






# The Effectiveness of Tutor Strategies in Enhancing Students' Learning and Attitudes in Scientific and Humanistic Subjects: An Analysis of Tutor Strategies Within the *Compiti@Casa* Project

Andrea Balbo<sup>1</sup><sup>a</sup>, Alice Barana<sup>2</sup><sup>b</sup>, Giulia Boetti<sup>2</sup><sup>c</sup>, Marina Marchisio Conte<sup>2</sup><sup>d</sup>  
and Sara Omegna<sup>2</sup><sup>e</sup>

<sup>1</sup>Department of Humanities, University of Turin, Via Sant'Ottavio 20, 10124 Torino, Italy

<sup>2</sup>Department of Molecular Biotechnology and Health Sciences, University of Turin, Piazza Nizza 44, 10153 Torino, Italy

**Keywords:** Academic Success, Distance Learning, Digital Learning Environment, Student Motivation, Tutoring.


**Abstract:** The COVID-19 pandemic has increased educational poverty, especially among students from low socioeconomic backgrounds. To address this problem, the *compiti@casa* project, initiated by the University of Turin in collaboration with the De Agostini Foundation, has provided a distance tutoring service for lower secondary school students, i.e., aged between 11 and 14, with learning difficulties. This study examines the effectiveness of tutoring in improving students' learning skills and attitudes by analysing tutors' responses to a final questionnaire they completed for each student they tutored, both in Mathematics and Italian. Specifically, it aims to address two research questions: "What strategies did the tutors consider effective in improving the skills and attitudes of each student?" (RQ1) and "Is the impact of different tutoring practices visible on students' learning approach and personal improvement?" (RQ2). The results show significant improvements in students' motivation, autonomy and confidence, particularly for those who were more actively engaged in an interactive and personalised approach. However, there are difficulties in engaging less motivated students or those with attendance problems. The study concludes by highlighting the importance of personalised teaching strategies to maximise the benefits of tutoring.


## 1 INTRODUCTION


In 2020, in response to the educational fragility exacerbated by the COVID-19 pandemic, the DELTA (Digital Education for Learning and Teaching Advances) research group of the University of Turin, in collaboration with the De Agostini Foundation, launched the project "compiti@casa: curing educational fragility". Funded by the same Foundation, this initiative aligns with the objectives of the Italian NRRP (National Recovery and Resilience Plan) as part of the Next Generation EU programme agreed upon with the European Union to address the pandemic-induced crisis. The NRRP is based on three pillars: digitalisation and innovation,


ecological transition, and social inclusion (Ministero dell'Istruzione e del Merito, 2022). Additionally, the project adheres to the DigCompEdu (Digital Competence Framework for Educators) framework developed by the European Commission's Joint Research Centre (JRC) in 2017 to promote the development of educators' digital competencies.


The broader context shaped by the COVID-19 pandemic caused unprecedented disruptions to education worldwide. School closures affected more than 1.6 billion learners, seriously affecting student learning (Unicef, 2021). Although most countries offered distance learning opportunities, the quality and accessibility of these programs varied widely and only partially replaced face-to-face teaching. By the

<sup>a</sup> <https://orcid.org/0000-0002-2227-7217>

<sup>b</sup> <https://orcid.org/0000-0001-9947-5580>

<sup>c</sup> <https://orcid.org/0000-0001-5329-3378>

<sup>d</sup> <https://orcid.org/0000-0003-1007-5404>

<sup>e</sup> <https://orcid.org/0009-0001-9796-5882>

end of 2021, many schools remained closed, putting millions of children and young people at risk of permanently dropping out of school. Evidence shows significant learning loss, with marginalised students facing the greatest challenges (Unicef, 2021).

The pandemic further deepened educational inequality, compounding economic hardship. Educational poverty - a condition in which young people lack opportunities to fulfil their potential and aspirations - has worsened (Save the Children, 2022). This situation is especially severe for students from low-income families with limited educational attainment (INVALSI, 2021a; Moscoviz & Evans, 2022).

In this context, the *compiti@casa* project was born with the aim of providing remote support to lower secondary school students (in Italy, "Scuola Secondaria di Primo Grado", where students are between 11 and 14 years old) who need help with homework. Specifically, it targets students facing learning difficulties, low autonomy, and lack of motivation, often compounded by socioeconomic disadvantage and the absence of adult support during homework. Its primary goal is to support learning recovery in scientific (mainly Mathematics) and humanistic (mainly Italian, i.e., L1 for native speakers and L2 for others) subjects through digital technologies and the potential of a digital learning environment. In tutoring activities, tutors can adopt different strategies to optimise the students' learning experience, adapting their approach to individual needs. Strategies that can foster effective tutoring include promoting support and interaction, enhancing motivation, supporting autonomy and encouraging active engagement. Strengthening tutor-student trust and friendship, improving concentration and attention and balancing exercises with theoretical learning are other methods that can effectively support struggling students. Interactivity also plays a crucial role in keeping students' attention and fostering more profound understanding.

Given the positive impact of the project in supporting students in their learning path, it has continued to evolve and expand, accessing more students each year and reaching its fifth edition in the 2024/2025 academic year. This paper aims to investigate the effectiveness of tutoring approaches in improving students' skills and attitudes, considering the 2022/2023 edition.

