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> "Institutional buildings act as if they were designed specifically to prevent change for the organisation inside and to convey timeless reliability to everyone outside. When forced to change anyway, as they always are, they do so with expensive reluctance and all possible delay."
> Stewart Brand[1]

Introduction: School at Stake

1 The approximately 40,000 buildings that make up Italy's school infrastructure are a stratified legacy spread throughout the country. Although this heritage is of social interest, it requires a systematic rethinking in light of both the limitations highlighted by the recent health emergency, as well as the demographic and educational changes that have been taking place in recent decades. What emerges is a picture characterised by profound local and national inequality,[2] with a spectrum of diversified needs and strong local specificity.[3]

2 Although the urgency of renewing the national school building stock is now widely discussed in the public and professional debate, policy implementation is still characterised by insufficient knowledge. The establishment of the School Building

Registry (Anagrafe dell'Edilizia Scolastica, ARES) — originally created in 1996 but whose actual implementation took many years and yielded very uneven results across Italian regions — and, more recently, of the National System (SNAES) by the same name, aimed at coordinating national and regional scales, are important steps towards collecting and systematising data on Italian school spaces. Available databases, however, are still difficult to integrate and compare. In particular, both the level of detail in the data and the reference systems used for the analyses differ from one context to another. In addition, the data collected in the registry is mainly quantitative, and does not include information relating to the formal characteristics of spaces.

3   The School Building Report published by the Fondazione Agnelli[4] has only recently provided an overview of the buildings that make up the Italian school infrastructure. Drawing on original analyses of data from the registry, the report brings to light and *measures* the inadequacy of what appears to be a dated and multi-layered asset, highlighting, in particular, the inadequacy of Italian school buildings to accommodate innovative forms of teaching due to safety, sustainability, and suitability issues.

4   The inter-ministerial guidelines introduced in 2013[5] emphasised the need to strengthen the relationship between school spaces and educational activities. Although the document does not provide operational guidance, it recommends increasing the flexibility of spaces and moving beyond the central role of the classroom in order to build a stimulating "educational landscape." This challenge is compounded by those posed by the transition of existing heritage from a phase of expansion to one of renovation, which is required to comply with the standards introduced by regulations in the 1990s[6] regarding safety and energy performance. However, the history of Italian school buildings[7] provides evidence of a structural difficulty in adapting distributions and uses to rapidly evolving educational needs.

5   In recent years, public and private initiatives have addressed the spatial regeneration of school building heritage. Some of the most successful examples include the competition "Scuole innovative," promoted in 2016 by the National Institute for Documentation Innovation Educational Research (Istituto Nazionale Documentazione Innovazione Ricerca Educativa, INDIRE) to build 51 new "sustainable and pioneering" schools across the country;[8] and, at a local level, the "Torino fa scuola" pilot project, supported by Compagnia di San Paolo and the Giovanni Agnelli Foundation, in collaboration with the City of Turin and the Fondazione per la Scuola, which led to the development of two school building redevelopment projects, setting an example both in terms of spatial outcomes and process management.[9] Overall, however, the most recent initiatives have been marked both by scarcity and discontinuity of funding provided for the management of the school building stock,[10] and by the lack of a comprehensive strategic vision. This has resulted in a polarised tendency, between implementing highly innovative but hardly reproducible pilot projects on the one hand, and much more frequent minimal actions undertaken to improve the buildings' energy efficiency on the other.

6   Current circumstances might favour the start of a new phase in the process of the Italian school building stock renewal. The funds already partly allocated by the Italian government[11] and supplemented by the Next Generation Europe programme, along with the recent approval of the National Recovery and Resilience Plan (Piano Nazionale di Ripresa e Resilienza, PNRR), could finally provide the operational and economic conditions to take systemic action, capable of seizing and enhancing the potential of

school infrastructure at a local level. Within the framework of the PNRR, and specifically under the programme "Futura - the school for tomorrow's Italy" ("Futura - la scuola per l'Italia di domani") — the part of the plan under the responsibility of the Ministry of Education —, the Italian government has recently outlined the first guidelines for what is defined as "great civic work of renewal of school facilities and improvement of the quality of learning."[12] On the one hand, the document acknowledges the fact that the PNRR opens up new opportunities for "widespread renovation of school buildings, unparalleled in recent Italian experience." On the other, it stresses the fact that "one of the still fragile links in this complex process [is] the dialogue among all the actors."[13]

7   Based on this framework, the implementation phase currently underway is unfolding on a dual track. On the one hand, regional governments have collected applications from local authorities — in particular municipalities and provinces or metropolitan cities, which actually own school buildings in Italy. On the other hand, they have started a process of reorganisation and selection of projects to be financed based on a strategic local approach. This working scheme implies an increasing relevance of the planning capacity of both local authorities and school communities. In view of this context, a design tool (a web application) was developed[14] to enhance the ability of school communities to design change. This article describes the methodological and theoretical framework that enabled the design of this tool and the building of the first prototype.

