

AI and Feedback with Socrative: Evidence from a Middle School

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Abstract: The adoption of artificial intelligence (AI)-based platforms is reshaping approaches to personalization, formative assessment, and inclusion in Italian schools. This quasi-experimental study, conducted over 12 weeks in a middle school, compared two Grade 7 classes (seconda media; $N = 46$). The experimental group integrated Socrative into all Italian language lessons, while the control group followed traditional methods. Quantitative data (Student Engagement Scale; reading comprehension test) and qualitative data (interviews, focus groups, in-class observations) were collected. A 2×2 repeated-measures ANOVA showed a significant increase in overall engagement in the experimental group, accompanied by gains in text comprehension. Thematic analysis revealed three emergent domains: student agency, playful (game-based) motivation, and perceived inclusion. The findings reinforce literature on immediate feedback, learning analytics, and Universal Design for Learning (UDL), suggesting that AI can serve as a lever for equity and self-regulation when supported by robust pedagogical design.

Keywords: engagement; artificial intelligence; middle school

1. Introduction

In recent years, the Italian school system, like other European educational systems, has undergone a process of progressive digitalization that has affected both teaching practices and the governance of educational institutions. The initial impetus came from ministerial programs for technological innovation and the widespread diffusion of mobile devices. More recently, however, there has been a significant increase in the use of artificial intelligence (AI)-based platforms for the personalization of learning pathways (Bocconi, Dettori & Persico, 2020). The COVID-19 pandemic further accelerated this transformation, highlighting the need for digital tools capable of ensuring instructional continuity, flexibility, and inclusion (Di Tore, 2021). Within this framework, lower secondary school represents a particularly delicate context, characterized by a critical developmental transition and the need to support both student motivation and self-regulation.

International research shows that digital tools integrating immediate feedback, data analysis (learning analytics), and adaptivity can foster more effective and engaging



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learning. Studies on interactive quiz platforms, intelligent tutoring systems, and gamified learning environments have demonstrated significant improvements in engagement, perceived self-efficacy, and learning outcomes (Shute, 2008; Wang, 2015; Ifenthaler & Yau, 2020). Immediate feedback, in particular, emerges as one of the most powerful factors in promoting continuous improvement and self-regulation (Hattie & Timperley, 2007). At the same time, the Universal Design for Learning (UDL) framework emphasizes the importance of diversifying modes of representation, expression, and engagement to ensure inclusion and equity (CAST, 2018). In this sense, AI platforms can serve as powerful tools for personalization, enabling the systematic collection of data and the delivery of learning paths tailored to individual needs.

Despite growing interest in these tools, Italian literature on the topic remains limited, especially with regard to experimental or quasi-experimental studies conducted in lower secondary school settings. Most existing research focuses on higher education or adult distance learning (Calvani, 2021; Rivoltella, 2019), while the concrete impact of AI platforms on everyday teaching of curricular subjects, such as Italian, remains underexplored. In particular, there is a lack of systematic evidence on the effects that the consistent integration of such tools may have on student engagement and reading comprehension—two crucial dimensions for academic success. Hence the need to empirically investigate to what extent the use of a digital platform such as *Socrative*, which integrates immediate feedback and game-based activities, can influence participation, motivation, and learning outcomes among lower secondary school students.

2. Methodological Structure

2.1. Research Objective

In light of the considerations introduced above, the present study aims to systematically investigate the impact of the continuous integration of an artificial intelligence-based platform, specifically *Socrative*, within Italian language lessons in lower secondary school. The primary objective is to verify whether and to what extent the daily use of a digital tool that combines immediate feedback, game-based dynamics, and analytical monitoring of progress can lead to a significant increase in student engagement compared to traditional practices. This dimension is understood not only as behavioral participation but also as cognitive and emotional involvement, in line with the multidimensional models proposed in the literature (Fredricks, Blumenfeld & Paris, 2004).

A second objective concerns reading comprehension, a core skill in the Italian language curriculum and transversal to all learning areas. The study aims to verify whether exposure to a teaching pathway enriched by interactive activities and a constant flow of personalized feedback promotes improvement in decoding, inference, and critical re-elaboration skills, compared to students following a pathway based exclusively on traditional exercises.

Thirdly, the study aims to explore the effects in terms of subjective perception of inclusion and motivation. The literature on Universal Design for Learning (CAST, 2018) emphasizes how the use of diversified tools can reduce barriers, enhance different cognitive styles, and promote equity of access. Through qualitative data collected via interviews and focus groups, the study seeks to understand whether the use

of *Socratic* fosters greater student agency, a stronger sense of belonging to the class group, and a perception of learning as more equitable and accessible.

