

Reflex as a compass for educational ecosystems: towards extended and connected learning

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Abstract: This article introduces Reflex, a self-evaluation tool designed to support systemic school innovation within an ecological and multi-level perspective. Grounded in theories of distributed cognition and organisational learning, Reflex is conceived as a reflective governance artefact enabling schools to connect micro-level practices, meso-level organisational dynamics, and macro-level policy frameworks. Developed through a Design-Based Research approach, the tool was tested with 119 Italian schools, involving over 7,000 teachers. The study combines quantitative analysis of aggregated questionnaire data with qualitative insights from follow-up meetings. Findings show that Reflex fosters shared organisational awareness, supports professional dialogue between leadership and teachers, and promotes data-informed decision-making. At the network level, aggregated data reveal recurring patterns of innovation and highlight a systematic gap between systematisation processes and the slower rooting of innovation within teaching practices. The study suggests that Reflex functions not only as a diagnostic tool but as an infrastructure for organisational learning and collective intelligence, contributing to more connected and sustainable educational ecosystems..

Keywords: School innovation; Systematisation; Rooting; Collective intelligence; Self-assessment.



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1. Introduction

Contemporary educational research increasingly challenges atomistic and individualistic conceptions of mind, learning, and, consequently, schooling, adopting an ecological and distributed perspective on cognition. From Gregory Bateson (1972) to the theory of the extended mind proposed by Andy Clark and David Chalmers (1998), cognitive processes are understood as emerging from circuits of interaction among individuals, contexts, and tools. This perspective is further enriched by the notion of collective intelligence developed by Pierre Lévy (1994) and by the concept of connective intelligence proposed by Derrick de Kerckhove

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(1997), which emphasize how knowledge is increasingly distributed across networks and emerges through processes of connection, participation, and shared meaning-making. Within this framework, the school is conceived not as a closed organization, but as a cognitive and organizational ecosystem in which knowledge and decisions emerge from distributed circuits connecting people, tools, and practices.

From this standpoint, self-evaluation tools can function as genuine cognitive artefacts that mediate organizational learning (Argyris & Schön, 1996; Senge, 1990) and support the systemic transformation of educational institutions. It has been shown that the intentional use of data can foster professional empowerment, an evidence-informed culture, and organizational learning, provided that it is intertwined with processes of participatory reflection and professional dialogue (Mandinach & Gummer, 2016; Schildkamp, 2019; Kools & Stoll, 2016).

It is within this theoretical framework that this article situates Reflex, a self-evaluation tool developed through a Design-Based Research approach (Benassi, Giunti & Rossi, 2025) and created to support schools and school networks in moving from individual knowledge to organizational knowledge. Conceived as a reflective governance artefact, Reflex enables schools to scale up innovation, contributing to the development of forms of institutional and collective intelligence.

The article is structured as follows. Section 2 frames school innovation as a multi-level phenomenon. Section 3 describes the methodology and participating schools. Section 4 presents the findings at both the school and network levels. The discussion and conclusions reflect on the implications of Reflex as a tool for extended governance and connected learning within contemporary educational ecosystems.

2. School innovation as a multi-level phenomenon

In contemporary debates on education systems, the concept of complexity has become an increasingly relevant lens for understanding knowledge processes. It enables a shift beyond reductionist and linear views towards a perspective that recognises the interdependence between elements, levels and dimensions (Morin; 2000; Ceruti 2018). In this sense, reality is understood as a system of dynamic relationships in which the whole and its parts co-determine one another, and knowledge emerges as a situated and evolving construct shaped through processes of connection, integration and reorganisation. This challenges the traditional fragmentation of knowledge and calls for forms of thinking able to move across levels, integrate heterogeneous dimensions and address uncertainty as a structural condition of contemporary contexts (Taleb, 2007).

