

Self- and peer-assessment in upper secondary schools. A quasi-experimental study to investigate the educational effectiveness of formative assessment

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Abstract

The assessment of student learning represents a key component of daily instructional practice. Formative assessment strategies are associated with the development and reinforcement of a series of skills linked to cognitive, metacognitive, behavioural and affective areas. This study investigated the effectiveness of formative assessment strategies in supporting the development of students' emotional and motivational capacities, resilience, self-efficacy, self-reflection, metacognitive awareness and self-regulation. Specifically, it examined whether formative assessment strategies could enhance these skills and improve students' academic preparation for a summative mid-term test. This quasi-experimental study involved 581 students from 37 Italian upper secondary school classes in an investigation that tested the use of self- and peer-assessment to support students' improvements in study organisation and effective summative test preparation. Findings indicate that formative assessment activities supported student preparation for a mid-term summative test. Specifically, improvements in emotional attitudes, self-efficacy, metacognitive awareness and aspects of self-regulation related to rehearsal, elaboration and organisation of learning materials were reported.

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The data indicate that this skill development was attributed mainly to the implementation of a peer-assessment strategy.

KEYWORDS

formative assessment, peer-assessment, self-assessment, self-regulation

Key insights**What is the main issue that the paper addresses?**

Formative assessment activities, in secondary schools, can support the students' development of a series of skills linked to cognitive, metacognitive, behavioural and affective areas, such as emotional and motivational capacities, resilience, self-efficacy, self-reflection, metacognitive awareness and self-regulation. By enhancing these skills, students can improve their preparation for a summative mid-term test.

What are the main insights that the paper provides?

Formative assessment activities supported student preparation for summative tests. In particular, data highlighted improvements in emotional attitudes, self-efficacy, metacognitive awareness and aspects of self-regulation related to rehearsal, elaboration and organisation of learning materials. Students perceived peer-assessment activities as more effective than self-assessment ones.

INTRODUCTION

The European Commission (2022), quoting Siarova et al. (2017), reported that to comprehensively assess content, skills and competences, various forms of assessment are recommended. Effective assessment depends on the coordinated and intentional use of diverse assessment methods, tools and types within instructional planning. Teachers' knowledge of and ability to implement assessment strategies are critical to supporting student academic success, developing competencies and creating a meaningful learning environment (Andrade & Heritage, 2017). As each teacher knows, assessment is a complex concept; consequently, a multifaceted approach to classroom assessment is necessarily composed of multiple and multidimensional procedures (Smith, 2010). Several studies (Asún-Dieste et al., 2023; Looney, 2011; Nazeef & Fareed, 2024; Tratt, 2018) emphasise the importance of combining summative and formative strategies in secondary schools to exploit the strengths of both approaches. The European School Education Platform (2023) confirms that balancing summative and formative strategies can enhance inclusiveness at all school levels.

The study presented in this article focuses on the integration of formative and summative assessment strategies as a mechanism for skill development that can support academic performance. In particular, we highlight the connection between academic achievement – typically measured through summative assessments of subject-specific content – and a range of skills connected to affective, behavioural and cognitive areas, as indicated by

Theobald (2021). From an affective standpoint, we examine how assessment can be linked to the development of students' emotional and motivational capacities (Guy et al., 2015; Hidi et al., 2004; Kim, 2012; Liu & Yu, 2021; Masgoret & Gardner, 2003; Muho & Taraj, 2022; Renninger & Hidi, 2022; Rodriguez et al., 2020), resilience (Clipa et al., 2021) and self-efficacy (Meusen-Beekman et al., 2016). Additionally, we investigate potential behavioural changes, such as improvements in effort regulation and time and study management (Dever et al., 2023; Karaca & Bektas, 2022; Pintrich et al., 1991; Theobald, 2021). We also examine how assessment can improve cognitive and metacognitive aspects such as self-reflection (Veugen et al., 2024), metacognitive awareness (Carney et al., 2022; Rajcoomar et al., 2024; Wafubwa & Csikos, 2022; Yazgı Yanık & Afat, 2022) and aspects of self-regulation (Buchholtz et al., 2018) related to rehearsal, elaboration and organisation of learning materials (Karabenick & Sharma, 1994; Lämsä et al., 2025; Martínez-López et al., 2023). These skills are typically fostered by formative assessment activities and we posit that their development can also enhance students' ability to perform well on summative academic tasks that assess subject-specific content.