8   After highlighting the relevance of the issues addressed by the web app, the second section describes the goals of the research, drawing on the concept of "project agency" as a tool for actor empowerment. More specifically, a review of the different ways in which the concept of agency is interpreted in the disciplinary literature allows us to set this study into context. Following this, the third section outlines the proposed methodological approach and the framework of scientific and cultural references behind it. The fourth section provides a detailed description of the web app and its functionalities. Finally, some remarks on the main critical issues and possibilities for research advancement are discussed in the conclusions.

Enabling Spatial Agency Through Spatial Form

9   Managing the transformation of school buildings in Italy involves many actors at different levels. The arrangement of territorial funding from a national level to a local scale; the fragmentation of ownership and related maintenance works among different local authorities — from regional governments to provinces to municipalities; the multiplication of the school managers' duties; the involvement of school communities; etc. — all contribute to making project work groups larger.[15] The large number of actors operating in school spaces, however, makes it extremely difficult to carry out projects that can match the complex challenges facing the school infrastructure, including those mentioned in the previous chapter.

10   In response to this situation, the goal of the web app is to stimulate and guide the designing capacity and agency of the actors involved in spatial transformation. More precisely, the web app is aimed at guiding and helping the actors entrusted with governing the transformation of the school building heritage, in particular the local

authorities, the schools, and their occupants — teachers, students, as well as technical and administrative staff.

11   These goals are in line with a reinterpretation of the practitioner as an *agency-enabler* that brings the spatial project to the forefront (i.e. the capability to act to modify the built environment), instead of spatial design (i.e. the envisioned modification of the built environment).

12   In architectural theory and practice, several approaches to agency enabling can be recognised.

13   A first approach focuses on identifying different forms of agency in transformation practices of the built environment. Examples of this are studies focusing on informal architecture and settlements that describe the ways in which these transformations are achieved and the tools[16] to make them possible. This approach is particularly relevant when studying peculiar states of the built environment produced by invisible practices that are not institutionalised.

14   A second approach focuses on the agency of architectural projects rather than spatial outcomes (architecture) or authors (architects, activists, citizens, etc.). This category encompasses scholarly approaches from many disciplines, such as ethnography, sociology, and architectural design: this research offers an understanding of the design process by prominent professionals,[17] or sheds light on the role of documents and drawings in balancing power and negotiating values within the architectural project.[18] These contributions are relevant to the self-reflection of professional practices, thus redefining the field of action of designers.

15   A third approach focuses on transformation processes of the built environment, aiming to identify and describe the key factors determining spatial developments (i.e. legal, financial, organisational, and spatial).[19] It provides tools for spatial transformation addressed to the communities, illustrating innovative processes and projects based on partnerships between the private and public sector, bottom-up initiatives, community involvement, and smart design, despite difficult conditions.[20] This is particularly important for communities and activists seeking methods and tools to trigger and manage spatial transformations that have already been envisioned.

16   A fourth approach focuses on transforming the potential of existing buildings.[21] Recognising the potential of existing buildings enables communities to explore spatial transformation alternatives, helping to identify the ones that are most suitable. The "Re-school" web app is built by adopting this understanding of agency as a goal. The challenge is to facilitate the understanding of spaces, their resources and criticalities also by non-experts.

17   Due to the scattered institutional scenario that characterises the modification of school buildings, supporting local communities and guiding transformation processes — integrating bottom-up initiatives with top-down financing strategies already in place — could be a way to untangle the complex system of institutional management.

Morphotypes as Tools for Regeneration

18   The method adopted to achieve these goals is centred on the architectural perspective: it considers the forms of the educational infrastructure, its materiality and its spatial organisation as the drivers for regeneration. This connection between the physical

characteristics of built space and urban or local area systems, like school buildings, have already been explored to tackle the processes of transformation of urban areas. Starting from a historical viewpoint, Daniel Abramson builds his understanding of *obsolescence* on the height of buildings, construction materials, and interior layout, amongst other factors,[22] thus explaining how these elements play a key role in the conservation, transformation, and demolition of buildings or entire neighbourhoods. From a more design-based perspective, seminal works in urban design explore the same field. Kevin Lynch's "five basic dimensions" for a *good city form* are based on the performativity of spaces and building forms that contribute substantially to shaping and transforming the built environment as a system, e.g. a neighbourhood.[23]

19   The same understanding of the elements of the built environment — and specifically their form — is assumed as the key methodological approach to the problem of expressing to local communities the potential for the transformation of school buildings. Typological classification is assumed as a way for highlighting the transformational potential of the building. To this end, the classification is based on the current spatial characteristics of the building rather than other kinds of information — i.e. historical, administrative, or performance-related. The approach attempted in the case we are presenting implies a use of the notion of "typology" that goes beyond the historical and cultural dimension, providing an operational understanding of architectural form.

20   Scholars have attempted typomorphological classifications of the built environment in several forms. To explore this transformation potential, we referred to some well-known contributions in this field.