## 2 THEORETICAL BACKGROUND

The literature shows that low academic achievement, especially among students from disadvantaged and ethnic minority backgrounds, is one of the main factors contributing to school dropout (Szabó, 2018). This problem is influenced by both internal factors, such as confidence, self-esteem, motivation, attitude, cognitive style and anxiety, and external factors, such as school environment, family support and socioeconomic status (Hossein-Mohand & Hossein-Mohand, 2023; Raj Acharya, 2017; Fagnani et al., 2020). In this context, the OCSE PISA 2022 survey on equity in education highlighted the importance of ensuring that all students can reach their full potential regardless of their background. In particular, it measured the percentage of 15-year-olds achieving at least a basic level in key subjects: on average, 69% of students in OCSE countries achieved at least a basic level in Mathematics and around 75% in Reading and Science. As Mathematics was the focus of PISA 2022, equity was assessed in this cycle by examining the extent to which socioeconomic status explains differences in student performance in Mathematics. The survey also highlighted other achievement gaps, including those related to gender and immigrant background. It showed that about 31% of the variation in student performance can be attributed to differences in education systems, particularly in terms of organisation, funding and resource allocation (OCSE PISA, 2022). Metacognition, i.e. the ability to reflect, plan, monitor and evaluate one's own learning processes, is a strong predictor of academic success (Hrbáčková et al., 2012). Therefore, addressing aspects such as motivation, self-esteem, self-awareness, the development of metacognitive skills and self-evaluation can positively impact school performance and help reduce the risk of dropping out. In this regard, Dietrichson et al. (2017) sought to examine the effectiveness of academic interventions designed to improve the achievement of primary and secondary school students from low socioeconomic status (SES) backgrounds. Focusing on students for whom at least 50% come from low-income, low-education, or minority households, the review excludes studies on high school and preschool settings to maintain focus on mandatory education. The aim is to provide evidence for policymakers on which intervention types—such as tutoring, cooperative learning, and progress monitoring—are most effective in narrowing the achievement gap between low-SES and higher-SES students. The findings reveal that

tutoring, feedback, and cooperative learning produce positive, statistically significant results in academic performance for low-SES students, though effectiveness varies. The authors highlight the need for further research on long-term impacts and cost-effectiveness, stressing that while these interventions are promising, local factors play a crucial role in their success.

One approach highlighted in the literature for fostering these skills is, as anticipated, tutoring, which is defined as "people who are not professional teachers helping and supporting the learning of others in an interactive, purposeful and systematic way" (Topping, 2000). It is most usually done on a one-to-one basis or in a pair. Tutors could include parents or other adult carers, brothers and sisters, other students from the peer group, and various kinds of volunteers. Then came peer tutoring, a form of tutoring in which individuals from the same peer group, such as classmates or students of a similar age, help each other learn (Topping, 2000). The tutor does not need to be an expert, but it is often helpful if they have slightly more knowledge than the tutee. Peer tutoring is seen as an interactive and collaborative method which promotes learning for both the tutor and the tutee (Topping, 2000).

In this regard, several studies in the literature examine the effectiveness of tutoring in improving students' skills and attitudes throughout their school careers. For example, Pasion (2024) investigated the impact of peer tutoring on the academic achievement of secondary school students in Mathematics, focusing on specific topics such as sequences, polynomials, and polynomial equations. She concluded that peer tutoring significantly improved students' understanding of Mathematics and found a strong positive correlation between the perceived benefits of peer tutoring and students' academic performance.

Gortazar, Hupkau and Roldán-Monés (2024) sought to provide the scientific community with experimental evidence on the effectiveness of an eight-week, fully online Mathematics tutoring programme designed to support disadvantaged children. Specifically, they wanted to measure the programme's impact on academic achievement (Mathematics test scores and grades) and social-emotional outcomes, such as aspirations and self-reported effort. The study concluded that online tutoring significantly improved students' performance in Mathematics, increasing their Mathematics grades by 0.49 SD.

Numerous projects have also been implemented in Italy to combat school failure and promote lower

secondary students' academic success. Among these, the *Fuoriclasse* project (Ambrosini & De Simone, 2015), active for a decade (from 2012 to 2022), offered out-of-school tutoring in the presence of students from disadvantaged backgrounds and at risk of dropping out of school in several Italian regions. The project aimed to intervene both at the cognitive level through peer tutoring and at the motivational, metacognitive and relational levels through workshops and extracurricular activities. The project's integrated approach focused on students, teachers and families and included innovative activities such as motivational workshops and peer education sessions to build self-esteem and increase engagement. *Fuoriclasse* also included school camps, which allowed students to work in non-traditional environments, fostering a sense of belonging and trust in school. This participatory approach not only improved their academic motivation but also strengthened their bonds with the school community. The impact of *Fuoriclasse* was carefully monitored through a quasi-experimental design to verify its effectiveness in reducing dropout rates and increasing students' commitment to education, with results showing increased student motivation and achievement in all participating schools.

Another example is the *Scuola dei Compiti* project (Barana et al., 2017; Giraudo et al., 2014), implemented in Turin from 2013 to 2020 with the support of the City of Turin and in collaboration with the University of Turin. This project provided afternoon sessions in small groups, led by university students as tutors, to support at-risk middle and high school students in various subjects, including Italian, Latin, Mathematics, Science and Foreign Languages. Although the activities were mainly face-to-face, some tutors enriched them with digital resources in a Digital Learning Environment (DLE). Compared to a classical learning environment (Wilson, 1995), i.e. a place where the student is involved and an environment where he/she operates, a DLE indicates a learning ecosystem in which teaching, learning, and the development of competence are fostered in classroom-based, online or blended settings. It is composed of a human component, a technological component, and the interrelations between the two (Barana & Marchisio, 2022). DLEs are provided and managed by a Learning Management System (LMS), which is also responsible for identifying and evaluating learning objectives, tracking the students' progress, and collecting data to monitor the learning process. According to the literature (see, e.g., Barana and Marchisio, 2022), a DLE supports learning through different functions:

- Instructional support: allows teachers and students to design, modify and manage educational resources and activities.
- Access to materials: provides users with accessible learning materials and activities anytime.
- Data collection: collects quantitative and qualitative information about activities, use of materials and participation.
- Data analysis and feedback: processes the data collected and provides feedback to learners on the results achieved and to teachers on designing future activities.