The main purpose of this study is to investigate the effectiveness of formative assessment strategies in supporting the development of the selected affective, behavioural, cognitive and metacognitive skills. Focusing on secondary students in Italian classrooms, we sought to verify whether formative assessment integration could support student preparation for summative mid-term tests (Sortwell et al., 2024). Our work examines how formative assessment strategies can help secondary students select strategies to achieve effective learning (Demekash et al., 2024) through deeper involvement in the learning processes (De Vries et al., 2024).

The scientific framework that guides this study is threefold: (a) the interplay between summative and formative strategies (Nazeef & Fareed, 2024), (b) the effectiveness of formative assessment strategies (Archer, 2017) and (c) the self-regulated learning approach (SRL) (Clark, 2012; Fatmawati et al., 2021; Gulikers et al., 2021; Hudesman et al., 2013; Li & Yongqi Gu, 2024; Morselli & Quartara, 2023; Van Der Linden et al., 2023).

LITERATURE REVIEW

The interplay between formative and summative assessment strategies

'Classroom assessment includes both formative assessment used to adapt instruction and help students improve and summative assessment used to assign grades or otherwise certify student achievement' (Shepard, 2019, p. 184). Secondary teachers are expected to implement a comprehensive classroom assessment model that balances several forms of assessment strategies and techniques. Several studies highlight these efforts (Asún-Dieste et al., 2023; Demekash et al., 2024; Kyaruzi et al., 2019; Mäkipää & Hildén, 2021; Parmigiani et al., 2025; Rahman et al., 2021; Veugen et al., 2024) along with evidence that summative strategies are usually predominant (Nazeef & Fareed, 2024; Shepard, 2019). Abd Halim et al. (2024) affirm the importance of secondary teachers' conceptions of assessment as an integrated process, rather than separate summative and formative components, in order to support teaching and learning outcomes.

To develop a coherent model of curriculum, instruction and assessment, Jin et al. (2019) suggest a horizontal coherence that involves a blended approach to formative and summative assessment strategies (Svensäter & Rohlin, 2023). Our study is based on the idea that summative and formative assessments are interconnected. Lau (2016) emphasises how

the concepts and the practices of assessment have been based on an unintentional and harmful dichotomy between summative and formative strategies. Wininger (2005) created the expression 'formative summative assessment' to indicate that these two types of assessment represent two key dimensions of the same process. Furthermore, Drouin (2010) uses this expression to underline how summative and formative assessments are linked. From the literature, it is evident that re-connecting diverse assessment forms is essential; therefore, we opted for simultaneous formative and summative assessment activities in our study design, because they represent complementary actions (Brown et al., 2019; Van Der Linden et al., 2023).

The effectiveness of formative assessment strategies

Archer (2017), McInerney et al. (2009) and Segers et al. (2006) affirmed that assessment has an overall broad influence on the improvement of learning. Specifically, Xuan et al. (2022) underlined the role of formative assessment in enhancing reading skills and achievement. Moreover, Lee et al. (2020) posed a fundamental research question: 'What is the impact of formative assessment on student learning?' (2020, p. 126). In their meta-analysis, the authors found that, in K-12 education, formative assessment strategies support improvements in overall activities as well as in literacy, mathematics, science and arts, with a high effect size. Additionally, this study's results indicate that formative assessment strategies can be more effective when led by students rather than conducted by teachers. Van Den Berg et al. (2018), Dahal (2019) and Khursheed and Khurram Khan Alwi (2023) underscore how formative assessment can improve student performance in mathematics and, together with a substantial increase in student motivation, improve overall academic performance.