21   The morphogenetic approach to urban form, starting from the Conzen school, identified three basic elements to describe and codify the complexity of the urban fabric: the street pattern; the land use pattern or plot division; and the buildings.[24] As specified by Kropf, streets, plots, and buildings — as interlocking elements — form a compositional hierarchy. This approach is based on different levels, from the city to the building, where the link between the levels is the relationship of the parts to the whole.[25] The main purpose of this type of classification is to describe, investigate, and plan the built environment and its transformations.

22   Moving to the scale of the single building and its interior spaces, studies by Francis Duffy[26] and Stewart Brand[27] offer additional classification tools. These approaches started by identifying the several layers of longevity of the built components. Using the classification proposed by Brand: site, structure, skin, services, space plan, and stuff (i.e. furniture) represent the different layers of a building that change at different rates in time. In these analyses the unit is not the building, but rather the use of a building in time. The reason behind this approach is to measure the transformative potential of buildings — i.e. the ability of a building to adapt to future changes.

23   Building on these two approaches, the classification we are proposing is based both on different scales — i.e. the building, the plot, and the neighbourhood — and on layers of longevity of built components — i.e. load-bearing structure, interior partitions, etc. The four dimensions observed in the web app are the built context of the school building, the land plot, the structure, and the spatial layout.

24   A first element is the relationship between the building and its surroundings. This relationship reflects the role that the building can play in the local community, depending on its physical consistence.

25   A second element is related to the way in which the building occupies the land plot. This aspect is key for understanding the transformation potential of open spaces, as well as for conceiving a transformation of the points of access to public spaces. For instance, buildings directly overlooking public spaces have the potential to act on nearby streets and squares, while buildings that are positioned at the centre of a plot may be used to differentiate the use of outdoor spaces.

26   A third element is the load bearing structure. Although it is not necessarily related to the building form, this factor is crucial to understand the changes that can be made on its layout and massing. According to Stewart Brand, "structures *are* the building,"[28] thus the most perilous element and the most expensive to change. Considering the load bearing structure in the transformation equation means avoiding encouraging changes of the *status quo* that are expensive and technically challenging.

27   A fourth element considered is the spatial layout of school buildings. This aspect is considered both when it concerns interiors (i.e. the way rooms are organised, the relationship between transition spaces and other spaces) and exteriors (i.e. the massing of the building, the organisation of volumes in space).

28   The combination of these factors guides the identification of a "transformative potential profile" suited for a specific school building. The building profile integrates different scales and layers of longevity, encouraging a holistic approach to building regeneration, in which various elements and spaces are interpreted as parts of a whole system.

29   It is essential to underscore that the elements considered in the profile are the ones that are almost immediately understandable and measurable by non-expert users/players. Other elements, such as the state of preservation of the building's technical elements, or the effectiveness of building systems and facilities, are detected through users' feedback, regarding the experience of inhabiting educational spaces as well as users' needs and expectations.

Re-school: An Application to Unveil Transformation Potential

30   To support the people in charge of the transformation and management of school spaces to build informed and effective decision-making processes, an open-access digital information tool was implemented as an experimental application of the methodological approach described above.

31   In this section, a detailed description of the functioning and outputs of the web app will be provided. More specifically, the operational and explicative presentation of the application components is aimed at questioning, in practical terms, the ways in which community agency can be activated on the basis of a systemic reading of the spatial and morphological characteristics of the built environment. In this view, the logical structure of the web app and its outcomes serve as the starting hypothesis to address this issue.

32   The "Re-school" web app was designed for all those involved in the management and use of school spaces — civil servants, school managers, teachers, school staff, students, families, etc. — allowing users to (i) recognise the spatial resources available in schools and assess possible modifications in operational terms; (ii) collect, share and organise information on the potential and criticalities of school buildings provided by the people who work in schools; (iii) build a library of national and international model projects, which can be freely accessed and filtered according to users' needs, in order to improve governance processes and multi-scale comparisons.

33   In the current planning phase of the PNRR, the web app performs a double function. On the one hand, it is a tool to guide design decisions for school renovation by identifying the potential for transformation starting from the specific spatial characteristics of each building and the needs expressed by users. On the other hand, the use of the web app by school occupants and operators makes it possible to acquire up-to-date data on the condition of school buildings and their key needs and critical issues, which can enrich existing databases. From this perspective, the app is proposed as a shared platform for stimulating and supporting bottom-up project initiatives, as well as for integrating and sharing data.

34   The prototype of the web app that is currently accessible online includes a relational database, a set of web services to read the database — on the user and the administration's side — and a website to access the services. Moreover, a spatially referenced database, or a geodatabase, embedded in the app allows us to systematise and integrate the information available on each school.

35   Since the scientific and operational relevance of the results and the meaningfulness of the data collected are proportional to the number and variety of users, it is crucial to promote the use of the application on a large scale to obtain a reliable overview of the national scenario. To this end, the web app has been developed in all its parts as a user-friendly tool that can be used dynamically by different types of players. In particular, in order to also involve younger members of school communities on a deeper level, the graphics and structure of the web app resemble a videogame.