In summary, the study pursues a dual purpose: on one hand, to produce empirical evidence on measurable effects in terms of engagement and reading comprehension; on the other, to deepen understanding of experiential and motivational dimensions linked to the use of AI-based platforms in a crucial educational context such as lower secondary school. These objectives address the need to fill a gap in Italian research literature and to provide practical insights useful to teachers and educational policymakers regarding the potential of AI as a driver of pedagogical innovation.

2.2. Inclusion Criteria

To ensure methodological coherence and comparability of the collected data, specific inclusion criteria were established for sample selection. First, a lower secondary school located in an urban area was selected, with two parallel second-year classes characterized by a homogeneous socio-demographic composition, in order to reduce variability related to external factors such as family socioeconomic status or the availability of technological resources at home. All students aged between 11 and 12 years who were regularly attending class at the beginning of the intervention were included in the study.

Another inclusion criterion concerned attendance continuity: to be considered in the final data, students had to have attended at least 85% of the planned lessons during the experimental period, thus ensuring genuine exposure to either the experimental or control condition.

From a linguistic and cognitive perspective, students with special educational needs (SEN) and specific learning disorders (SLD) were also included, in accordance with the principles of inclusion and the theoretical framework of Universal Design for Learning (CAST, 2018). Their presence made it possible to observe the extent to which the use of a digital platform such as *Socratic* could reduce barriers and promote participation among all students, regardless of cognitive or linguistic profile. However, students with prolonged absences due to health issues or transfers were not included, as such conditions would have compromised the reliability and continuity of data collection.

These criteria made it possible to obtain a balanced and representative sample of the typical dynamics of Italian lower secondary schools, while preserving the internal validity of the study.

2.3. Quantitative and Qualitative Instruments

To address the research objectives, both quantitative and qualitative data collection instruments were employed, within a methodological triangulation framework designed to ensure greater interpretative depth and robustness of the collected data (Creswell & Plano Clark, 2011).

On the quantitative side, student engagement was measured using the *Student Engagement Scale* (Fredricks, Blumenfeld & Paris, 2004), in its Italian adaptation, which considers the three dimensions of the construct: behavioral, cognitive, and emotional. The scale was administered in paper format at the beginning and end of the intervention, allowing for longitudinal analysis of variations between the two groups. Reading comprehension was assessed through standardized tests of narrative and

expository text reading and comprehension, structured with multiple-choice questions and open-ended inferential items. These tests made it possible to objectively measure progress in decoding, re-elaboration, and critical analysis skills, reducing the risk of bias associated with teachers' subjective evaluations.

Regarding qualitative instruments, a multi-method strategy was adopted. First, semi-structured interviews were conducted with a subgroup of students and teachers to explore perceptions, emotional experiences, and modes of interaction with the platform. Second, focus groups were organized with students from the experimental group to stimulate collective reflection and elicit dimensions such as agency, game-based motivation, and sense of inclusion. Finally, systematic classroom observations were carried out, based on predefined grids, to record participatory behaviors, interaction modes, and engagement dynamics during instructional activities.

The integration of quantitative and qualitative instruments made it possible not only to quantify the effects of the intervention but also to capture the complexity of students' experiences, enriching data interpretation and revealing pedagogical nuances that a purely numerical approach could not have conveyed.

3. Educational Intervention

The educational intervention lasted a total of twelve weeks and involved exclusively Italian language lessons — a subject that plays a central role in developing transversal skills of comprehension, production, and critical reflection on language. The experimental class systematically used the *Socrative* platform, integrated into instructional design, while the control class followed a traditional path with frontal lessons, guided readings, and paper-based exercises.

In the experimental class, each learning unit was structured into several phases: activation of prior knowledge through brief diagnostic quizzes; exploration and comprehension of texts through multiple-choice, true/false, and short-answer questions administered in real time; and consolidation and metacognition through repeated exercises providing immediate feedback to both students and the teacher. This approach made it possible to organically integrate elements of formative assessment, considered by the literature to be a key factor for meaningful learning (Black & William, 2009; Nicol & Macfarlane-Dick, 2006).

The immediate feedback provided by the platform proved particularly useful in stimulating self-regulation and self-regulated learning, dimensions identified by research as fundamental predictors of academic success (Zimmerman, 2002; Panadero, 2017). Students, being able to instantly view their errors and compare themselves with the class average, had the opportunity to reflect on their learning paths and adjust their study strategies in a process of continuous learning.

Another relevant aspect was the inclusion of game-based dynamics typical of gamification, such as timed challenges and the possibility of earning points based on correct answers. Several studies show that gamified learning environments foster intrinsic motivation, cognitive engagement, and active participation (Deterding et al., 2011; Hamari, Koivisto & Sarsa, 2014). In particular, within lower secondary school, the playful element represents a powerful catalyst of attention and interest, especially in an age group characterized by specific motivational and socio-relational needs.