From this perspective, educational phenomena can be interpreted as multi-level systems, allowing innovation to be understood not as a discrete intervention, but as a process involving cultural, organisational and epistemological dimensions. In line with Perkins (2013), educational innovation is not a simple “installation” of practices or models transferred linearly, but a process that develops through interactions across different levels of the system, from classroom practices to policy frameworks.

Research and empirical evidence (Fullan, 2008; Hargreaves and Shirley, 2009) show that innovation takes shape through processes of appropriation, adaptation and reorganisation, confirming its dynamic and situated nature. This view is reinforced by ecological models (Bronfenbrenner, 1979), which frame education as embedded in interconnected environments across micro (classroom practices), meso (organisational

dynamics and relationships) and macro (policies and cultural frameworks) levels (European Commission, 2018). Innovation emerges from the alignment and interaction among these levels, requiring systemic coherence.

Within this framework, the concept of “policy enactment” further clarifies the non-linear nature of innovation. Policies are not simply implemented, but interpreted and translated in context through the actions of school leaders, teachers and organisations. Schools act as mediating environments where policies are reconfigured in light of professional cultures, resources and constraints, producing outcomes that may diverge from original intentions (Ball, Maguire, & Braun, 2012).

A systemic perspective is therefore essential: innovation is not the application of reforms, but a process of organisational learning in which schools develop the capacity to reflect, adapt and improve over time. It is shaped by how actors perceive and reinterpret change within their contexts.

Educational innovation can thus be understood as a complex, intentional and observable process, never merely replicable and always context-sensitive, aimed at addressing real needs and requiring tools to support its analysis, evaluation and development (Benassi et al, 2024).

Building on these premises, the INDIRE research group, within its observatory on innovation represented by the *Avanguardie educative Movement* (hereafter AE), a national network of schools engaged in experimenting with and disseminating innovative pedagogical and organisational models (Laici et al., 2015; Giunti et al., 2025), identified a key challenge: the difficulty of systematically understanding and interpreting the behaviours of the approximately 1,900 participating schools and the trajectories of their innovation processes.

To address this, Reflex was developed as a self-assessment tool with a dual purpose: supporting schools in the reflective analysis of their innovation processes, and enabling INDIRE to build an aggregated and systemic understanding of patterns of convergence, divergence and recurring configurations of innovation.

From this perspective, Reflex is not merely a data collection tool, but a knowledge and support device linking the micro level of practices with meso and macro interpretations of change.

The tool is grounded in the concept of innovation defined as follows: « a phenomenon that introduces elements of transformation aimed at resolving a problematic condition or responding to a need within the context of the classroom, the school and/or the education system as a whole. It can be an organized or spontaneous process, or a combination of both, and it is guided by a coherent framework of reference. Its nature may concern both the process and the product, and it necessarily implies the possibility of observing, measuring, evaluating, and, to a certain extent, predicting its effects». (Mosa & Panzavolta, 2025; Benassi, Giunti & Rossi, 2025).

Systemic innovation is thus interpreted through the interaction between two interdependent processes: “Systematization”, concerning organisational integration, and “Rooting”, relating to the internalisation of innovation within professional practices of the school community, rather than at the level of the individual.

Systematization is defined as «an organizational process carried out by a school institution, aimed at operationally integrating an educational innovation into the system of existing practices. The process of systematization may be autonomous or embedded

within local, national, or international initiatives. Integration can be considered consolidated when it is reflected in a process of embedding» (Ibid).

Rooting is defined as «a process through which a school community consolidates an educational innovation, with the aim of transforming existing professional routines. A condition for embedding is the internalization of the innovation at the behavioral, value-based, affective, and identity levels» (Ibid). These two processes can be understood as two sides of the same coin: without embedding, systematization remains formal; without systematization, rooting remains fragile. To capture the interplay between them, two questionnaires were designed to explore the perceptions of school leadership, staff and teachers across ten analytical dimensions².