36   The user/player is prompted to go through a series of questions arranged in different levels that allow them to pinpoint the spatial resources of the school they are "playing" with — distributional and functional characteristics, dimensional parameters of the rooms, relationship with the physical context, etc. — and to identify as a prize the most suitable and appropriate solutions for their needs. Based on the information and parameters collected, the system will act as a filter to offer the transformation proposals that are most consistent with the characteristics of the individual case. The web app will then show a collection of graphic and text solutions selected according to the answers and spatial parameters entered by the user. The app also allows for a second mode of use, independent from registration and the game, which involves free consultation of the database of exemplary cases.

37   Using the application, which is linked to identifying the school the user is "playing" with, makes it possible to collect and combine new data shared through user responses on the national school building stock. In particular, the answers relating to the needs and criticalities of the school are updated in real time and made immediately available to subsequent players. Conversely, the data relating to the spaces, in the first phase, remains available only in the back end in order to be adequately processed.

Figure 1. Georeferencing system of schools integrated in the web app
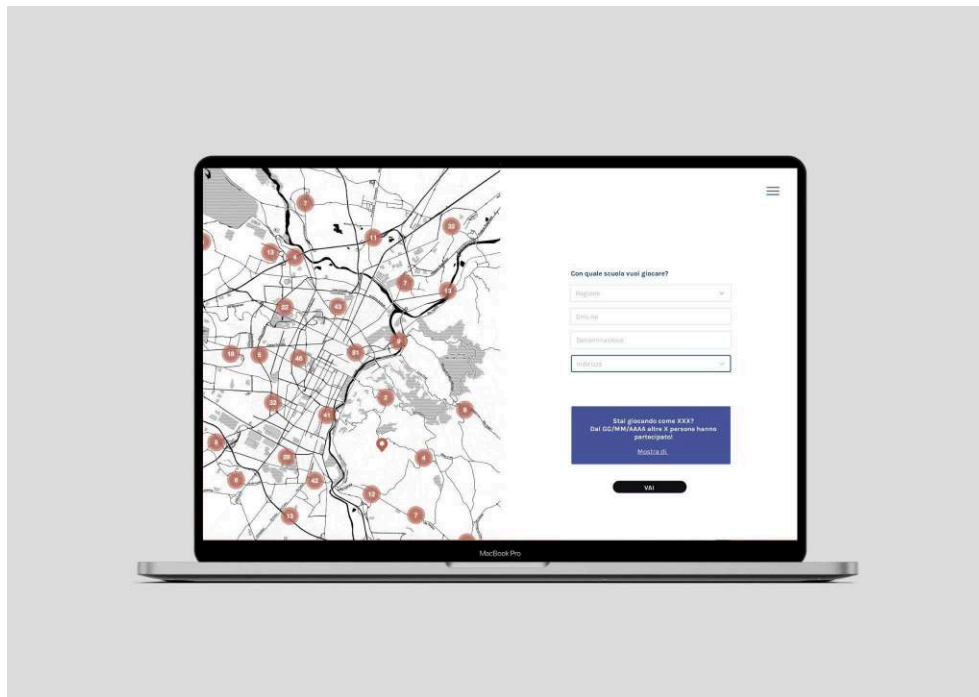
The web app's introductory screen allows players to select the school they wish to play with
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38   More in detail, the logical structure of the application is based on three sets of questions as input — corresponding to the three levels of the game — and two types of output results (fig. 2). A first type of "first results" is uniquely associated with one of the three sets of questions, while the "final results" are the outcome of a combination of the answers given in different questionnaires.
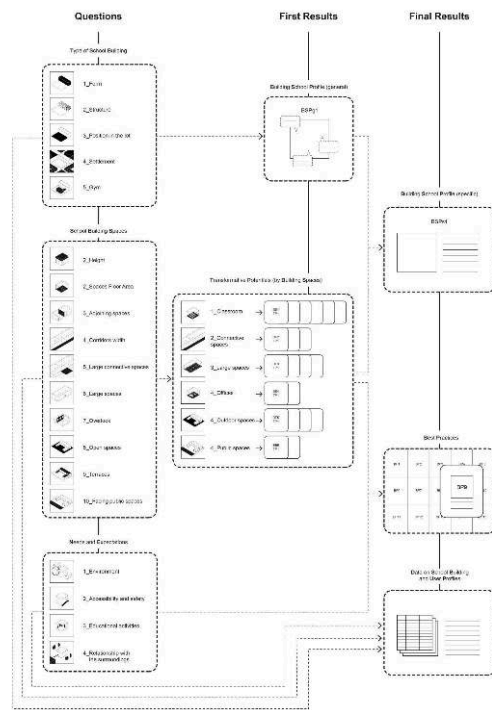
Figure 2. Methodological outline of the web app

Diagram of the functioning structure of the web app, with the three levels of questions, the initial results and the final results

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39   The first level of the game is devoted to the typological identification of the school building. As described in the methodological section, typology is used as an operational tool to develop design strategies. To this end, each building is assigned to a particular "profile" based on questions relating both to space and construction and their relationship to the context. More specifically, at the end of the first level, players obtain a general profile of the school with the selected features as a first result, including comments on the transformation potential of that building type. The potential thereby identified may concern, for example, the use of hallways or transition spaces for educational activities; the identification of alternative accesses and routes; the enhancement of the relationship between open and closed areas; the use of open spaces for educational, sporting or cultural activities; the management of incoming and outgoing flows towards public space; etc.