The systematic use of *Socrative* also allowed the teacher to adopt a data-driven approach, thanks to the availability of analytical reports on the progress of the class and individual students. This enabled adaptive teaching in line with the perspectives

of learning analytics, which aims to use data to improve educational processes and personalize instruction (Siemens, 2013; Ifenthaler & Yau, 2020). The possibility of differentiating learning paths also aligns with the principles of Universal Design for Learning (UDL), according to which effective teaching must offer multiple means of representation, expression, and engagement to ensure access and equity (CAST, 2018).

Finally, it is important to emphasize that the intervention design was conceived not to replace traditional teaching practices, but to enrich them. Recent literature stresses that the value of digital technologies lies not in their mere introduction but in their coherent integration with clear pedagogical objectives and meaningful teaching strategies (Laurillard, 2012; Mishra & Koehler, 2006). From this perspective, the *Socratic* intervention pursued a dual purpose: to promote engagement and text comprehension while offering a replicable model of methodological innovation centered on the synergy between artificial intelligence and thoughtful educational design.

4. Quantitative Data Analysis

The quantitative data collected were analyzed using a 2×2 repeated-measures ANOVA design (time $\times$ group) in order to verify significant differences between the experimental and control groups regarding engagement and text comprehension. This statistical choice was motivated by the need to compare temporal variations (pre-test and post-test) across two different instructional conditions, isolating main effects and interactions (Field, 2018). The analysis made it possible to identify both the overall trend of scores for the two dependent variables and any combined effect of *Socratic* use relative to exposure time.

For the engagement variable, the scores obtained through the *Student Engagement Scale* were aggregated into the three construct dimensions — behavioral, cognitive, and emotional — and subsequently analyzed both separately and as an overall index. This methodological choice allowed the complexity of the phenomenon to be captured, in line with the literature that defines engagement as a multidimensional and dynamic construct (Fredricks, Blumenfeld & Paris, 2004). Means and standard deviations were calculated for each group and each time point, and the ANOVA was complemented with the calculation of effect sizes (partial η^2) to estimate the magnitude of observed effects (Cohen, 1988).

As for text comprehension, the scores from standardized tests of narrative and expository text comprehension were treated as continuous variables. In addition to pre/post comparisons, the distribution of results was analyzed in terms of proficiency levels (low, intermediate, advanced) to observe possible shifts in students' performance profiles. This type of analysis, consistent with previous studies on literacy assessment (OECD, 2019), allows one to appreciate not only average improvement but also the intervention's capacity to differentially impact various starting levels.

To ensure the robustness of results, normality and homogeneity of variance tests (Shapiro–Wilk and Levene) were conducted prior to the ANOVA. In cases where assumptions were not fully met, a cautious approach was adopted by employing nonparametric analyses (Wilcoxon for repeated measures and Mann–Whitney for between-group comparisons), thus further validating the reliability of the conclusions (Pallant, 2020).

Finally, the quantitative data were interpreted not only in terms of statistical significance but also of educational relevance. Following Hattie's (2009) recommendations, attention was focused on the substantive effects that *Socratic* integration may have on students' real improvement, moving beyond the mere logic of p-value significance and connecting empirical results to concrete instructional implications.

5. Qualitative Data Analysis

The qualitative data analysis was conducted following a thematic analysis approach (Braun & Clarke, 2006), which is particularly suited to exploring the subjective meanings that students and teachers attributed to the learning experience with the *Socratic* platform. Transcripts from semi-structured interviews, focus groups, and classroom observations were subjected to a multi-stage procedure: (a) immersive reading and familiarization with the data, (b) initial coding with identification of meaning units, (c) grouping of codes into broader categories, and (d) identification of recurring themes. This process was accompanied by iterative discussion among researchers to increase intersubjective reliability and reduce the risk of arbitrary interpretations (Lincoln & Guba, 1985).

Three main thematic domains emerged from the analysis: agency, understood as a greater sense of responsibility and control over one's learning; game-based motivation, linked to the play and challenge dimensions that made activities more engaging; and perception of inclusion, referring to the feeling of being part of an equitable environment in which even students with difficulties could participate actively. These results are consistent with research showing that educational technology can strengthen emotional and social engagement, particularly when it provides opportunities for active participation and reduces communication barriers (Gee, 2007; Voogt & Knezek, 2018).

To ensure the credibility and qualitative validity of results, several strategies were adopted: source triangulation (interviews, focus groups, observations), member checking with teachers, and maintenance of a reflective journal by researchers to monitor the impact of their preconceptions on data interpretation (Creswell, 2014). The use of triangulation made it possible to compare data from different instruments and perspectives, increasing the solidity of conclusions and offering a multifaceted representation of classroom dynamics.