3. Materials and Methods

The development and deployment of Reflex followed a Design-Based Research (DBR) approach (Benassi, Giunti & Rossi, 2025), a methodology widely recognised for its effectiveness in the design and study of educational tools, environments, and artefacts (Design-Based Research Collective, 2003; McKenney & Reeves, 2018; Pellerey, 2005). DBR is characterised by iterative cycles in which theoretical design alternates with experimentation in authentic contexts, progressively refining the tool in response to empirical feedback from practitioners (Cacciamani, 2008; Ranieri, Raffaghelli & Pezzati, 2018). Its collaborative, practice-embedded nature makes it particularly suited to research aimed at generating solutions that can produce meaningful and sustainable changes in existing educational practices (Bruni, Ranieri & Gabbi, 2020; Clarke-Midura et al., 2006).

The Reflex development process was structured in four iterative cycles: (1) theoretical framing of the constructs of innovation, systematisation and rooting; (2) instrument design and operationalisation across ten innovation dimensions; (3) field experimentation and iterative revision in collaboration with pilot schools; (4) final review and optimisation phase. The findings reported in this article draw primarily on data collected during the final testing phase.

3.1. Participants

The final testing phase involved 119 Italian schools subdivided into two groups: 19 Regional School Hubs of the Avanguardie Educative Movement, with a coordinating and dissemination function and 100 schools participating in the Città dell'Educazione project, promoted by the Compagnia di San Paolo Foundation. The two groups differ in their relationship to the level of maturity with respect to innovation processes: Regional School Hubs represent institutionally mature contexts with an established culture of innovation and network engagement, whereas Città dell'Educazione schools are embedded in a broader territorial initiative and represent a wider range of organisational profiles. For the purposes of this article their data are presented in aggregate form. Disaggregated comparisons between the two groups are reported elsewhere (Benassi, Giunti & Rossi, 2025; Mosa & Panzavolta 2025).

² Reflex covers ten key dimensions of school innovation: governance and leadership, innovative teaching, professional development, assessment practices, curriculum design, collaboration, learning environments, internationalization, well-being, and time management.

The data presented in this paper refer to the final testing phase, which concluded in January 2026 and involved a total population of approximately 15,490 teachers, of whom 7,244 completed the questionnaire.

3.2. Data Collection Methods

Quantitative data were gathered through the two Reflex online questionnaires administered to all participating schools. Responses in aggregate form are automatically processed by the Reflex digital infrastructure built on Microsoft Power BI, which visualises three key indicators that refer to the three definitions previously described: the Systematisation Index, the Rooting Index, and a Multidimensional Radar Chart (Borra & Benassi, 2026).

Qualitative data were collected through online follow-up meetings conducted by researchers between October 2024 and January 2026. Each meeting, lasting approximately one hour, involved the school leader and a small group of teachers and was held after the school had completed the questionnaires and accessed the Reflex report. The meetings served two complementary purposes: first, to identify any critical issues regarding the clarity and usability of the instrument; second to explore the extent to which Reflex was perceived as useful in sustaining internal reflection and promoting shared participation in school innovation processes.

3.3. Data Analysis

Quantitative analysis was conducted on the aggregated Reflex dataset, drawing on responses from all 119 schools and 7,244 teachers. Statistical analysis focused on the distribution of the Systematisation Index and the Rooting Index across schools and dimensions, enabling the identification of network-level patterns, recurring strengths, and critical areas. Particular attention was paid to the relationship between the two indices which constitutes one of the most diagnostically relevant outputs of the Reflex framework (Borra & Benassi, 2026; Benassi, Giunti & Rossi, 2025).

Qualitative analysis was conducted on the corpus of data produced during the follow-up meetings, which included field notes, verbatim quotations, and discursive summaries transcribed manually by the researchers. The corpus was subjected to thematic analysis (Braun & Clarke, 2006), proceeding through an inductive first phase of open coding, followed by a deductive phase in which emergent categories were refined in relation to the research objectives and the theoretical framework. The analytical categories were constructed around seven key areas: the primary function attributed to Reflex; interpretation of results; perception of misalignments between systematisation and rooting; the role of the tool in governance processes; prospective uses of Reflex; its cultural value as an organisational device; and immediate effects observed within the school community. A constant comparison between researchers was maintained throughout the analysis to ensure the reliability and consistency of the theme–code combinations.