Figure 3. Building school profile (general)
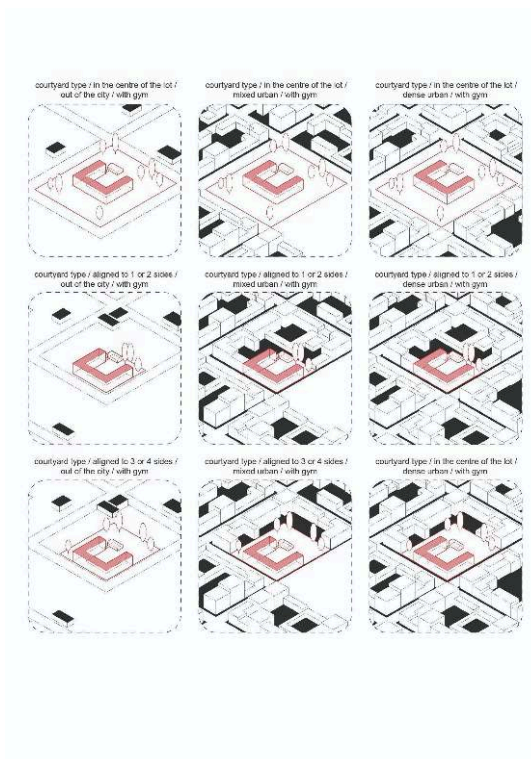
Example of the alternative solutions for the "courtyard" type at the end of the first level of the game
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40   The second level guides players to identify the specific transformation potential of the school building they are playing with, through a series of questions relating to the spatial layout of the interiors and exteriors, as well as their dimensions. In this section, the user must answer questions organised according to different categories of open and closed spaces. The complexity of the building's body is thus broken down into a series of fundamental and intuitive spatial units, bringing the user's attention towards identifying potentially underused resources of spaces — both in the condition they are currently in or as a consequence of transformation. To this end, questions mainly concern the size, constraints and mutual location of the school spaces.

41   After passing level two, players can access a more detailed profile of their school. The identification and description of these "final" profiles is therefore related both to the typological characteristics of the building — shape, structure, position in the lot, and settlement situation — and to the potential of specific school spaces. Based on a cross-reading of the answers provided, level two provides a systemic analysis of the school, identifying specific resources and possibilities for transformation, also in relation to its setting in the local area. The transformation potential of each profile therefore offers an overview of the relationships and uses that can be generated within the building, as well as its relationship to the context, making explicit the role the school can play as infrastructure for the community. Although the profile does not provide specific indications on how the transformation will take place, it should be seen as a first step towards building a decision-making and design process.

**Figure 4. Building school profile (specific)**
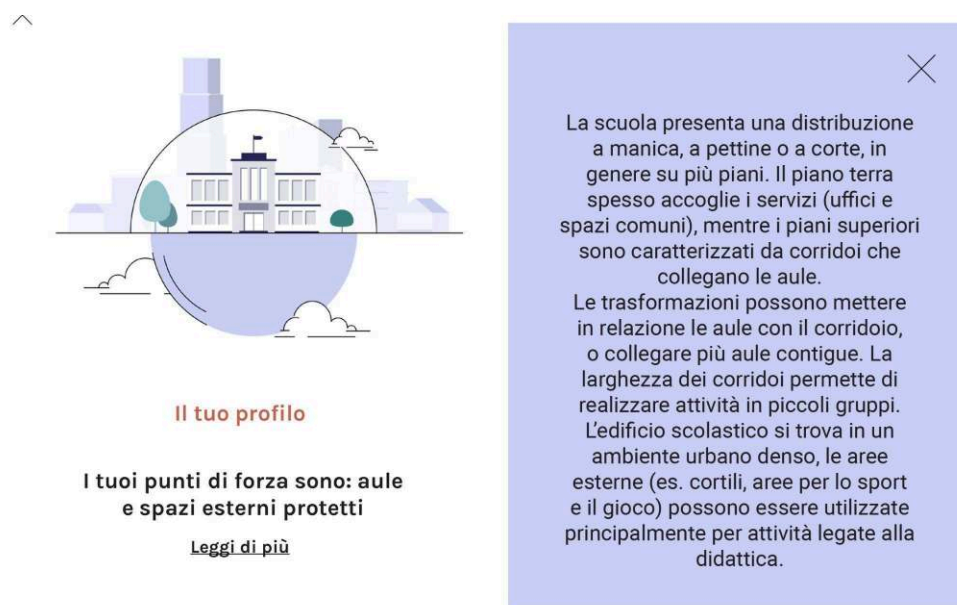
Example of a specific profile description at the end of the second level of the game, "classroom school — urban island"

Translation: On the left, "Your profile. Your strenghts are: classrooms and protected outdoor spaces"; on the right, "This type of school has a sleeve, comb or courtyard distribution, usually over several floors. The ground floor often houses services (offices and common areas), while the upper floors are characterised by corridors connecting the classrooms. Transformations may connect classrooms to the corridor or connect several adjoining classrooms. The width of the corridors allows activities to be carried out in small groups. The school building is located in a dense urban environment, the outdoor areas (e.g. courtyards, sports and play areas) can be used mainly for educational activities."