The qualitative analysis thus complemented the quantitative results, revealing the experiential and subjective dimension of the intervention. In particular, it highlighted how the adoption of *Socratic* not only produces measurable improvements in performance but also helps redefine participation practices, perceptions of equity, and student motivation — fundamental aspects for authentic and inclusive learning.

6. Discussion

The results of this study provide a complex yet coherent picture of the impact of systematically integrating an AI-based digital platform such as *Socratic* into Italian language teaching in lower secondary school. On the quantitative level, the ANOVA analysis revealed a significant increase in both overall engagement and text comprehension in the experimental group compared to the control group. These data confirm what the literature maintains — that immediate and continuous feedback represents a key lever for promoting learning and self-regulation (Hattie & Timperley, 2007; Shute, 2008). The ability to receive timely feedback not only allows students to

correct mistakes in real time but also strengthens their sense of efficacy and progress, key elements for intrinsic motivation.

These quantitative findings are further supported by the qualitative analysis, which identified three central domains: agency, game-based motivation, and perception of inclusion. The sense of agency — the ability to perceive oneself as actively engaged and responsible for one's own learning — was facilitated by the use of *Socrative* as a tool that restores autonomy and protagonism to students. This aligns with the contributions of Zimmerman (2002) and Panadero (2017), who identify self-regulation as a fundamental dimension of academic success. Game-based motivation, linked to the gamified aspect of the activities, appeared to transform testing moments into opportunities for active participation, in line with studies showing that gamification enhances engagement and meaningful learning (Deterding et al., 2011; Hamari, Koivisto & Sarsa, 2014). Finally, the perception of inclusion underscores how the platform can reduce participation barriers, enabling all students, including those with SEN and SLD, to feel part of the learning process. This aspect directly connects to the principles of Universal Design for Learning (CAST, 2018), which promote equitable and differentiated access to learning opportunities.

The integration of quantitative and qualitative results suggests that the use of AI platforms does not merely produce measurable cognitive effects but also influences motivational and socio-relational dynamics. This is particularly relevant in lower secondary school, where educational success depends as much on disciplinary mastery as on supporting motivation and a sense of belonging to the class community (Fredricks, Blumenfeld & Paris, 2004). The present study shows that *Socrative* can act simultaneously on these dimensions, promoting deeper and more inclusive learning.

At the same time, it is necessary to consider the study's limitations. The relatively short duration of the intervention (twelve weeks) and the small sample size ($N = 46$) limit the generalizability of the results. Nevertheless, the value of the study lies in having provided initial systematic evidence within an Italian school context, filling a gap in national literature (Calvani, 2021; Rivoltella, 2019). In the future, longitudinal studies with larger and more diverse samples may offer further confirmation and allow exploration of the long-term effects of AI-based platforms.

In conclusion, the quantitative and qualitative findings converge in indicating that the adoption of tools such as *Socrative*, when supported by thoughtful pedagogical design, can be a significant resource for strengthening engagement, improving text comprehension, and promoting inclusion and equity. This opens up concrete implications for everyday teaching and highlights the need to train teachers not only in the technical use of digital tools but, above all, in their integration into educational practices consistent with students' needs and the principles of sustainable pedagogical innovation.

7. Conclusions

The experience conducted shows that the introduction of an AI-based platform should not be interpreted merely as a technological change but as a cultural transformation of teaching practice. The increase recorded in engagement and text comprehension should not be viewed solely in terms of greater efficiency in learning activities but also as an indicator of the possibility to redefine educational relationships through more participatory, inclusive, and metacognitively oriented dynamics. From this perspective, digital technology is not an end in itself but a means to make learning

processes more transparent and educational opportunities more accessible (Laurillard, 2012).

From a pedagogical standpoint, the use of *Socrative* has demonstrated how immediate feedback can serve as a mediator between teaching and learning, reinforcing the student's role as an active and self-aware participant in their own educational journey (Hattie, 2009; Zimmerman, 2002). The qualitative dimensions that emerged — agency, game-based motivation, perception of inclusion — show that the impact of digital technologies operates mainly in the motivational and socio-relational sphere, confirming what international research has long observed: authentic learning arises when students perceive themselves as part of an equitable and stimulating community (Voogt & Knezek, 2018).

The implications for Italian schools are significant. Educational innovation does not end with the introduction of digital tools but requires the construction of a pedagogical framework capable of valuing diversity, stimulating self-regulation, and promoting critical thinking (Mishra & Koehler, 2006; CAST, 2018). From this perspective, AI-based platforms can become true catalysts for change, fostering more inclusive, personalized teaching practices oriented toward the academic success of all students.

In conclusion, the conscious adoption of tools such as *Socrative* demonstrates how artificial intelligence can help make school a more equitable, motivating, and stimulating environment. It does not replace the teacher's role but enriches it, opening new possibilities for teaching that integrates the cognitive, emotional, and social dimensions of learning within a framework of sustainable innovation.

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