TECNOLOGIE PER L'APPRENDIMENTO NELLA SCUOLA IN OSPEDALE: IL RUOLO DELL'IA E DELLA GAMIFICATION NELL'INNOVAZIONE EDUCATIVA

TECHNOLOGIES FOR LEARNING IN HOSPITAL SCHOOLS: THE ROLE OF AI AND GAMIFICATION IN EDUCATIONAL INNOVATION

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ABSTRACT

The Hospital School represents a valuable educational response in moments of vulnerability of students, ensuring continuity of training and inclusion during hospitalization. However, this context faces challenges related to the discontinuity of the paths, the unpredictability of the demand and the fragility of the students. This contribution analyzes these pedagogical, organizational and relational criticalities of the School in Hospital, proposing the integration of innovative tools in the teaching action to strengthen the engagement and well-being of students.

La Scuola in Ospedale rappresenta una preziosa risposta educativa nei momenti di vulnerabilità degli studenti, garantendo continuità formativa e inclusione durante la degenza. Tuttavia, tale contesto si confronta con le sfide legate alla discontinuità dei percorsi, all'imprevedibilità della domanda e alle fragilità degli studenti. Il presente contributo analizza tali criticità pedagogiche, organizzative e relazionali della Scuola in Ospedale, proponendo l'integrazione nell'azione didattica di strumenti innovativi per rafforzare l'engagement e il benessere degli studenti.

KEYWORDS

Hospital Schools, Gamification, Artificial Intelligence, Innovation, Inclusion
Scuola in Ospedale, Gamification, Intelligenza Artificiale, Innovazione, Inclusione

1.   The Hospital Schools: challenges for a quality service

The Hospital School represents one of the most complex and meaningful expressions of the right to education: in moments of extreme vulnerability, such as long hospital stays, often marked by emotional, cognitive, and social difficulties brought on by a diagnosis, it plays a fundamental role in ensuring continuity in educational paths and in preserving a sense of normality and stability (Pini et al., 2019). However, this service is confronted daily with a reality full of critical issues and unresolved challenges, many of which remain underexplored and involve both the students and the teachers who work in these contexts.

An analysis of the most recent data provided by the Italian Ministry of Education and Merit confirms a general trend of growth in the Hospital School system, though with some significant fluctuations. In the 2023/2024 school year, there are 254 hospital sections active, involving 62,812 students and 998 teachers. The previous year, 2022/2023, recorded a slightly higher number of sections (257), but a lower number of both students (59,226) and teachers (955). Looking at medium-term data, a steady growth is apparent: in the 2021/2022 school year, 43,243 students accessed the service, distributed across 257 sections with 955 teachers, while in 2016/2017 there were 245 sections, serving 58,049 students with the involvement of 784 teachers. This trend confirms a strengthening of the service in terms of territorial coverage and professional resources. However, the variability in the number of students highlights the unpredictability of demand and, consequently, the urgency of adopting flexible organizational models capable of adapting to emerging needs and varying levels of demand. Additionally, the slight decrease in the number of sections recorded over the past two years suggests the need for careful monitoring of local dynamics and resource allocation policies.

From a pedagogical perspective, these features translate into significant and often complex challenges, linked both to organizational difficulties and to the inherent fragility of the medical and hospital context. One primary challenge emerging from the preliminary analysis of Hospital School data relates to the difficulty of designing systematic, long-term interventions. Whereas in mainstream school settings the most reported issue is the discontinuity of support teachers, resulting in students experiencing frequent changes, in hospital contexts the opposite phenomenon occurs: teachers are unable to predict, year to year, either the number or the characteristics of the students they will serve.