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42   In addition to identifying their profile, at the end of level two, players are given a list of potential transformations associated with specific spaces in the school they are playing with. The potential identified thus corresponds to recurrent spatial conditions in Italian school buildings. More practically, they illustrate opportunities to intensify and diversify the use of spaces through transformational actions to different extents — e.g. by improving spatial flexibility; connecting or extending spaces; arranging them for unconventional uses; etc. In this way, different possibilities of action relating to a specific set of spaces will be highlighted. As for profiles, the descriptions of potential spatial transformations are not intended to provide definitive solutions, but to highlight a set of possibilities based on each school's features, which can be used to support a systemic and contextual design process.

**Figure 5. Transformative potentials (through building elements)**
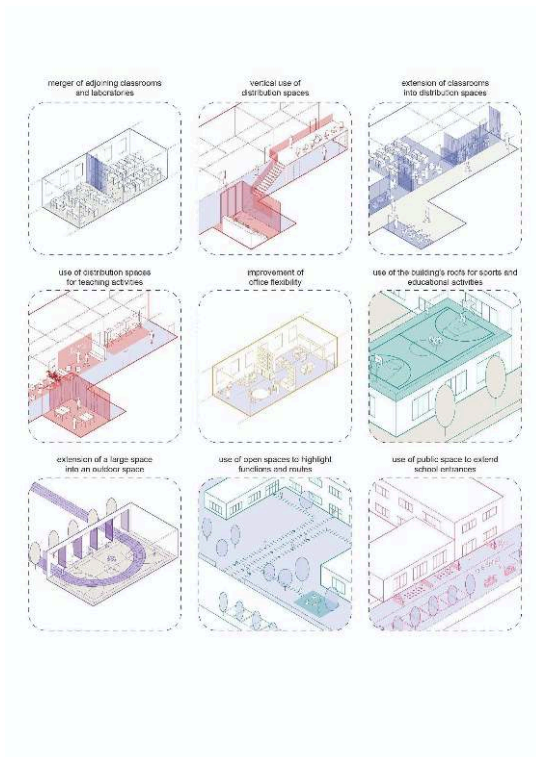
Examples of the transformative potential of specific building elements at the end of the second level of the game
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43   The third level is dedicated to collecting players' opinions on their experience of using school spaces in order to identify main needs and criticalities, and to set priorities for action. The questionnaire is divided into four domains, which outline a series of issues that directly affect the transformation of school spaces: environment, accessibility and safety, educational activities, and urban context. The choice of these four thematic areas therefore serves the goal of creating a framework of needs that allows us to build a guiding matrix for design.[29]

44   At the end of the process, the last section of the web app allows players to access an archive of good practices selected according to the needs they have identified and the specific features of the school they have played with. The catalogue of best practices was built through an extensive analysis of national and international case studies — both construction and renovation projects — which were examined and traced back to specific spatial strategies. The proposed design solutions are therefore interpreted as operational tools: they identify spatial devices that enable certain uses and enhance the potential of school spaces, ranging from light, reversible actions to larger, more costly transformations. Moreover, they extend the scope of design beyond the boundaries of school sites, looking at the context and at neighbouring public spaces. The good practice "cards" can either be consulted depending on all the answers given by players, or further filtered by choosing specific environments, needs and potentials.