Therefore, they are widely used to support online educational processes, but the literature has shown how they also implement classroom learning (Barana & Marchisio, 2022). In summary, a DLE enables the creation of an interactive and accessible learning environment, supports collaboration between students, and promotes formative assessment, providing feedback to both students and teachers to monitor and improve the educational journey.

As it emerged in the experiences above, tutoring actions are shaped by students' individual needs. In particular, the online tutoring carried out within the *compiti@casa* project can be conceptualised as "student-centred online one-to-one tutoring" (Zhang et al., 2021). Although the structure in our case involves a two-to-one student-to-tutor ratio, the small group format ensures that the intervention remains highly focused on the students, maintaining their needs and learning as the core of the process. Small-group tutoring contexts allow for a more personalised and interactive approach, thereby improving attention and comprehension. The effectiveness of such tutoring models largely depends on the strategies employed by tutors. As highlighted by Zhang et al. (2021), the success of online tutoring is contingent upon adopting teaching methods that actively engage students, foster autonomy, and build a supportive learning environment. These findings align with the principles of student-centred learning, fostering adaptability, confidence, active engagement and autonomy as key factors in enhancing educational outcomes (Ryan & Deci, 2000).

### 3 SETTING AND RESEARCH METHODOLOGY

#### 3.1 The *Compiti@Casa* Project

The *compiti@casa* project (Balbo et al., 2024), which literally means "homework@home", is the result of a collaboration between the University of Turin and the De Agostini Foundation, inspired by the experience of the *Scuola dei Compiti* project (Barana et al., 2017; Giraudo et al., 2014). This initiative pursues several educational objectives: catching up, overcoming learning difficulties, increasing motivation to study, reducing the number of early school leavers and strengthening the skills of the students involved. The intervention includes support for distance learning, divided into four hours per week within a DLE. It is aimed at students from peripheral schools located in contexts characterised by particularly critical issues (Balbo et al., 2024). The project's third edition, covering the academic year 2022/2023, involved approximately 290 students from six different Italian cities (Milan, Naples, Novara, Rome, Palermo and Turin) and 105 tutors. The tutors were students from the University of Turin, adequately trained in innovative methods and technologies for education (Barana et al., 2021) and supported by professors and members of the Delta Research Group. A distinctive element of the project is, therefore, the minimal age difference between tutors, who are undergraduate and master students, and the beneficiary students, who are between 11 and 14 years old. This aspect favours a more empathetic interaction and makes the experience highly formative for both students and tutors (Balbo et al., 2024).

Each group of students typically consists of two—though occasionally one or three—and receives a total of 30 hours of tutoring in scientific subjects (mainly Mathematics) and 30 hours in humanities (mainly Italian, i.e., L1 for native speakers and L2 for others), scheduled over two non-consecutive days per week. Each group is assigned two tutors: one specialised in scientific disciplines and the other in humanities. Tutoring sessions are conducted weekly, with two-hour web conferences per discipline, from February to May. In these meetings, students can receive support in carrying out the homework assigned by their teachers at school, but not only. For many of them, it is also an important opportunity to express their doubts in a more relaxed and non-judgemental environment. This aspect is particularly significant for those who, for lack of time during lessons or due to shyness, are unable to ask questions



or clarify their uncertainties in class. Moreover, these moments allow students to challenge themselves more consciously, confronting their difficulties and learning how to recognise and overcome them.

In the DLE, courses dedicated to both science and humanities subjects are created for each pair of students. Within these courses, students can access a variety of tools useful for their learning. The forum, for instance, is a versatile environment: on the one hand, tutors can use it to communicate service information, such as updates on the calendar; on the other hand, students are encouraged to write to report doubts or problems. This facilitates an open and continuous dialogue, both between tutors and students and between the students themselves.

The DLE also hosts an attendance management system, a tool that allows tutors to record student attendance at each meeting accurately. This system ensures timely monitoring and enables the tutors to check whether the students participating in the project are taking advantage of the opportunity offered.

In addition, teaching materials can be downloaded from each course: concept maps specially created by the tutors to support students in their studies, links to materials already available online, documents prepared during the tutoring sessions, interactive quizzes and materials with immediate feedback to help students assess and consolidate their knowledge (Barana *et al.*, 2019a; Barana *et al.*, 2019b; Barana *et al.*, 2019c; Barana *et al.*, 2020b) and other open educational resources. Interactive materials are particularly valuable, since they can increase the engagement level of students who show a low interest in subjects they are learning (Barana *et al.*, 2020a). This variety of tools and contents contributes to creating a stimulating and flexible learning environment that is adaptable to the different needs of the students.

In addition, the DLE is integrated with BigBlueButton, an open-source web conferencing system that facilitates access to tutoring sessions through its compatibility with major learning management systems. This integration offers significant benefits, such as allowing students to access virtual classes without entering an email address and eliminating the need for manual permissions. Furthermore, students and tutors can participate in the same session, even if they belong to different organisations (e.g. university or school domains). This reduces technical barriers and allows all participants to focus on the learning experience.

The project develops through four main phases:

1. in November, the DLE is prepared, preliminary meetings are held between professors and

organisers, followed by the selection and enrolment of students;

2. in December and January, the teachers are trained through a course on innovative teaching tools and methodologies, the tutors are selected through a public call for tenders, and they are trained;
3. from February to May, the tutoring activities take place, with weekly meetings aimed at the two disciplinary areas;
4. in May, the final event takes place at the University of Turin, representing an opportunity for comparison and exchange between all the participants in the project.