While there are several studies on the effectiveness of formative assessment strategies, others provide critical perspectives and reveal potential limitations. For example, Brown (2019) presents the following weaknesses of formative assessment: feedback occurs in an ephemeral way; comparing and validating teachers' interpretations can be difficult and inaccuracies may result because formative assessment conclusions cannot be validated. Moreover, Parmigiani et al. (2025) identified a series of formative assessment weaknesses reported by Italian secondary school teachers: (a) difficulties in application due to large class sizes; (b) unsystematic with high subjectivity and low levels of clarity and validity; (c) lack of time and space; (d) lack of connection between summative and formative assessment; (e) increased teacher workload; (f) insufficient experience with formative techniques and (g) student desire for and limited commitment without formal grades. Additionally, teachers suggested that formative assessment can be stressful, create anxiety and confusion and result in unclear feedback (2025). Additionally, Marsh (2007) found that formative assessment is infrequently used at school, perhaps because of these perceived weaknesses.

A balanced approach is proposed by Higgins et al. (2010), who identify and specify the efficiency and effectiveness of seven formative assessment strategies. They found that self-assessment has good efficiency, since it reduces teachers' work, and has a high level of effectiveness because it fosters student independence and allows for deep self-reflection. Similarly, peer-assessment allows students to learn from each other (efficiency) and encourages students' engagement, promoting confidence and dialogue (effectiveness). Overall, the study 'critically analyses dilemmas between educational effectiveness and resource efficiency when considering formative assessment' (2010, p. 4).

Formative assessment to develop self-regulated learning (SRL)

The principal effect of formative assessment on students' learning processes is the potential to facilitate and improve self-regulation. Self-regulated learning (SRL) can be defined as a cyclic process of several phases by which students plan strategies for a task, monitor their performance and then reflect on the outcome (Zimmerman, 2002). Through SRL, students should be able to establish goals for learning and achievement, and, as Pintrich (2000) specified, employ a variety of cognitive, motivational and behavioural actions, guided and constrained by their goals and the learning environment. In practice, as stated by Zimmerman (2000), SRL allows students to self-generate thoughts, feelings and actions that can be arranged and adapted to accomplish either personal or academic goals.

There is a deep relationship between SRL and formative assessment strategies, as argued by Granberg et al. (2021). These authors present data that show a significant enrichment of students' SRL through the application of formative assessment. Students benefit from ongoing, actionable formative assessment that helps them reflect, plan, monitor and adapt their learning strategies. Concordantly, Greene (2020) and Panadero et al. (2018) affirm that SRL represents a basic goal of formative assessment.

It is important to understand that the relationship between formative assessment and SRL is bidirectional, as emphasised by Andrade and Brookhart (2020). The first direction considers formative assessment AS SRL. The second direction contemplates formative assessment FOR SRL, guiding students to understand how they learn, not just what they learn. Our study is more focused on the second direction. Additionally, Li and Yongqi Gu (2024), inspired by (Baas et al., 2015), state that many studies showed empirical evidence indicating that self- and peer-assessment have significant influences on students' self/co-regulated learning and strategic learning (Beekman et al., 2021; Meusen-Beekman et al., 2016; Panadero et al., 2016).

The relationship between SRL and formative assessment has been established and occurs through key educational phases. Zimmerman (2002) and Zimmerman and Campillo (2003) present a framework composed of three phases: forethought, performance and self-reflection. The first phase includes planning for learning and the processes and the beliefs that precede the learning. The second phase is composed of the behaviours that the students put into practice to implement their learning plan, such as self-instruction, rehearsal, elaboration, imagery or task strategies. The third phase focuses on the analysis of the learning performance and involves metacognitive attitudes such as self-judgement and casual attribution.

The study we conducted is situated within and reflects these phases, especially the first and the second. The students involved experimented with self- and peer-assessment (forethought phase) to activate and stimulate new learning behaviours (performance phase) prior to a mid-term summative test. The self-reflection phase was represented by students' self-report data on levels of motivation, self-efficacy, resilience and metacognitive awareness.