Figure 6. Best practices cards
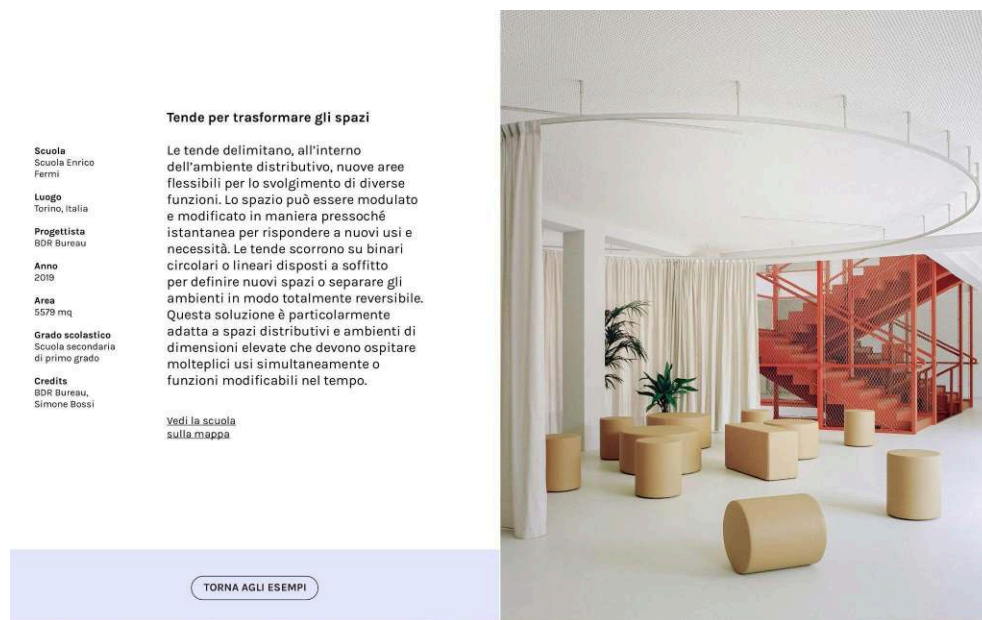
Example of a best practice card obtained at the end of the game, "Curtains to transform spaces" Translation: "School: Scuola Enrico Fermi / Location: Turin, Italy / Project: BDR Bureau / Year: 2019 / Surface: 5579 sq. m / School grade: Secondary school / Credits: BDR Bureau, Simona Bossi / Curtains to transform spaces. Curtains delimit new, flexible areas in transition spaces to perform different functions. Space can be modulated and changed almost instantaneously to meet new uses and needs. The curtains slide on circular or linear tracks on the ceiling to create new spaces or separate rooms in a totally reversible way. This solution is particularly suitable for transition spaces and large rooms that must simultaneously accommodate multiple uses or functions that can be modified over time."

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45   At the end of the game, players can download a summary report of all the main stages of the game and share their school's results via the main social media channels. The aim is for players to use the report not only to keep track of what they have learned about their school, but also as a document that can be shared and discussed with other actors in the decision-making processes.

Towards Form-Driven Regeneration of Italian School Infrastructure: Criticalities and Perspectives

46   The challenge today is not only to renovate school building heritage, but also to redefine the ways of acting on and managing this public asset, integrating bottom-up initiatives with top-down local strategies.

47   The Re-school web app is designed to facilitate the interaction between its users and other actors involved in the spatial transformation of the built environment. This interaction is possible at least on three levels.

48   The first one considers the community of students and teachers as enablers of transformation. Through the web app, students and teachers can launch surveys regarding the perception of school spaces by a given group of people (e.g. one class, one cohort), examine priorities, identify alternative design proposals, and hopefully start a democratic process to discuss potential transformations of the built environment. This

may not lead to an actual change in the spatial layout of the school building, but it could support students experiencing a democratic and technical process and/or trigger soft changes — such as furniture rearrangement within existing spaces.

49   The second level is related to the management of the school. School Principals can use the web app to have an overview of the main needs and transformation potentials of the school building(s) they are managing, thus evaluating ongoing projects — are they living up to those potentials or not? — or starting new ones. Results from the web app can therefore be used as a starting point for the drafting of design proposals to address local authorities — e.g. municipalities, which in Italy are the owners of primary and secondary school buildings —, and to inform the discussion with professionals for possible regeneration projects.

50   The third level concerns territorial strategy. Local authorities can use the app to collect and compare data regarding the school buildings they are managing with the aim of tuning territorial policies — e.g. in terms of distribution of funds and evaluation of contingencies.

51   In light of the possibilities opened up by the Next Generation EU funds, the Re-school project raises some questions which are worth considering as we draw to a close.

52   Firstly, the need to invest in the digitalisation, codification and integration of data was made evident in the course of the work. This would allow us not only to refine the level of detail and the quality of the interpretation of data available at present, but also to enrich existing databases with other types of information and reports. In particular, research has highlighted the importance of supplementing quantitative data with insights concerning the architectural-formal characteristics of each environment and/or with knowledge produced by the school communities that experience the spaces on a daily basis.

53   In this context, the aggregated data collected by the web app can spot inequalities in the way school communities experience the space of their buildings and, in doing so, bring to the fore some issues that cannot be pointed out through the use of existing databases like ARES. Indeed, ARES can provide an important understanding of objective elements, such as a deficit in buildings' safety or a lack of adequate spaces for educational activities, but it gives little or no indication when it comes to addressing subjective experience. The detection of "experience inequalities" is a hypothesis of the Re-school research that could only be verified with a large number of interactions with the web app, which has not yet been achieved.

54   Secondly, regarding the actual construction and maintenance conditions of the existing school building stock, the picture that arises from research is the opposite. Indeed, the inertia of architecture to adapt to the evolution of educational models and regulatory requirements is balanced by the presence of significant spatial resources — such as large transition spaces or green areas. Both represent common preconditions for the regeneration of existing heritage.