Other challenges are particularly related to the emotional, cognitive, and social difficulties that hospitalization, especially when prolonged, brings with it. Recent scientific literature highlights how long-term hospital stays often lead to social

isolation, loss of daily routines, reduced opportunities for social interaction, and a progressive decline in motivation. In such contexts, education may risk being perceived as secondary to medical needs, as emphasized by St Leger (2014), whose study points to a deep tension between the clinical and educational perspectives. From a strictly didactic standpoint, hospitalization can also create substantial learning barriers (di Padova, Dipace, Pettoello-Mantovani, 2023; Hay et al., 2015): not only the social isolation and loss of relational dynamics typical of school life, but also the difficulty in maintaining a sense of belonging, the sharp decline in motivation, and the erosion of self-efficacy due to the hospital environment and the procedures associated with illness. These factors can lead to dysfunctional behaviours linked to emotional fatigue and frustration.

Another critical aspect concerns the delicate process of personal and family "resymbolization" that follows a diagnosis and the resulting changes in family life (Pavone, 2009). During this period, families must develop resilience strategies to move beyond an initial state of immobilization and redefine their roles and expectations (Amatori, 2019a, 2019b, 2020). This process is even more delicate in new life contexts, such as prolonged hospitalization due to illness (Azevedo et al., 2019). Furthermore, families must engage with medical professionals and healthcare workers in a triadic relationship that presents unique challenges (Kanizsa, 2013). This dynamic can have significant educational repercussions: families may experience difficulties in collaborating with the school due to feelings of disorientation, powerlessness, or, conversely, an excessive delegation of responsibility (Palomino & Sanchez, 2017; González et al., 2013). Teachers must be able to recognize and competently manage these complex relational dynamics to foster constructive dialogue with families and to promote their sense of belonging to a broader school community.

From an operational standpoint, teachers face numerous daily challenges in delivering quality educational services. The variability in students' clinical conditions, the unpredictability of hospital stay duration, and the structural and time-related limitations of the hospital environment make lesson planning extremely difficult. Teachers often lack adequate information about the student's academic background and cannot plan in advance the most effective educational interventions. This undermines the ability to design truly personalized learning paths aligned with the curriculum and appropriate to the student's skills and competencies.

Another major challenge concerns the relational dimension. In an environment that can be perceived as alienating, marked by rigid clinical procedures and high emotional stress, the teacher may be the student's only link to the outside world

and to the school life they have lost due to hospitalization. The educational relationship in hospital settings is often individual: in most cases, the teacher-student relationship is one-on-one, a condition that allows for highly personalized instruction but also demands significant adaptability from the teacher. The teacher must be able to build a relationship of trust, recognize the student's emotions, respect their pace, and guide them through a journey that involves not only learning but also care and support. This requires a conception of teaching that differs profoundly from that of mainstream schools and involves a professional profile that diverges significantly from the traditional model.

This brings to light critical questions about what happens beyond the period of hospitalization. On one hand, there is a clear evolution in terms of institutional recognition, evidenced by the growing number of hospital sections and national service coverage. On the other, the complex scenario described so far does not always effectively address the pedagogical and educational challenges at stake, risking turning the hospital experience into a significant rupture in the student's educational journey.

2. Beyond the Hospital School: which horizons?

Although the Hospital School can offer an extremely protective, flexible educational environment that is particularly attentive to the needs of each and every student, it necessarily represents a transitory dimension. Once hospitalization ends, students are called to return to their original schools or to continue their educational journey in other, sometimes still unstable, contexts. It is in this transitional phase that new critical issues strongly emerge, requiring careful, and indeed pedagogical, reflection. Returning to school is far from being a mere logistical step; rather, it is a highly delicate process of identity, academic, and relational reintegration that involves the entire educational system.

The significant emotional and social imbalance described previously can, in some cases, have considerable consequences in terms of schooling. Prolonged and repeated hospitalizations may lead to significant difficulties when re-entering school (Fotheringham, 2021), as well as an increased risk of school dropout (di Padova et al., 2023; Emerson et al., 2016; French et al., 2013). Other studies (Conley & Bennett, 2000; Haas & Fosse, 2008) have shown that students who experience repeated hospitalizations and disruptions in school routines are less likely to complete compulsory education or access higher education.

At the end of their hospital experience, many students experience ambivalent feelings: on one hand, the desire to return to normalcy and reintegrate into their

peer group; on the other, the fear of not being understood and of feeling different from others (di Padova et al., 2023). A lack of adequate support during this delicate phase can lead to confusion and anxiety, triggering a sense of rejection toward returning to the original school. Furthermore, discontinuity in learning pathways and a potential lack of understanding from classmates or teachers may deepen the sense of alienation experienced by the student during hospitalization, further hindering the reconstruction of their academic and social identity.

In this scenario, it becomes essential to design structured reintegration strategies starting from educational and instructional practices within the hospital setting. Such practices should actively involve families, home schools, teachers, and any support staff, with the goal of maintaining students' sense of belonging to the school community and fostering a sense of self-efficacy that can support them through transitions typical not only of development but also of educational pathways. It is crucial to consider not only formal learning outcomes but also the experiences and personal resources developed by the student during hospitalization. Reintegration should be planned through flexible pathways, personalized reintegration plans, mediation actions with the class, and opportunities for individual support and listening.

However, for such strategies to be truly effective, the active role of teachers is indispensable, as they are central figures in ensuring educational continuity both during and after hospitalization. The teacher in the Hospital School plays a unique role, one that requires specific professional competencies. Hence, the strong need emerges for a rigorous pedagogical reflection on the initial and ongoing training of teachers working in hospital settings, beginning with the crucial role these professionals play in ensuring continuity and accessibility during the most vulnerable periods of a student's school life.

3.   The role of teachers in Hospital Schools

The teacher working in the Hospital School is called upon to fulfil a highly specialized role, one that significantly diverges from the traditional teaching profile found in mainstream educational settings. Their educational work takes place in a context deeply marked by vulnerability, discontinuity, and the need to reconcile, on a daily basis, educational demands with caregiving needs. This entails a range of complex and unique professional challenges, spanning from pedagogical and didactic matters to emotional and social dynamics. It is no coincidence that the literature refers to a constant balance between educating and caring, which

requires relational sensitivity, operational flexibility, and a solid pedagogical foundation (di Padova, Dipace, Pettoello-Mantovani, 2023).

The complexity of the role is evident first and foremost in the ability to adapt educational practices to ever-changing medical conditions. Teachers must be able to tailor content, teaching methods, and timing based on the student's physical and psychological state, considering ongoing treatments, periods of fatigue, or emotional vulnerability. Lessons are often conducted individually and in spaces that are not particularly suitable, such as hospital rooms or shared clinical environments, where the educational dimension physically coexists with the medical one. In this context, the teacher is often the student's only school contact, acting as the guardian of educational and relational continuity, and restoring a sense of normalcy to a daily life disrupted by illness.

The teacher-student relationship typically assumes an individualized (1:1) configuration. On the one hand, this allows for a high degree of personalization; on the other, it requires great adaptability and the ability to manage the unexpected. The teacher must be able to recognize non-verbal cues, adapt the educational approach in real time, and suspend or modify learning objectives based on the student's clinical or emotional condition. In this sense, the professionalism of hospital teachers is grounded in profound relational and personal competencies.

This relational dimension also extends to collaboration with families and healthcare teams. The teacher is expected to work alongside a range of professionals, doctors, nurses, psychologists, social workers, contributing to the creation of an educational environment that considers the student's overall situation in light of their life project. At the same time, the teacher must establish a constructive dialogue with families, who are often disoriented or overwhelmed by the burden of illness, and act as a mediator between the hospital school and the home school. This bridging role is crucial for ensuring coherence in learning pathways and facilitating reintegration into school, preventing educational gaps, duplications, or discontinuities.

Another particularly delicate aspect of hospital teaching is the capacity to restore a sense of everyday normality, which is fundamental to the student's psycho-educational balance. Long-term hospitalization causes a rupture in school, social, and family routines, replaced by new rituals dictated by clinical rhythms, treatments, and the hospital environment. The teacher must therefore recreate an educational routine, not merely by presenting academic content, but by building meaningful, recognizable, and stable moments in the child's daily life. This process requires careful integration of school habits with hospital routines, in a dynamic

and personalized balance that considers both clinical conditions and the student's need for continuity and predictability.

Added to this is the complexity of supporting the student through transitions, not only those related to returning to school, but also those linked to development, growth, and critical phases connected to illness. The teacher must be able to accompany the student through delicate developmental transitions, integrating them with the challenges posed by treatment processes. In these situations, the teacher acts as a mediator and facilitator during transitions, offering a symbolic and relational space where the student can process complex experiences, strengthen their identity, and maintain a sense of future-oriented planning.

In this context, the teacher's ability to propose stimulating, motivating, and engaging educational activities becomes strategically important. The hospital environment, by its very nature, can generate isolation, passivity, and demotivation. To counter these risks, it is essential that the teacher can design learning experiences that spark interest, activate personal resources, and rebuild a positive connection with learning. This requires advanced methodological skills, as well as a willingness to experiment with alternative languages and innovative tools. Ultimately, the challenge is to transform a fragile context into a generative space, one in which illness does not erase the desire to learn and to belong.

4.   Artificial Intelligence and Gamification: potential for teaching in Hospital Schools

Within the delicate and complex educational landscape described so far, the integration of emerging technologies to support engaging and stimulating teaching has become a real necessity. Digital tools, when consciously designed and used, can help compensate for the limitations of the hospital context, facilitate access to educational content, sustain student motivation, and offer flexible, personalized, and inclusive learning experiences. In this perspective, Artificial Intelligence (AI) and Gamification emerge as strategic allies for educators, particularly in highly vulnerable educational contexts such as the Hospital School.

In recent years, Artificial Intelligence has shown increasing potential in the field of education, especially due to its ability to personalize and adapt teaching to the individual characteristics and needs of each student. According to recent studies, AI can serve as a valuable support for both students and teachers, providing tools capable of monitoring learning progress, suggesting alternative learning paths, offering content adapted to comprehension levels, and delivering real-time feedback (Amatori et al., 2024). This is particularly useful in vulnerable settings like the Hospital School, where it can ensure greater adaptability of educational content

and interventions in a timely and precise manner, allowing teachers to focus more on other critical aspects of the educational relationship.

For students, AI also enables the creation of educational experiences within safe and motivating environments (Amatori et al., 2024), which can help reduce cognitive and emotional overload, especially in situations marked by isolation and emotional fragility. Through digital tutors and adaptive platforms, it becomes possible to ensure educational continuity even in the absence of face-to-face lessons, strengthening the sense of participation and maintaining a connection with school pathways. The ability to access content in a personalized and flexible way can allow students to progress at their own pace and according to their psychophysical condition, supporting their sense of self-efficacy and reducing the risk of isolation.

From the teacher's perspective, AI can be seen as a valuable partner in instructional design, offering tools to track progress, analyse educational needs, and identify the most effective strategies. It enables the collection of useful data for personalizing interventions, provides immediate feedback, and simplifies repetitive or complex tasks, freeing up more time and energy for educational relationships and personalized care.

Equally important is AI's role as Assistive Technology (AT). In this function, it contributes to making learning materials more accessible and usable, facilitating participation even in the presence of sensory, motor, or cognitive barriers. It does so through tools such as text-to-speech, automatic transcription, content summarization, contextual translation, or simplified visualization.

Alongside Artificial Intelligence, Gamification is establishing itself as another strategic tool for building engaging learning environments, particularly in situations where motivation to study is compromised. Gamification is based on the integration of playful elements (challenges, rewards, points, narratives) into non-game contexts, such as education, with the aim of increasing student engagement and transforming learning into an active, immersive, and stimulating experience (Gaggioli, 2022; Toda et al., 2023).

In hospital settings, where daily life is shaped by objective difficulties, psychological vulnerability, and social isolation, the integration of game dynamics into teaching and learning processes proves especially effective. Gamification can help counter the sense of passivity and marginalization that often accompanies long hospital stays, restoring to the student an active role in the learning process.