### 3.2 Research Method

At the end of the activities carried out as part of the 2022/2023 edition of the *compiti@casa* project, we collected the answers given by the science and humanities tutors to the final questionnaire about the students they had supported. First of all, each tutor filled in a separate questionnaire for each student assisted, which means that we collected approximately two questionnaires per student, one for Italian (L1 and L2) and one for Mathematics. From the analysis of these responses, in this paper, we set out to answer the following questions:

- RQ1. What strategies did the tutors consider effective in improving the skills and attitudes of each student?
- RQ2. Is the impact of different tutoring practices visible on students' learning approach and personal improvement?

To answer RQ1, the answers to the following open-ended question posed to tutors were analysed: 'Which aspects did you find particularly useful and effective for the student?'. After careful reading, recurring themes were identified, which allowed us to classify the responses according to the main topics covered. When more than one theme emerged in the same answer, they were all considered. Once classified, the frequency of each theme within the responses was calculated to provide information on the aspects that most commonly tutors considered valuable and effective.

Above all, to ensure the reliability of the qualitative analysis, all responses to the open-ended questions were initially analysed by one researcher. A second researcher then independently analysed a subset of the responses. Any discrepancies between the two analyses were discussed in detail, and a third researcher joined the discussions to validate the

coding process. Once agreement was reached on the coding categories, the first researcher analysed the responses again, incorporating feedback from the discussions. This triangulation process helped ensure the consistency and accuracy of the qualitative data. Finally, the frequency of each identified theme was recalculated based on the validated coding categories, providing a more reliable measure of tutors' most commonly perceived effective strategies.

To answer RQ2, the following questions on cognitive and metacognitive aspects were considered. Tutors could respond using a Likert scale of 1 to 5, where 1 is 'Not at all' and 5 is 'To a great extent'.

- [D1] Does the student show motivation?
- [D2] Does the student demonstrate competence in the subject?
- [D3] Does the student demonstrate the ability to learn?
- [D4] Does the student study independently?
- [D5] Does the student show confidence in his/her abilities?
- [D6] Does the student have self-esteem?
- [D7] Does the student identify the real causes of his/her difficulties?
- [D8] Is the student aware of his/her strengths?

Each D-question was asked twice: the tutors answered once considering the beginning of the project and once considering the end of the project. In this way, tutors were asked to reflect on the level of each learner recorded at the beginning and end of the project to highlight the variation in each aspect for each learner. This allowed us to examine the effectiveness of tutoring in improving students' skills and attitudes.

The average of the variations of the ratings for each question was then calculated. Only the scores of students for whom the tutor indicated that they had used a particular strategy during the tutoring were considered. This allowed us to check whether there was a correlation between the strategies used during tutoring and the learning approach and personal improvement of each student, determining which strategies had the most significant impact by correlating their responses with the strategies used. In particular, we will discuss the differences greater than 1 and less than 0.61.

## 4 RESULTS

To answer the research questions, 553 tutors' responses to questionnaires administered at the end of the project were analysed.

In particular, in response to RQ1 ("What strategies did the tutors consider effective in improving the skills and attitudes of each student?"), the key themes in Table 1 emerged after reading the responses to the question: 'What aspects did you find particularly useful and effective for the student?'. The first column contains the keywords representing the tutors' strategies, and the second column describes what we attributed to them.

Table 1: Key terms found within the tutors' answers to the question 'What aspects did you find particularly useful and effective for the student?'

Keywords	Description
[K1] Support and interaction	A set of practices, resources and dynamics designed to facilitate student learning and promote an effective and engaging educational environment.
[K2] Motivation	Reasons and incentives that motivate students to engage in learning and educational activities.
[K3] Autonomy	Support and encouragement aimed at fostering students' responsibility for their own learning, promoting independence and decision-making.
[K4] Engagement	Encouragement of students' active participation in educational activities to foster involvement and enthusiasm.
[K5] Confidence and friendship	Encouraging confidence in students' abilities, tutors, and peers by creating a trusting and supportive learning environment.
[K6] Concentration and attention	Guiding attention, maintaining concentration, and managing distractions to enhance students' ability to focus their thinking and mental energies on a specific task for an extended period of time and direct their senses and cognitive resources to a specific stimulus for a short period of time.
[K7] Exercises and Theory	Conceptual foundations and exercises that enable the practical application of these concepts.
[K8] Interactivity	Use of information tools that 'dialogue' with the user.
[K9] No strategy found	Absence of effective approaches or adequate resources to promote student learning and participation, including lack of interest or high levels of student absenteeism.

Table 2 shows the frequencies with which the key themes were identified in the tutors' answers. The first column contains the keywords, the second column shows the absolute numbers, and the third column presents the percentages relative to the total number of responses analysed. It is important to clarify that the total number of responses shown in Table 2 does not correspond to the total number of answers to the final questionnaire since some messages included more than one key theme. In some cases, tutors even indicated that they used more than one strategy in a single tutoring session. To avoid losing relevant information and to ensure a more complete representation of the content, it was decided to consider each strategy separately, thus increasing the total number of responses. This approach allows us to reflect the variety of responses given by tutors more accurately.

Table 2: Frequencies of key terms within the answers given by the tutors.

	Number of answers	Percent (%)
[K1] Support and interaction	138	18.47
[K2] Motivation	85	11.38
[K3] Autonomy	23	3.08
[K4] Engagement	64	8.57
[K5] Confidence and friendship	83	11.11
[K6] Concentration and attention	22	2.95
[K7] Exercises and Theory	241	32.26
[K8] Interactivity	42	5.62
[K9] No strategy found	43	5.76
Empty answer	6	0.8

The two most used strategies that emerge from the data analysis are "exercises and theory" (K7) (32.26%) and "support and interaction" (K1) (18.47%). The former, representing the most used strategy, highlights the importance of solid practical

and theoretical learning for students. The combination of practical exercises and theory, included under the same keyword as they were always found together within the tutors' answers, allows knowledge to be consolidated and helps to overcome learning difficulties, especially in scientific subjects such as Mathematics. It is important to remember that the primary objective of the *compiti@casa* project is to provide support to students who need assistance in their learning through distance tutoring. Therefore, these results align with the project's main objective of helping students overcome their learning challenges. Support and interaction, on the other hand, respond to the need to create an empathetic and motivating learning environment. Thanks to the proximity in age between tutors and students, the interaction is more natural and favourable, stimulating engagement.