55   Furthermore, the urban and public role of schools raises the issue of capturing both the physical and territorial aspects of spatial weaknesses and potential. In this perspective, identifying recurring *types* can be a useful way to produce a description of the Italian educational infrastructure that could possibly contribute to tackling the current challenges with context-sensitive strategies. To this end, this article proposes an operative reinterpretation of "typology," disassembled into a series of essential and

interconnected "ingredients." This allows us to simultaneously increase the level of simplification and communicability of the analysis, and to describe more precisely the complexity of building compounds, also with regard to their local context. The use of a vocabulary based on simple and intuitive spaces and concepts can, on the one hand, help all the actors involved become familiar with technical language and with the understanding of spaces: it is easier to observe a building by analysing its parts than as a whole. On the other hand, the great variety of possible combinations also makes it possible to describe schools with "hybrid" characteristics more accurately and, consequently, to obtain greater precision in identifying their spatial potential and possible strategies for action.

56   Finally, it is crucial to provide the stakeholders involved with shared tools to support the decision-making and design process. Research shows the particular interest in using space as a common documentary basis and shared language, to develop analyses and transformation strategies in a flexible design perspective. By endowing stakeholders with methodological, digital and operational tools for managing the design process at different levels — from the definition of a territorial strategy to the drafting of calls for tenders — the regeneration of school building heritage could become a valuable opportunity for the co-construction of multi-scalar governance systems aimed at promoting and guiding the development of public welfare infrastructure in the short and long term.

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5. Interministerial decree 11 April 2013, Norme tecniche-quadro, contenenti gli indici minimi e massimi di funzionalità urbanistica, edilizia, anche con riferimento alle tecnologie in materia di efficienza e risparmio energetico e produzione da fonti energetiche rinnovabili, e didattica indispensabili a garantire indirizzi progettuali di riferimento adeguati e omogenei sul territorio nazionale.

6. These norms are summed up in the Decree of the President of the Republic of 6 June 2001, n° 380, Testo unico delle disposizioni legislative e regolamentari in materia edilizia.

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11. It specifically refers to the resources allocated by the Budget Law 2020 and Legislative Decree 19 May 2020, n° 34 and subsequent amendments and additions: Misure urgenti in materia di salute, sostegno al lavoro e all'economia, nonché di politiche sociali connesse all'emergenza epidemiologica da COVID-19.

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13. Ministero dell'Istruzione, *op. cit.*, p. 4, translated by the authors.

14. The project was developed within the framework of the FISR's (Fondo Integrativo Speciale per la Ricerca) call for proposals, funded by the Ministry of University and Research in 2020. The web app — currently in beta version — is available online at reschool.polito.it.

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ABSTRACTS

Italian school infrastructure is a multi-layered and diversified spatial asset which requires systemic rethinking in order to respond to evolving educational, energy and health needs. This has become evident not only as a consequence of the Covid-19 emergency, but also due to demographic and educational changes that have taken place over the years. The objective of the present work is to outline a methodological approach aimed at promoting agency within local communities and defining regeneration priorities and strategies through the co-construction of shared spatial knowledge. In a context in which tools and funds for a substantial renovation of the Italian public infrastructure are and will be available, the article explores the theoretical framework that enabled the implementation of a specific design tool — a web application — as a replicable operative model for school regeneration and describes how its prototype was built. More precisely, the web app is aimed at supporting and empowering the actors entrusted with governing the transformation of schools by identifying spatial resources and potentials. To this end, typological classification based on the current spatial characteristics of the buildings is assumed as a way to highlight the transformation potential of schools and to outline intervention priorities at a regional level. Drawing on the concept of spatial agency, the physical space of schools is therefore conceived as a shared documentary basis for the development of multi-scalar governance systems.

L'infrastructure scolaire italienne constitue un patrimoine spatial stratifié et diversifié, qui nécessite une révision systémique pour répondre à l'évolution des besoins éducatifs, énergétiques et sanitaires mis en évidence non seulement par l'urgence pandémique mais aussi par les changements démographiques et pédagogiques des dernières années. L'objectif de cet article est de définir une approche méthodologique visant à favoriser la capacité d'agir des collectivités locales et à définir des priorités et des stratégies de régénération par la co-construction de connaissances spatiales partagées. Dans un contexte politique et financier qui offre l'occasion pour une restructuration substantielle de l'infrastructure publique italienne, le texte explore le cadre théorique qui a permis la mise en œuvre d'un outil de conception - une application web - comme modèle opérationnel reproductible pour la régénération des écoles et décrit la réalisation de son prototype. Plus précisément, l'application web développée dans le cadre de la recherche vise à soutenir et à habiliter les acteurs chargés de la transformation des espaces scolaires par l'identification des ressources et potentiels spatiaux. À cette fin, un système de classification typologique basé sur les caractéristiques spatiales actuelles des bâtiments est utilisé comme un moyen pour mettre en évidence le potentiel de transformation des écoles et

pour définir des priorités d'intervention à l'échelle régionale. À partir du concept d'« agentivité spatiale », l'espace physique des écoles est donc conçu comme une base documentaire partagée pour le développement de systèmes de gouvernance multi-scalaires.

INDEX

Mots-clés: Espaces éducatifs, Agentivité spatiale, Typologie, Régénération urbaine, Potentiel de transformation
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