The two analytical strands were not treated as independent but as mutually informing perspectives revealing the mechanisms through which Reflex mediates organisational learning and professional reflection.

4. Results

For the purposes of this section, the findings are organised around the qualitative data collected during follow-up meetings (Section 4.1), with a focus on the school level and on the mechanisms through which Reflex mediates organisational self-reflection and professional learning within individual institutions. Section 4.2 will address the network level, drawing on aggregated data to explore emerging patterns and dynamics across schools.

4.1. *Reflex at the School Level: Enabling Organizational Learning through Self-Reflection*

The primary objective of this section is to investigate how Reflex, at the level of the individual school, functions as a device for organisational learning through self-reflection. Qualitative data from the follow-up meetings were analysed through thematic analysis, with analytical categories constructed around seven key areas: (see Section 3.3). This process allowed the identification of four recurring themes, presented in the synoptic Table 1 and discussed in the following sub-sections.

Table 1. School-level thematic analysis

Theme	Key patterns
1. Development of shared awareness	Schools recognise an 'honest mirror' function; data surface tacit misalignments; first-time collective reflection on innovation processes
2. Professional dialogue and school collaboration	Results trigger structured dialogue between school leaders and teaching staff; gap between leadership and teachers becomes a resource for conversation, not a source of conflict
3. Data use for reflection and decision-making	Schools plan to present results in collegiate bodies; Reflex positioned as input for PTOF/RAV/PdM processes
4. Towards schools as learning organizations	Reflex described as a 'compass'; schools express desire for recursive use to track change; tool perceived as catalyst for building shared innovation culture

4.1.1. Theme 1: Development of shared awareness

The most consistently recurring pattern across the follow-up meetings concerns the capacity of Reflex to generate a new form of shared organisational awareness. At the collective level, the Reflex report transformed individual responses into a shared organisational portrait that could be discussed, questioned and interpreted together.

Across a wide range of school contexts, participants reported that confronting the Reflex data was, in many cases, the first time their institution had collectively stopped to reflect on innovation processes in a structure. As one school leader observed:

«It is the first time that, as a school, we have paused to engage in this kind of reflection».³

In several cases, the Reflex output revealed misalignments between the school's self-image and what the data showed. Yet even these uncomfortable revelations were generally received constructively, as an honest and legitimate 'mirror' rather than an external judgement:

«It is reassuring to see ourselves reflected in a mirror like this, because it is not judgmental. It is a kind of zone of proximal development».

4.1.2. Theme 2: Professional dialogue and collaboration

The second theme concerns the role of Reflex as a generator of professional dialogue between different actors within the school community: between the school leader and management staff on one side, and the broader teaching community on the other. The systematic divergence between the two questionnaire responses (Leadership/Staff vs. Teachers) emerged as one of the most analytically productive features of the Reflex report and highlights the gap between organisational intent and professional practice (Borra & Benassi, 2026)⁴.

In the large majority of cases, this gap was not experienced as threatening but as informative and as a powerful catalyst for conversational and evidence-based way. School leaders tended to interpret the divergence as structural and expected, reflecting the different perspectives and responsibilities of leadership and teachers:

«The data do not concern me because they reflect exactly how I perceive the school. Staff advances more in innovation because it has a broader, more systemic view. Teachers follow more slowly, and this is normal: they see only their own classroom».

In contrast, school leaders and teachers showed a certain convergence in the ranking of the 10 dimensions proposed by Reflex, indicating that, beyond the different perspectives of the classroom and school levels, there is still a shared vision and direction to be pursued.

4.1.3. Theme 3: Use of data for reflection and decision-making

A third and closely related theme concerns the schools' expressed intentions to use the Reflex data for concrete reflection and decision-making processes. Across the corpus, the most frequently cited intended uses were: presentation of the Reflex report in collegiate bodies; integration with existing planning instruments (PTOF, RAV, PdM⁵); and re-administration of the questionnaires in subsequent periods to enable longitudinal

³ All verbatim quotations are translated from Italian originals collected during follow-up meetings.

⁴ «In over 70% of schools, leadership teams explicitly commented on discrepancies between high organisational investment (e.g. governance, environments, internationalisation) and lower perceived rooting among teachers (Borra & Benassi, 2026).

⁵ The acronyms refer to key documents in the Italian school system: PTOF (Piano Triennale dell'Offerta Formativa), the Three-Year Educational Offer Plan; RAV (Rapporto di Autovalutazione), the Self-Evaluation Report; and PdM (Piano di Miglioramento), the Improvement Plan.

comparison⁶. The desire to share results with the full teaching community was expressed by the large majority of schools, often immediately after the follow-up meeting reflected a genuine conviction that the data belonged to the whole school community and should be used to support shared decision-making:

«I will present the results in the next Collegio. Not to show what is wrong, but because it is important that teachers know where we are and can contribute to deciding where we go».

Several schools explicitly framed Reflex as a more fine-grained complement to existing institutional evaluation tools (RAV, PdM), highlighting its potential to support and inform their completion:

«It will also be an important resource for reorienting the RAV and the school's improvement processes».

The aspiration towards recursive, longitudinal use was also prominent. Several school leaders described plans to administer Reflex at specific moments in the school year, typically at the beginning and end, in order to track progress and detect change (Borra & Benassi, 2026). As one school leader observed:

«I would like to administer it again in June in the same form in order to compare the data following a training intervention».

4.1.3. Theme 4: Towards schools as learning organizations

The fourth theme concerns the potential of Reflex to contribute to the transformation of schools into learning organizations: institutions characterised by continuous, collective learning, data-informed governance, and the progressive alignment between organisational intent and professional practice (Senge, 1990; Hargreaves & Shirley, 2009). While none of the schools explicitly used the term 'learning organization', the language and aspirations expressed across the corpus converged on a set of defining features: recursive self-monitoring, shared ownership of institutional data, the development of a common innovation culture, and the integration of reflection into the ordinary rhythms of school life.

Reflex was consistently described as a tool capable of supporting this transformation, specifically because of its non-judgemental, internally-oriented design. Unlike accountability instruments that generate data for external use, Reflex was experienced as a device for internal sense-making:

«I would like to use it as a compass to orient ourselves. Unlike the RAV, which has become bureaucracy, this can make a real difference».

⁶ «100% of leadership teams stated that Reflex is useful for supporting internal evaluation processes; over 85% of schools explicitly declared their intention to reuse the tool periodically; more than 70% planned to integrate Reflex results into statutory school planning and evaluation documents, and social accountability reports (Borra & Benassi, 2026).

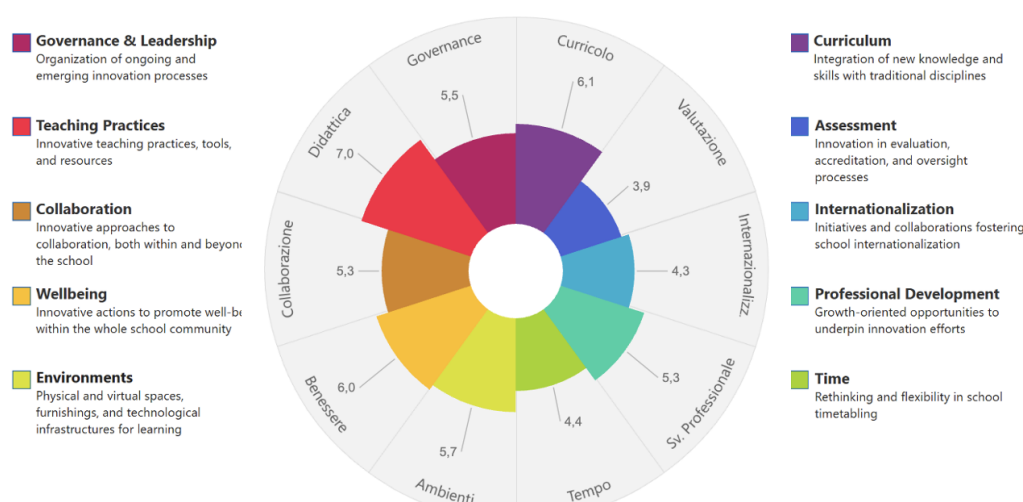
4.2. Reflex at the Network Level: Scaling Collective Intelligence across Educational Ecosystems

While section 4.1 highlighted how Reflex supports organisational learning within individual schools, at the network level the tool reveals a different and complementary function. When aggregated across schools, Reflex enables the emergence of systemic patterns, transforming distributed individual perceptions into a shared cognitive infrastructure for the educational ecosystem.

At the school level, Reflex acts as a mirror, enabling schools to reflect on their own practices and organisational dynamics. At the network level, it takes on a broader role, becoming an infrastructure that supports the development of collective intelligence across the educational ecosystem.

At this level, Reflex does not simply collect data from multiple schools, but makes visible recurring configurations of innovation, highlighting areas of convergence, divergence and systemic misalignment across the network.

Figure 1. Average between systematization and rooting spread over 10 dimensions of innovation.



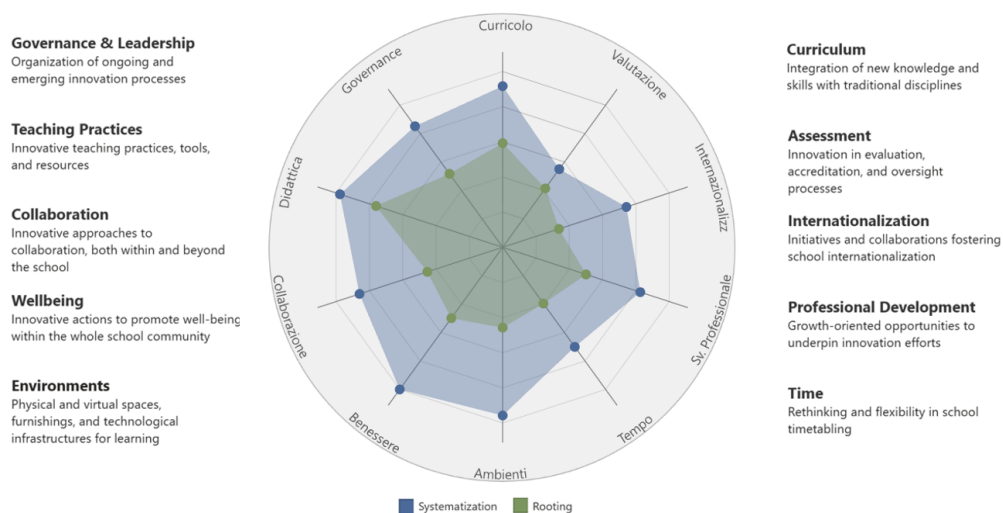
In Figure 1, the aggregated results are presented as means values derived from the responses of all school leaders (questionnaire reflecting the “systematization” perspective) and all teachers (questionnaire reflecting the “rooting” perspective) capturing how innovation is perceived and experienced within their schools.

While individual schools can access their own specific charts related to their context, Reflex also provides an aggregated “view” depicting the overall trend across the 119 schools, highlighting, for example, the dimensions perceived as more or less innovative. In figure 1, these correspond respectively to “assessment” (on a scale from 3.9 to 10) and “teaching and learning practices” (7/10).

Another possible aggregated analysis concerns the difference in perspective between school leaders and staff (systematisation) and the teaching body (rooting). In the

radar chart (Figure 2), two different areas are visible: the blue one represents the former, while the green one represents the community.

Figure 2. Difference between systematization and rooting spread over 10 dimensions of innovation.



Often, in individual school representations, the blue area encompasses the green one, suggesting that the organisational processes supporting innovation tend to precede those of embedding. The latter are necessarily slower, as they involve a large group of individuals (the community) and require a level of engagement and commitment that also affects professional identity and underlying values.

In this regard, Rogers (2003) also described an “adoption rate” curve of innovation, according to which innovations are not adopted simultaneously by all members of a social system, but rather spread progressively over time across different groups: from innovators and early adopters to the early majority, late majority, and finally laggards. This pattern helps explain why organisational alignment may appear earlier than deep cultural embedding within schools.

The analysis of aggregated data suggests the possibility of identifying different “innovation profiles” across schools, based on the relationship between systematisation and rooting. These profiles offer a nuanced understanding of how innovation is distributed and enacted within the network.

However, this perspective is explicitly conceived as an alternative to ranking logics: the aim is not to classify schools according to their level of innovation, but to provide interpretative reference points that can support reflection and improvement processes. For the research group and for the AE network, Reflex provides a strategic tool for interpreting innovation trajectories at scale, supporting more informed and adaptive forms of governance.

Ultimately, Reflex shifts the focus from isolated school improvement to ecosystem-level learning, where the capacity to generate, share and interpret data becomes a key condition for sustainable and systemic innovation.

5. Discussion and Conclusions

Reflex has the potential to evolve into a significant tool for the governance of educational innovation, particularly when interpreted within an ecological and distributed perspective on cognition and learning. In line with Gregory Bateson (1972) and the theory of the extended mind proposed by Andy Clark and David Chalmers (1998), Reflex can be understood as a cognitive artefact that supports the emergence of knowledge through interactions among individuals, contexts, and tools. Similarly, it contributes to processes of collective and connective intelligence, as described by Pierre Lévy (1994) and Derrick de Kerckhove (1997), by enabling schools to generate shared representations of their innovation processes.

From this perspective, the value of Reflex lies in supporting schools in making sense of their own trajectories of change, identifying barriers and enabling conditions, and orienting decision-making in a more evidence-informed way. As suggested by Chris Argyris and Donald Schön (1996), as well as by Peter Senge (1990), tools that mediate reflective processes can foster organisational learning and contribute to systemic transformation. When used systematically, Reflex may therefore strengthen the sustainability of innovation over time and foster broader involvement of the school community, moving beyond fragmented or episodic reforms.

In its current configuration, however, the tool is primarily used for research purposes, particularly within the AE network, to identify recurring patterns in innovation processes, such as barriers to systematisation and rooting, uneven development across dimensions, and emerging areas of excellence. Moreover, the application does not yet include a school-facing view providing benchmark reference values against which schools can compare their results.

Future developments will therefore focus on extending the tool's scope and usability. A first direction concerns the construction of benchmark references, which will require applying Reflex to a larger and more diversified sample of schools, representative of the system as a whole. A second line of development relates to the need for longitudinal research, in order to explore whether Reflex functions merely as a diagnostic device or can progressively become an infrastructure for organisational learning and collective sense-making.

A third crucial dimension concerns the development of schools' data literacy. As highlighted by Ellen B. Mandinach (2016) and Kim Schildkamp (2019), the effective use of data depends on schools' capacity to interpret evidence, integrate multiple sources, and translate insights into informed pedagogical and organisational decisions. Strengthening data literacy (both among school leaders and teachers) thus represents a key enabling condition for Reflex to function as a governance tool.

Finally, an important future development concerns the integration of students' perspectives through the implementation of a dedicated questionnaire. Including students' voice would enrich the interpretive power of Reflex, allowing for a more multidimensional understanding of innovation processes and reinforcing the

participatory and democratic dimension of the tool, particularly in capturing the alignment between organisational intentions and students' lived educational experience.

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