In particular, embedding educational activities within gamified environments makes it possible to harness the key features of play-based experiences, such as progression, understood as the gradual increase of difficulty and content, continuity, meaning the coherence between activities and a sense of advancement, and challenge, which stimulates active engagement and perseverance. When integrated with pedagogical rigor and coherence, these elements can contribute to

the design of more engaging, accessible, and personalized learning experiences that sustain curiosity and the desire to learn.

Moreover, the flexible and modular nature of gamified platforms suits the changing conditions of hospitalized students, who can access content based on their state of health, choose participation modes aligned with their energy levels, and perceive a sense of achievement even during short sessions. In this scenario, the teacher's role in the design phase is complemented by that of an educational game designer, capable of calibrating the level of challenge, supporting intrinsic motivation, and valuing the achievements attained.

The immersive and deeply engaging dimension provided by both Artificial Intelligence and Gamification offers hospital-based education a flexible and effective response to the complexity of special educational needs. These technologies do not replace teaching but instead enhance the educational relationship, making learning a more accessible and meaningful experience, especially in contexts where it may seem marginal or secondary.

5. Conclusions and research perspectives

The reflections carried out so far clearly highlight how the Hospital School represents one of the most challenging educational settings, yet also one of the richest in terms of pedagogical innovation and inclusion. It concentrates many of the critical issues that currently affect the education system: the unpredictability of learning pathways, the need for personalization, the fragility of educational relationships, and the challenge of combining care and learning. Yet it is precisely from these difficulties that new visions of schooling can emerge, ones that are better able to adapt to the complexities of the present and to meet the needs of the most vulnerable students.

The structural issues that have emerged, such as the lack of specific training and the difficulties in ensuring educational continuity, continue to impact the Hospital School and call for structured interventions involving educational, healthcare, and training institutions.

At the same time, the centrality of teachers in building meaningful and personalized learning environments within hospital settings has become evident. The hospital teacher emerges as a hybrid figure, capable of supporting students through transitions, building trust-based relationships, and enabling, through teaching, a reattribution of meaning even in particularly difficult life moments. Investing in the initial and ongoing training of hospital teachers is therefore a priority to ensure quality, equity, and accessibility within the education system.

As already discussed, Artificial Intelligence and Gamification, when guided by a solid pedagogical framework and carefully designed for vulnerable contexts, can

offer new opportunities for personalized teaching, active student participation, and the overcoming of learning barriers. Their use in the Hospital School can support teachers in their work and also enhance students' motivation, engagement, and well-being, helping to counteract the isolation and demotivation that often accompany extended hospital stays.

These premises give rise to new questions and research perspectives that deserve further exploration. First and foremost are the challenges related to the application of Universal Design for Learning in emerging and still underexplored contexts, which involve unique and complex challenges. In the specific case of the Hospital School, it is necessary to reflect on how to provide multiple means of engagement, representation, action, and expression in an educational and social environment marked by significant constraints. AI and Gamification have been shown to be powerful tools within the UDL framework, but they require rigorous design and a mindful implementation in teaching practice.

Furthermore, it is important to systematically investigate the impact of educational technologies in hospital settings, with particular attention to issues of inclusion, sustainability, and educational relationships. Since, as noted, the Hospital School has unique features requiring specific solutions, it is necessary to explore the benefits and integration methods of Artificial Intelligence and Gamification in teaching, while focusing on the typical challenges and critical aspects of this context.

Finally, there is an urgent need to explore the most effective ways of training and professionally supporting teachers, to provide a high-quality service that effectively meets the specific needs of the students. A broad professional profile is required, one that combines pedagogical awareness with the relational, emotional, and social competencies demanded by medical environments. It will also be necessary to broaden the perspective towards the post-hospital trajectories of students, analysing the factors that facilitate or hinder their reintegration into school and their long-term educational success.

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