To answer RQ2 ("Is the impact of different tutoring practices visible on students' learning approach and personal improvement?"), we instead looked at the answers to questions D1-D8, where the tutor was asked, considering the aspect investigated in the question, to indicate the level of each student at the beginning and end of the project. This allowed us to calculate each student's difference between the beginning and end of the project and highlight improvements.

The average difference was then calculated for each question, taking into account only the data of those students for whom the tutor indicated that they had used a particular strategy during the tutoring sessions. Table 3 shows the average difference of ratings across the different aspects investigated in questions D1-D8 in relation to the tutoring strategies used (K1-K9). Each cell then indicates the average difference observed in each D-aspect correlated with a specific K-strategy. For example, we can see the relationship between focusing tutoring on K1 (support and interaction) and aspects such as motivation (D1), subject competence (D2), etc.

Firstly, it is interesting to observe that all the values in Table 3 are positive, meaning that all the aspects investigated with the D-questions improved thanks to the project. Looking at the data in the last row, which represents the average of the difference between the initial data and the final data for each keyword, we can see that the tutor strategies based on "confidence and friendship" (K5), "motivation" (K2), and "engagement" (K4) had the greatest effect overall since they result in a higher growth considering altogether the aspects investigated by questions D1-D8 (the growths are 0.91, 0.89 and 0.79 respectively). These results suggest that overall, acting on the

students' motivation and awareness of their abilities significantly impacts learning attitudes.

Table 3: a) Average difference in responses to questions D1-D8 on students' skills and attitudes according to the tutoring strategies (K1-K5) that tutors reported using in the compiti@casa project.

	K1	K2	K3	K4	K5
D1	0.64	0.71	<u>0.57</u>	0.72	0.83
D2	0.72	0.84	0.7	0.86	0.92
D3	0.68	0.68	0.74	0.86	0.84
D4	0.75	0.86	0.87	0.65	0.83
D5	0.85	<b>1.13</b>	0.74	0.88	<b>1.05</b>
D6	0.83	<b>1.04</b>	0.65	0.88	<b>1.01</b>
D7	0.7	0.87	0.74	0.74	0.82
D8	0.83	<b>1.01</b>	<u>0.61</u>	0.75	0.98
Total average	0.75	0.89	0.7	0.79	0.91

Table 3: b) Average difference in responses to questions D1-D8 on students' skills and attitudes according to the tutoring strategies (K6-K9) that tutors reported using in the compiti@casa project.

	K6	K7	K8	K9
D1	<u>0.41</u>	<u>0.54</u>	0.74	<u>0.49</u>
D2	0.77	0.75	0.79	0.68
D3	0.91	0.64	0.69	<u>0.61</u>
D4	0.82	0.65	0.79	0.65
D5	0.73	0.86	0.86	0.78
D6	0.82	0.81	0.71	0.75
D7	0.82	0.7	0.62	0.65
D8	0.77	0.79	0.76	0.75
Total average	0.76	0.72	0.74	0.67

In Table 3, we have highlighted the values greater than 1 in bold, which indicate the higher growths. In particular:

- "Motivation" (K2) and "Does the student show confidence in his/her abilities?" (D5): this suggests that working on motivation tends to make students more confident in their abilities. When students are engaged and motivated in their learning journey, they are more likely to recognise their progress and feel competent (Deci et al., 1991). In the context of *compiti@casa*, students receive personalised support from tutors who guide them through their learning process, which boosts self-confidence and helps students feel

able to face challenges and solve problems with greater confidence.

- "Motivation" (K2) and "Does the student have self-esteem?" (D6): students with whom the tutor has worked on motivation tend to develop a positive self-evaluation, as they are more likely to notice their successes and recognise improvements in their skills. In the *compiti@casa* project, the continuous support from tutors and the structured approach that helps students achieve concrete improvements in academic subjects can contribute to building a positive self-image, which promotes a calm and confident learning experience.
- "Motivation" (K2) and "Is the student aware of his/her strengths?" (D8): students with whom the tutor has worked on motivations tend to be more aware of their strengths as they are more engaged in the learning process and focus on their achievements. With the support of the tutors and the opportunity for regular interaction through the DLE, students in the *compiti@casa* project have the chance to reflect on their progress and continuously recognise and develop their skills. This awareness strengthens their commitment and motivates them to continue growing in both scientific and humanistic subjects.
- "Confidence and friendship" (K5) and "Does the student show confidence in his/her abilities?" (D5): working on students' confidence in their abilities is often linked to the ability to establish positive social relationships. Students who feel confident in their abilities tend to be more open and interact positively with others (e.g., Amerstorfer & Freiin von Münster-Kistner, 2021; Gorsy & Panwar, 2015). In *compiti@casa* tutoring sessions, students work in small groups and receive support from young tutors who are, as mentioned, close to them in age, which creates a more empathetic environment. This facilitates peer interaction and the creation of relationships, contributing to a positive climate that further fosters everyone's confidence in their abilities.
- "Confidence and friendship" (K5) and "Does the student have self-esteem?" (D6): students with whom work has been done to improve self-esteem tend to form stronger friendships because they are able to interact with others in a healthy and positive way. Indeed, good self-esteem allows students to feel more confident



in social interactions, facilitating the formation of stronger and more lasting friendships (see, e.g., El-Daw & Hammoud, 2015). In the *compiti@casa* project, the interaction between students and tutors fosters a supportive environment where relationships can easily develop as each participant feels respected and valued, which also contributes to an improved overall learning atmosphere.