Students' perceptions about formative assessment

It is important to highlight the research on students' perceptions of the effectiveness of formative assessment in developing the skills described in the previous sections. A crucial point pertains to students' perceptions of feedback (Van Der Kleij, 2019). When students consider formative feedback as an integral part of the learning process, they tend to show higher levels of motivation for formative assessment (Harks et al., 2014). On the contrary, if students do not consider the feedback as an essential step within their learning processes, they tend not to develop their own SRL skills (Harris et al., 2014; Hattie &

Gan, 2011; Winstone et al., 2017). Considering this distinction, we recognise the importance of highlighting students' perceptions of formative assessment activities (Jonsson & Panadero, 2018). According to Zimmerman and Moylan (2009), self-reflection and self-perception represent crucial phases in the development of self-judgement when learners are self-assessing their own performances. Consequently, students are able to clarify their own ideas about success and failure in a cognitive task (Cai & Yu, 2024). We situate our study within educational research focused on student voice during educational activities, knowing that it can provide valuable insights: students can simultaneously improve their own learning experiences and provide crucial information about the implementation of effective formative assessment practices (Sun et al., 2023).

CONTEXT OF THE STUDY, AIMS AND RESEARCH QUESTIONS

This research was conducted in the Italian educational system, which is comprised of 13 grades split into two main levels. The first level, comprehensive school, is split into primary (1st to 5th grade) and lower secondary (6th to 8th grade). The second level, upper secondary, is composed of five grades (9th to 13th grade). The students involved in this study were in the upper secondary level.

The primary aim of the study was twofold: to investigate the effectiveness of formative assessment strategies on the development of a series of skills related to affective, behavioural, cognitive and metacognitive areas, as students prepared for a summative mid-term test. A secondary aim included the opportunity to examine the relationship between formative and summative assessment. Consequently, the overall research question can be expressed as follows: to what extent can self- and peer-assessment strategies help upper secondary students develop a series of skills to prepare for summative mid-term tests? Further, we identified specific research questions: did the use of self- and peer-assessment strategies help students to:

(RQ #1) enhance their emotional, motivational and resilience capacities?

(RQ #2) develop their self-efficacy, self-reflection and metacognitive awareness?

(RQ #3) foster their self-regulation competencies both in time/study management and in rehearsal, elaboration and organisation of learning materials?

Additionally, we specified a supplementary research question: (RQ #4) were there differences, in terms of effectiveness, between self- and peer-assessment?

RESEARCH DESIGN

To answer the research questions, a quasi-experimental research design was chosen. Specifically, we followed Cook and Campbell (1979) and Privitera and Ahlgrim-Delzell (2018) by adopting a one-group posttest-only design. We selected this model because quasi-experimental designs are increasingly used in educational contexts. They are often more feasible, especially in real-world settings such as schools where the participants and groups are represented by an entire class and not randomly assigned (Gopalan et al., 2020; Mark & Reichardt, 2008; Miller et al., 2020). In this specific context, 581 students across 37 upper secondary school classes were involved in the study. This research design, while feasible for our context, is potentially susceptible to limitations: selection bias, when the treatment effect can be confounded with pre-existing differences (Salzberg, 1999); maturation bias that

can 'occur when natural changes over the passage of time may influence the study outcome' (Schweizer et al., 2016, p. 7); participants were not randomly assigned and there could be pre-existing differences among the participants (Miller et al., 2020).

Participants, procedure and instrument

Participants

We proceeded with a two-stage sampling procedure for participant recruitment. In the first stage, we used a technique which is particularly effective for educational studies involving schools located in a large territory (Ahmed, 2024; Galway et al., 2012) and created four clusters, one for each of the four provinces in the region where the University of Genoa (Italy) is located. Clusters 1, 2, 3 and 4 comprised 15, 5, 4 and 6 upper secondary schools, including 14,273, 3704, 4112 and 5451 students, respectively. We drew six schools from cluster 1 and two schools from clusters 2, 3 and 4. The second stage was based on a non-probabilistic self-selection procedure (Berndt, 2020; Stratton, 2023). We sent invitations to all selected schools, an invitation to participate in the research (716 teachers from the six cluster 1 schools; 522 teachers from the five cluster 2 schools; 415 teachers from four cluster 3 schools; 607 teachers from six cluster 4 schools). Twenty-eight teachers from 12 schools across the 4 clusters agreed to be involved in the study. Participating teachers indicated how many classes they were teaching (74) and from these, we drew the classes to be involved. The 37 final classes selected were composed of a total of 581 students. