness: Social Interaction Networking & Community (Pact)	Classroom Social Climate (CSC); Students-Teachers Relationships (STR); Teachers-ATA Relationships (TATAR); Teachers-Parents Relationships (TPR) School Initiative about Diversity (SiD); School Inclusion Action (SIA) Support to Student Social Interaction (SSSI) Peer Relationships Quality (PRQ); [School Networking Adequacy (SNA) (national & international level);] Belonging to School Community (BSC); Support to Territorial Social Interaction (TSI); Utility of Territorial Community Development (UTCD); Utility of Territorial Virtual Community Development (UTVCD); [Belonging to School Territory (BST) ; School Space4 2 students (SS4S); Availability to support the School Community (ASSC); Availability to support the School Territory (ASST)]
Smartness: Safety	Internal Safety at Work (ISeW); Internal Safety (ISe); External Safety (ESe)
Smartness: Food	Food Service Adequacy (FSA)
Smartness: Mobility	Internal mobility (IMo)
Smartness: Environment	Environmental Care (EnC)

Table 2 – Mean values taken by the factors making up the integrated evaluation framework *smarteness/well-being/e-maturity* according to principals (Mean Pr), teachers (Mean T) and parents (Mean Pa)

Factors	Mean Pr	Mean T	Mean Pa
E-maturity: technological resources and infrastructures			
School Connectivity (SC)	M = 7.79 [7.52, 8.06]	M = 7.09 [6.77, 7.42]	M = 6.72 [6.36, 7.08]
School Technological Adequacy (STA)	M = 7.79 [7.56, 8.04]	M = 7.19 [6.93, 7.45]	M = 6.49 [6.15, 6.82]

Student Technological Adequacy (StTA)	M = 6.25 [5,96, 6.54]	M = 6.06 [5.74, 6.38]	M = 6.64 [6.25, 7.03]
Individual Technological Adequacy (ITA)	M = 8.01 [7.77, 8.25]	M = 7.69 [7.40, 7.98]	-
Infrastructures: additional factors			
School Spaces Adequacy (SSA)	M = 6.57 [6.26, 6.88]	M = 6.42 [6.11, 6.74]	M = 6.78 [6.46, 7.11]
E-maturity: competences			
Average Teachers' Digital Competences (ATDC)	M = 6.40 [6.19, 6.61]	M = 6.39 [6.14, 6.63]	-
Average Teachers' Technology Enhanced Pedagogical Preparedness (ATTEPP)	M = 6.05 [5.83, 6.27]	M = 5.89 [5.64, 6.13]	-
Average Students' Digital Competences (ASDC)	M = 6.57 [6.35, 6.78]	M = 6.49 [6.27, 6.72]	-
E-maturity: Organizational factors			
Quality of Life Long Training (QLLT)	-	M = 6.55 [6.25, 6.86]	-
Impact of Life Long Training (ILLT)	-	M = 6.92 [6.64, 7.21]	-
School Digital Leadership (SDL)	M = 7.30 [7.08, 7.52]	M = 6.63 [6.31, 6.96]	M = 6.09 [5.71, 6.48]
School Digital Future Vision (SDFV)	M = 7.19 [6.96, 7.42]	M = 6.58 [6.28, 6.88]	M = 6.31 [5.91, 6.70]
Operational Assistance (OA)	M = 6.66 [6.32, 7.00]	M = 6.58 [6.23, 6.92]	-
Technology Enhanced Process Management *(Smart Organization)* (TESO)	M = 7.71 [7.47, 7.94] *M = 7.55 [7.30, 7.80]*	M = 6.69 [6.32, 7.05] *M = 6.62 [6.29, 6.95]*	M = 6.71 [6.33, 7.09]
Technology Enhanced Peer Collaboration (TEPC)	M = 7.68 [7.44, 7.92]	M = 6.94 [6.66, 7.23]	-
Easiness to Access Information and Communication (EAIC)	M = 7.93 [7.71, 8.15]	M = 6.87 [6.57, 7.16]	M = 7.45 [7.07, 7.83]
Administrative Practices Friendliness (APF)	M = 7.20 [6.92, 7.49]	M = 6.53 [6.19, 6.87]	M = 6.96 [6,55, 7.37]
Other Organizational Factors			
School professional competences (SPC)	M = 7.14 [6.93, 7.35]	M = 6.93 [6.65, 7.21]	M = 6.66 [6.32, 7.00]
Agreement on School Objectives (ASO)	-	M = 7.04 [6.73, 7.34]	M = 7.00 [6.66, 7.34]
Sharing of Objectives and Actions (ShOA)	M = 7.45 [7.23, 7.67]	M = 6.71 [6.39, 7.02]	-
Funds Usage Adequacy (FUA)	M = 7.69 [7.44, 7.94]	M = 6.68 [6.35, 7.01]	-
Responsibilities and Working Load Sharing Adequacy (RWLSA)	M = 7.72 [7.49, 7.96]	M = 6.44 [6.08, 6.80]	-
Human Resources Valorization (HRV)	M = 7.87 [7.64, 8.09]	M = 6.32 [5.94, 6.70]	-
Support to Co-Working (SCoW)	M = 7.46 [7.23, 7.68]	M = 6.32 [5.97, 6.67]	-
Impact of Co-	M = 7.78	M = 6.69	-

Working (ICoW)	[7.54, 8.02]	[6.37, 7.01]	
Support to Co-Design (SCoD)	M = 7.43 [7.18, 7.68]	M = 6.24 [6.91, 6.57]	M = 6.08 [5.72, 6.44]
Impact of Co-Design (ICoD)	M = 7.21 [6.96, 7.47]	M = 6.19 [6.85, 6.53]	
Support to Participatory Evaluation and Self-Evaluation (SPESE)	M = 6.87 [6.63, 7.12]	M = 5.74 [5.37, 6.10]	M = 5.86 [5.50, 6.21]
Cohesion among colleagues (CC)	-	M = 7.10 [6.81, 7.39]	-
Best Practices Sharing (BPS)	M = 6.50 [6.28, 6.73]	M = 6.21 [5.93, 6.50]	-
School Organization Appreciation (SOA)	-	M = 6.93 [6.63, 7.22]	M = 6.80 [6.42, 7.17]
External Communication of School Objectives (ECSO)	M = 7.40 [7.19, 7.62]	M = 6.69 [6.38, 7.01]	M = 6.59 [6.24, 6.9£]
Interaction with Principal (IwP)	-	M = 7.81 [7.48, 8.15]	M = 6.67 [6.25, 7.10]
Interaction with DSGA (IDSGA)	M = 8 [7.63, 8.37]	M = 6.80 [6.40, 7.20]	-
Interaction with ATA (IATA)	M = 8.19 [7.92, 8.45]	M = 7.10 [6.73, 7.47]	-
Support to Local Networks among schools (SLNS)	M = 7.64 [7.41, 7.87]	M = 6.50 [6.15, 6.85]	
Support to International Networks among schools (SINS)	M = 6.74 [6.39, 7.09]	M = 6.05 [5.66, 6.44]	
Personal factors: Competences			
Individual Digital Competences (IDC) (StDC)	M = 7.78 [7.57, 7.98]	M = 7.77 [7.59, 7.96]	-
IDC1	M = 7.64 [7.30, 7.99]	M = 7.28 [6.87, 7.69]	-
IDC2	M = 7.61 [7.27, 7.95]	M = 7.40 [7.01, 7.80]	-
IDC3	M = 6.57 [6.23, 6.91]	M = 6.61 [6.20, 7.03]	-
IDC4	M = 6.67 [6.32, 7.03]	M = 6.58 [6.17, 6.98]	-
IDC5	M = 5.85 [5.46, 6.23]	M = 5.79 [5.39, 6.20]	-
Individual Technology Enhanced Pedagogical Preparedness (ITEPP)	-	M = 7.43 [7.22, 7.63]	-
Personal factors: Well-being			
School Challenge Quality (SCQ)	-	M = 6.35 [5.94, 6.76]	M = 6.47 [6.07, 6.86]
Self-Fulfillment Increase (SFI)	M = 6.53 [6.13, 6.93]	M = 6.14 [5.74, 6.55]	-
Self-Esteem Increase (SEI)	M = 6.74 [6.36, 7.13]	M = 6.39 [5.98, 6.81]	-
Appreciation by Peers (AbP)	M = 6.74 [6.38, 7.09]	M = 6.66 [6.26, 7.06]	-
Autonomy Level Increase (ALI)	M = 7.88 [6.51, 7.26]	M = 6.73 [6.34, 7.12]	-
Self-Motivation Increase (SMI)	M = 6.73 [6.31, 7.15]	M = 6.55 [6.12, 6.97]	-
Extrinsic-Motivation Increase (EMI)	M = 6.57 [6.16, 6.98]	M = 6.22 [5.78, 6.67]	
Others Personal factors			
Involvement in Shool Activities (ISA)	-	M = 7.35 [7.03, 7.67]	

Individual Competences Appreciation (ICA)	M = 7.81 [7.59, 8.03]	M = 7.23 [6.92, 7.54]	-
Individual Results Valorization (IRA)	M = 7.44 [7.17, 7.72]	M = 6.91 [6.55, 7.28]	-
Individual Opinions Consideration (IOC)	-	M = 7.26 [6.97, 7.55]	M = 6.14 [5.73, 6.55]
School Support to Individual Development (SSID)	-	M = 6.94 [6.67, 7.22]	M = 7.00 [6.65, 7.34]
Personal Time Management (PTM)	M = 5.91 [5.54, 6.27]	M = 6.67 [6.34, 7.00]	-
Working Load Adequacy (WLA)	M = 6.57 [6.16, 6.98]	M = 6.13 [5.79, 6.47]	
E-maturity: Technology enhanced educational			
Technology Enhanced Didactics (TED)	M = 7.36 [7.13, 7.58]	M = 6.91 [6.63, 7.18]	M = 6.46 [6.08, 6.84]
Technology Enhanced Collaborative Activities (TECA)	-	M = 6.05 [5.66, 6.44]	-
Technology Enhanced Design Activities (TEDA)	-	M = 6.07 [5.69, 6.46]	-
Technology Enhanced Evaluations (TEE)	-	M = 5.84 [5.45, 6.24]	-
Technology Enhanced Personalized Learning (TEPL)	-	M = 6.09 [5.68, 6.50]	M = 4.82 [4.32, 5.32]
Technology Enhanced Reinforcement (TER);	-	M = 5.79 [5.39, 6.20]	M = 4.31 [3.80, 4.81]
Production of Digital Content (PDC)	M = 6.36 [6.09, 6.62]	M = 6.37 [6.03, 6.71]	
Digital Archive Development (DAD)	M = 5.80 [5.50, 6.10]	M = 5.70 [5.32, 6.07]	
(Personal) Usage of Digital Content (UDC)	-	M = 7.51 [7.26, 7.77]	-
Students -Teachers Digital Communication (STDC)	-	M = 6.52 [6.13, 6.92]	-
Parents-School Digital Communication (PSDC)	-	M = 6.63 [6.25, 7.02]	M = 7.27 [6.89, 7.65]
Digital divide reduction initiative (DDRI)	M = 6.66 [6.40, 6.92]	M = 6.13 [5.80, 6.45]	M = 6.10 [5.70, 6.50]
Other Educational process related factors			
Collaborative Work Support & Stimulation (CWSS)	-	M = 7.65 [7.42, 7.87]	-
Design Activities Support & Stimulation (DASS)	-	M = 7.24 [7.00, 7.48]	-
Competence Based Learning (CBL)	M = 6.78 [6.54, 7.02]	M = 6.86 [6.60, 7.11]	-
Individual usage of CBL (IUCBL)	-	M = 7.74 [7.53, 7.96]	-
Usage of Innovative Learning Practices (UILP)	-	M = 7.49 [7.26, 7.72]	-
Interdisciplinary Stimulation (IS)	M = 7.41 [7.19, 7.64]	M = 6.83 [6.55, 7.10]	-
PCTO Satisfaction/Quality (PCTOQ)	M = 7.40 [7.00, 7.81]	M = 7.17 [6.89, 7.45]	M = 6.42 [6.03, 6.81]
Orientation Initiative Quality (OIQ)	M = 7.68 [7.45, 7.91]	M = 7.35 [7.07, 7.62]	M = 6.55 [6.17, 6.94]
Personalized Learn-	-	M = 6.97	M = 5.98

ing (PL)		[6.68, 7.26]	[5.58, 6.38]
Support to Excellence Development (SED)	M = 7.25 [6.99, 7.51]	M = 6.70 [6.36, 7.04]	M = 6.29 [5.91, 6.67]
Efficacy of Support to Students with Learning Difficulties (ESSLD)	-	M = 7.27 [7.00, 7.54]	M = 6.09 [5.65, 6.52]
Outcome: e-maturity			
Degree of e-Maturity (SeM)	M = 6.65 [6.42, 6.88]	M = 6.40 [6.12, 6.68]	M = 6.56 [6.21, 6.90]
Smartness: Social interaction			
School/Classroom Social Climate (CSC)	-	M = 7.15 [6.89, 7.41]	M = 6.78 [6.43, 7.14]
Students-Teachers Relationships (STR);	-	M = 8.54 [8.36, 8.71]	-
Teachers-ATA Relationships (TATAR)	-	M = 8.03 [7.78, 8.28]	-
Teachers-Parents Relationships (TPR)	-	M = 7.76 [7.53, 7.98]	M = 7.63 [7.30, 7.95]
School Initiative about Diversity (SiD)	M = 8.08 [7.84, 8.32]	M = 7.69 [7.41, 7.97]	M = 7.03 [6.69, 7.38]
School Inclusion Action (SIA)	M = 8.30 [8.07, 8.52]	M = 7.80 [7.53, 8.07]	M = 7.28 [6.97, 7.59]
Support to Student Social Interaction (SSSI)	M = 8.06 [7.84, 8.29]	M = 7.59 [7.31, 7.87]	M = 6.95 [6.61, 7.29]
Peer Relationships Quality (PRQ)/	-	M = 7.51 [7.27, 7.76]	M = 6.74 [6.44, 7.05]
Social interaction: Community Pact Related Factors			
Belonging to School Community (BSC)	M = 8.62 [8.36, 8.87]	M = 7.86 [7.56, 8.15]	M = 6.45 [6.08, 6.83]
Support to Territorial Social Interaction (STSI)	M = 8.27 [8.03, 8.51]	M = 7.38 [7.06, 7.71]	M = 6.91 [6.57, 7.26]
Utility of Territorial Community Development (UTCD)	M = 8.66 [8.39, 8.93]	M = 8.26 [8.02, 8.51]	M = 7.74 [7.44, 8.03]
Utility of Territorial Virtual Community Development (UTVCD)	M = 7.42 [7.11, 7.73]	M = 7.34 [7.03, 7.65]	M = 6.95 [6.61, 7.29]
Belonging to School Territory (BST)	M = 7.79 [7.45, 8.09]	M = 7.78 [7.53, 8.03]	M = 6.56 [6.16, 6.97]
Availability to support the School Community (ASSC)	-	M = 8.04 [7.77, 8.32]	M = 7.07 [6.68, 7.47]
Parents Involvement in School Activities (PISA)*	M = 6.87 [6.58, 7.16]	M = 6.30 [6.00, 6.60]	M = 6.74 [6.36, 7.11]
Involvement in School Activities for Parents Education (ISAPE)	-	-	M = 6.40 [6.01, 6.79]
Smartness: Safety			
Internal Safety at Work (ISeW)	M = 7.85 [7.60, 8.09]	M = 7.22 [6.92, 7.52]	-
Internal Safety (generic) (ISe)	M = 7.92 [7.68, 8.16]	M = 7.21 [6.90, 7.51]	M = 7.74 [7.41, 8.08]
Smartness: Food			
Food Service Adequacy (FSA)	M = 6.82 [6.49, 7.15]	M = 5.79 [5.43, 6.14]	M = 5.18 [4.77, 5.59]
Smartness: Mobility			
Internal mobility (IMo)	M = 7.84 [7.60, 8.08]	M = 7.72 [7.44, 8.00]	-
Smartness: Environment			

Environmental Care (EnC)	M = 7.49 [7.22, 7.76]	M = 6.75 [6.43, 7.08]	M = 6.84 [6.50, 7.19]

Table 3 – Overall values and categorial values (principals = Pr; teachers =T; parents = Pa) taken by the indices *smarteness, well-being* and *e-maturity* and by the sub-dimensions (sub-indices) that compose such indices. For each index/sub-index are listed the factors that contribute to the determination of its value.

Indices	2023
e-maturity	
e-maturity factor [SeM]	6.54 /6.65Pr /6.4T /6.56Pa
e-maturity: mean of subindices	6.76 /6.98Pr /6.71T /6.69Pa
e-maturity subindices	
e-maturity: technological resources and infrastructures [SC, STA, StTA, ITA (no parents)]	7.13 /7.46Pr /7.01T /6.62Pa
e-maturity: competences (no parents) [ATDC, ATTEPP, ITEPP (only teachers), ASDC, QLLT (only teachers), ILLT (only teachers), IDC]	6.62 /6.49Pr /6.68T
e-maturity: organizational factors and relationships [SDL, SDFV, OA (no parents), TESO, TEPC (no parents), EAIC, APF]	6.99 /7.40Pr /6.70T /6.83Pa
e-maturity: technology enhanced educational activities [TED, TECA (only teachers), TEDA (only teachers), TEE (only teachers), TEPL (only teachers), TER (only teachers), PDC (no parents), DAD (no parents), UDC (only teachers), STDC (only teachers), PSDC (no principals), DDRI]	6.29 /6.55Pr /6.45T /6.61Pa
Smartness: integrated values	
Average Total Smartness	6.95 /7.48Pr /6.95T /6.85Pa
Infrastructures/Resources & Competences [e-maturity factors: technological resources and infrastructures & competences; + SSA, SPC)	6.90 /7.92Pr /7.71T /6.66Pa
Organization-Communication-Services [e-maturity factors: organizational factors and relationships; + SOA (no principals), ECSO, IwP (no students and principaals), IDSGA (no parents), IATA (no parents)]	6.70 /7.46Pr /6.76T /6.77Pa
Learning Process (LE contextual index)	6.90 /6.61Pr /6.76T /6.60Pa
Learning process: design [ASO (no principals), ShOA (teachers and principals), FUA (teachers and principals), RWLSA (teachers and principals), SCoW (teachers and principals), ICoW (teachers and principals), SCoD (teachers and principals), ICoD (teachers and principals), BPS (teachers and principals)]	*6.85* /6.02Pr /6.52T /7.00Pa
Learning process: activities [PL (no principals), ESSLD (no principals), OIQ, SED, SPESE (no parents), IS (no parents), UILP (only teachers), CBL (no parents), CWSS (only teachers), DASS (only teachers)]	*6.95* /7.20Pr /6.99T /6.21Pa
Environment [EnC]	7.03 /7.49Pr

	/6.75T /6.84Pa
Mobility [IMo]	7.78 /7.84Pr /7.72T
Food [FSA]	5.93 /6.82Pr /5.79T /5.18Pa
Safety [ISe, ISeW(no parents)]	7.58 /7.89Pr /7.22T /7.74Pa
Socialization	7.41 /7.88Pr /7.50T /7.04Pa
School Climate [CSC (no principals), PRQ (no principals)]	*7.05* /7.33T /6.76Pa
Relationships [CC (only teachers), STR (only teachers), TPR (no principals), TATAR (only teachers)]	*7.84* /7.86T /7.63Pa
Support to socialization [SSSI, SiD, SIA]	*7.64* /8.15Pr /7.69T /7.09Pa
School community and networking [STSI, UTCD, UTVCD]	*7.26* /7.75Pr /7.11T /7.05Pa
Social capital [PISA, ISAPE (only parents), BSC, BST, ASSC (no principals)]	*7.29* /7.76Pr /7.50T /6.66Pa
Challenges [SCQ no principals]	6.41 /6.35T /6.47Pa
Flow [QLTT (only teachers), ILTT (only teachers), SSID (no principals), PCTOQ]	6.90 /7.40Pr /6.95T /6.71Pa
Wellbeing (PRINCIPALS/TEACHERS)	
Individual feelings (no parents) [SFI, SEI, ALI, ABP, SMI, EMI]	6.66 /6.87Pr /6.45T
Individual competencies & development [IDC, ITEPP (only teachers), ICA (no parents), SSID (no principals)]	7.30 /7.57Pr /7.21T
Wellbeing at work	6.97 /7.43Pr /7.00T
Average Total Wellbeing	6.98 /7.29Pr /6.89T