Moving on to analyse the lower values, specifically those below or close to 0.61, underlined in Table 3, we can observe the following relations:

- "Autonomy" (K3) and "Does the student show motivation?" / "Autonomy" (K3) and "Is the student aware of his/her strengths?" (D8): this suggests that although autonomy is an important factor in promoting awareness of one's abilities, the effect does not seem to be particularly pronounced. Students with greater autonomy in learning tend to be more inclined to reflect on their strengths and manage their learning process. However, the results suggest that the student's motivation might be key in this process. Motivated students may be more likely to develop awareness of their strengths, even if they enjoy greater autonomy. Additionally, students' age could affect their ability to self-reflect. Young students may not have fully developed an awareness of their strengths, but students whose tutors have worked on autonomy are more likely to develop this awareness in the future. Furthermore, the context of *compiti@casa*, which provides constant support, may somewhat mitigate the impact of autonomy on self-awareness, as students may rely on their tutors for guidance.
- "Concentration and attention" (K6) and "Does the student show motivation?" (D1): although working on concentration and attention is important for motivation (see, e.g., Anggraini & Dewi, 2022; Suparman *et al.*, 2023), the results suggest that they are not the only elements influencing students' motivation levels. Motivation may also depend on other factors, such as personal interest in the subjects being studied, a sense of competence, or the environment in which the student is placed. For example, if a student does not find the subject interesting or useful and is not engaged, he or she may find it difficult to concentrate (Suparman *et al.*, 2023; Ng *et al.*,

2018). In the *compiti@casa* project, motivation may be influenced more by the relationship with the tutor or the support received than simply the ability to concentrate, including the use of digital activities, highlighting that motivation is multifactorial.

- "Exercises and theory" (K7) and "Does the student show motivation?" (D1): this suggests that working on exercises and theory does not have a strong impact on students' motivation. While it is true that exercises can stimulate interest in a subject, the balance between theory and practice does not always lead to a significant increase in motivation. Motivation could also be influenced by the perception of usefulness or the degree of personal interest in a topic. In the case of *compiti@casa*, motivation may come more from the personalised support and the opportunity to be actively guided by the tutor and from the use of digital activities than from the theoretical or practical approach itself.
- "No strategy found" (K9) and "Does the student show motivation?" (D1) / "No strategy found (K9)" and "Does the student demonstrate the ability to learn?" (D3): These scores suggest that the absence of strategies employed by the tutor to work with the student does not appear to be strongly associated with either motivation or learning potential. It may be the case that students without structured strategies employed by the tutor may still show good motivation or learning potential. Alternatively, it may be that the tutor was unable to identify the proper strategy to implement. It is also worth noting that the answers classified in K9 are also those in which the tutors stated that students showed up little to tutoring sessions or whose students participated with much disinterest (i.e., did not interact with the tutor and peer, did not turn on the webcam, said they had no homework or did nothing at school). This may have led to difficulty for the tutor in identifying and then implementing specific strategies to foster motivation and ability to learn. In addition, if a student has been encouraged by family members or teachers to participate in the project, he or she may not develop effective learning strategies without intrinsic motivation. This could result in a superficial level of engagement with limited active participation because the initiative does not stem from genuine personal motivation. This

type of approach, where pupils are not entirely motivated from within, can also have a negative impact on the quality of learning, especially if the group dynamics or environment does not encourage deeper participation.

An ANOVA test was applied to explore further the effectiveness of those tutoring strategies that have had a greater improvement in relation to the corresponding aspects of students' skills and attitudes in learning (i.e., those highlighted in bold in Table 3). We investigated if there is a statistically significant difference in the students' skills or attitudes between having used or not having used a certain strategy during the tutoring sessions. We divided the answers for each D-question into those in which a particular K-strategy emerged and those in which it did not. We considered the differences of the tutors' ratings in D-questions between the end and the beginning of the project. We then compared the two groups. In this way, the relationships between strategies such as "Motivation" (K2) and "Confidence and friendship" (K5) and specific dimensions of students' development, including confidence in abilities (D5), self-esteem (D6), and awareness of strengths (D8), have been examined. The results are shown in Table 4. In particular, the first column explicates the relation studied. The second column ("mean\_n") shows the average of the differences between the initial and final values for each D-question, considering only those in which the K-strategy studied was not used by the tutor, the third ("mean\_y") instead refers to the D-question values in which the tutor used the K-strategy. The fourth column shows the F-value, and the fifth shows the respective p-value.

Table 4: Results obtained with the ANOVA test to highlight the statistical significance of the relationships between the strategies adopted and the improvements obtained.

	mean_n	mean_y	F	p-value
K2 - D5	0.74	1.13	283.43	<0.001
K2 - D6	0.71	1.04	251.76	<0.001
K2 - D8	0.71	1.01	293.20	<0.001
K5 - D5	0.75	1.05	287.53	<0.001
K5 - D6	0.71	1.01	255.58	<0.001

The p-values, significantly below the conventional threshold of  $\alpha=0.05$ , indicate that the probability of the observed relationships occurring by chance is extremely low. This provides strong evidence of a statistically significant relationship between the tutoring strategies adopted (such as "motivation" (K2) and "confidence and friendship" (K5)) and the specific aspects of students' development analysed (confidence in abilities (D5); self-esteem (D6); and awareness of strengths (D8)). In other words, the results confirm that the strategies implemented during the project had a measurable and meaningful impact on these dimensions of student improvement.

## 5 CONCLUSIONS

In response to the first research question (RQ1) - What strategies did tutors consider to be effective in improving the skills and attitudes of individual students? - the analysis of the tutors' responses showed that the most effective strategies were those based on support and interaction, which aligns with what is suggested in the existing literature. The active involvement of students through practical activities, such as the use of tailor-made exercises, was considered an important aspect by tutors, even though, as highlighted in the analysis of RQ2, such practical activities were not always the most effective in improving aspects like motivation. This discrepancy may suggest that while tutors view these activities as valuable, further reflection on their actual impact on students' motivation is needed. Furthermore, creating an environment of trust and cooperation between tutors and students promoted the development of interpersonal skills and increased students' self-esteem, confirming the findings of previous studies such as those by Pasion (2024) and Gortazar et al. (2024), which had already highlighted the effectiveness of tutoring in improving academic and social performance.

Concerning the second research question (RQ2) - Is the impact of different tutoring practices visible on students' learning approach and personal improvement? - the data collected show a significant improvement in "motivation" and "confidence and friendship", particularly for those who were more actively engaged in an interactive and personalised approach. Analysis of the average difference between the final and initial answers according to the tutoring strategies used by the tutors revealed that "motivation" (K2) and "confidence and friendship" (K5) were particularly prominent. Furthermore, when analysing the relationship between each question

according to the tutoring strategies, 'Does the student show confidence in his/her abilities?' (D5) and 'Does the student have self-esteem?' (D6) emerged significantly. This is in line with metacognitive theories that emphasise the importance of reflection and monitoring one's own learning processes (Hrbáčková et al., 2012). However, in some cases, the effectiveness of tutoring practices was limited by the lack of active student participation, especially when lack of motivation or high absenteeism hindered progress. This confirms the importance of more personalised approaches, as suggested by Hossein-Mohand and Hossein-Mohand (2023), to address the specific needs of struggling students. The statistical significance of the results, supported by the ANOVA test, further validates the positive impact of strategies such as "motivation" (K2) and "confidence and friendship" (K5) on key dimensions of students' personal growth, including confidence (D5), self-esteem (D6), and awareness of strengths (D8). In conclusion, the results of this study confirm that tutoring is an effective tool for improving learning skills and students' attitudes and self-esteem. These results align with studies such as (Gortazar et al., 2024), which demonstrate the potential of well-designed tutoring programs to produce both cognitive and emotional benefits. Additionally, the project's emphasis on relational aspects between tutors and students reflects findings from interventions like the *Fuoriclasse* project (Ambrosini & De Simone, 2015), which helped reduce dropout rates by integrating motivational and relational components into its educational strategies. However, there is still room for improvement, particularly in terms of adapting tutoring methods to better engage less motivated students or those with attendance difficulties. Future studies could explore new ways of making these strategies more flexible and effective, adapting them to the different needs of students and thus maximising the benefits both in terms of learning and personal. One potential avenue is the exploration of advanced technologies, such as artificial intelligence, to further personalise the tutoring experience and provide real-time adaptive feedback.

Despite the positive results, the study has some limitations that need to be highlighted. Firstly, the sample analysed includes a limited number of students and tutors belonging to a specific context, which may reduce the generalisability of the results to other educational contexts. Secondly, the data collected are mainly based on tutors' perceptions, a methodology that, although useful for exploratory analysis, may introduce a subjective bias. Integration with more objective measures, such as school results

or direct observation, could provide a more complete picture of the impact of tutoring.

To overcome these limitations, future research could explore the effectiveness of tutoring in more diverse contexts and larger samples, including more instruments and viewpoints.

## ACKNOWLEDGEMENTS

We thank Fondazione *De Agostini*, IGT, Fondazione *Alberto e Franca Riva*, and Fondazione *Comunità Novarese*, which made it possible to repeat the project in the 2023/2024 school year. We would also like to thank the school principals and teachers who collaborated to develop the project.

Part of the research of this publication is supported by a grant under the National Recovery and Resilience Plan (NRRP), D.M. 118/2023 by the Italian Ministry of University and Research (MUR), funded by the European Union–NextGenerationEU.

## REFERENCES

- Acharya, B. R. (2017). Factors affecting difficulties in learning mathematics by mathematics learners. *International Journal of Elementary Education*, 6(2), 8-15.
- Ambrosini, M. T., & De Simone, G. (2015). *Fuoriclasse: Un modello di successo per il contrasto alla dispersione scolastica*. Fondazione Giovanni Agnelli - Save The Children. <https://www.savethechildren.it/cosa-facciamo/pubblicazioni/fuoriclasse-un-modello-di-successo-il-contrasto-alla-dispersione>
- Amerstorfer, C. M., & Freiin von Münster-Kistner, C. (2021). Student perceptions of academic engagement and student-teacher relationships in problem-based learning. *Frontiers in psychology*, 12, 713057.
- Anggraini, S., & Dewi, S. K. (2022). Effect of Brain Gym in Increasing the Learning Concentration of 6th Grade on Online Learning during the Covid-19 Pandemic. *Malaysian Journal of Medicine & Health Sciences*, 18.
- Balbo, A., Barana, A., Boetti, G., Conte, M. M., & Omegna, S. (2024). Digital Technologies and Their Impact on Metacognitive Aspects in Learning Recovery in Scientific and Humanistic Subjects. *Proceedings of the 18th International Conferences on e-Learning and Digital Learning 2024, ELDL 2024*, 105–112.
- Barana, A., Boffo, S., Gagliardi, F., Garuti, R., & Marchisio, M. (2020a). Empowering Engagement in a Technology-Enhanced Learning Environment. In M. Rehm, J. Saldien, & S. Manca (A c. Di), *Project and Design Literacy as Cornerstones of Smart Education* (Vol. 158, pp. 75–77). Springer.
- Barana, A., Brancaccio, A., Conte, A., Fissore, C., Floris, F., Marchisio, M., & Pardini, C. (2019a). The Role of an

- Advanced Computing Environment in Teaching and Learning Mathematics through Problem Posing and Solving. *Proceedings of the 15th International Scientific Conference eLearning and Software for Education*, 2, 11–18.
- Barana, A., Marchisio, M. and Miori, R. (2019b). MATE-BOOSTER: Design of an e-Learning Course to Boost Mathematical Competence, *Proceedings of the 11th International Conference on Computer Supported Education (CSEDU 2019)*, 280–291.
- Barana, A., Casasso, F., Fissore, C., Marchisio, M., & Roman, F. (2021). Mathematics Education in Lower Secondary School: Four Open Online Courses to Support Teaching and Learning. *Proceedings of the 18th International Conference on Cognition and Exploratory Learning in Digital Age CELDA2021*, 95–102.
- Barana, A., Fioravera, M., Marchisio, M., & Rabellino, S. (2017). Adaptive Teaching Supported by ICTs to Reduce the School Failure in the Project “Scuola Dei Compiti”. *Proceedings of 2017 IEEE 41st Annual Computer Software and Applications Conference (COMPSAC)*, pp. 432–437.
- Barana, A., Fissore, C., & Marchisio, M. (2020b). From Standardised Assessment to Automatic Formative Assessment for Adaptive Teaching. *Proceedings of the 12th International Conference on Computer Supported Education*, 285–296.
- Barana, A., & Marchisio, M. (2022). A model for the analysis of the interactions in a digital learning environment during mathematical activities. In *International Conference on Computer Supported Education* (pp. 429–448). Cham: Springer International Publishing.
- Barana, A., Marchisio, M., & Rabellino, S. (2019c). Empowering Engagement through Automatic Formative Assessment. *2019 IEEE 43rd Annual Computer Software and Applications Conference (COMPSAC)*, 216–225.
- Deci, E. L., Vallerand, R. J., Pelletier, L. G., & Ryan, R. M. (1991). Motivation and education: The self-determination perspective. *Educational psychologist*, 26(3-4), 325–346
- Dietrichson, J., Bøg, M., Filges, T., & Klint Jørgensen, A. M. (2017). Academic interventions for elementary and middle school students with low socioeconomic status: A systematic review and meta-analysis. *Review of educational research*, 87(2), 243–282.
- El-Daw, B., & Hammoud, H. (2015). The effect of building up self-esteem training on students' social and academic skills 2014. *Procedia-Social and Behavioral Sciences*, 190, 146–155.
- Fagnani, G., & Scanu, P. (2020). Emergenza scuola: I bisogni ignorati dei nostri figli nella crisi sanitaria. Il Leone Verde Edizioni.
- Giraud, M.T., Marchisio, M. and Pardini, C. (2014). Tutoring with new technologies to reduce the school failure and promote learning of mathematics in secondary school, *Mondo Digitale*, 13(51), 834–843
- Gorsy, C., & Panwar, N. (2015). Study of self-confidence as a correlate of peer-relationship among adolescents. *International Journal of Education & Management Studies*, 5(4), 298–301.
- Gortazar, L., Hupkau, C., & Roldán-Monés, A. (2024). Online tutoring works: Experimental evidence from a program with vulnerable children. *Journal of Public Economics*, 232, 105082.
- Hossein-Mohand, H., & Hossein-Mohand, H. (2023). Influence of motivation on the perception of mathematics by secondary school students. *Frontiers in Psychology*, 13, 1111600
- Hrbáčková, K., Hladík, J., & Vávrová, S. (2012). The relationship between locus of control, metacognition, and academic success. *Procedia-Social and Behavioral Sciences*, 69, 1805–1811.
- INVALSI. (2021). Le diseguaglianze che non si vedono senza dati per tutti [online]. *INVALSIopen*.
- OCSE PISA. (2022). I risultati degli studenti italiani in matematica, lettura e scienze
- Ministero dell'Istruzione e del Merito (2022). Azioni di prevenzione e contrasto della dispersione scolastica [online]. Futura PNRR.
- Moscoviz, L., & Evans, D. K. (2022). Learning loss and student dropouts during the covid-19 pandemic: A review of the evidence two years after schools shut down.
- Morabito C. (2022). Povertà educativa: necessario un cambio di passo nelle politiche di contrasto. *Save The Children Italia*. [https://s3-www.savethechildren.it/public/files/Poverta\\_educativa.pdf](https://s3-www.savethechildren.it/public/files/Poverta_educativa.pdf)
- Ng, C., Bartlett, B., & Elliott, S. N. (2018). Empowering engagement: Creating learning opportunities for students from challenging backgrounds. Springer.
- PASION JR, O. V. (2024). Benefits of Peer Tutoring in Enhancing Students' Academic Performance in Mathematics.
- Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary educational psychology*, 25(1), 54–67.
- Suparman, T., Anggraeni, S. W., Nurjanah, T., & Cahyaningsih, U. (2023). THE INFLUENCE OF LEARNING MOTIVATION AND LEARNING CONCENTRATION ON UNDERSTANDING OF MATHEMATICS CONCEPTS. *Jurnal Cakrawala Pendas*, 9(1), 153–163.
- Szabó, C. M. (2018). Causes of early school leaving in secondary education. *Journal of Applied Technical and Educational Sciences*, 8(4), 54–76.
- Topping, K. (2000). Tutoring. *Educational Practices Series*-5.
- Unicef. (2021). The state of the global education crisis: a path to recovery: a joint UNESCO, UNICEF and WORLD BANK report. Paris: UNESCO, cop. 2021.
- Wilson, B. G. (1995). Metaphors for instruction: Why we talk about learning environments. *Educational Technology*, 35(5), 25–30.
- Zhang, L., Pan, M., Yu, S., Chen, L., & Zhang, J. (2021). Evaluation of a student-centered online one-to-one tutoring system. *Interactive Learning Environments*, 31(7), 4251–4269.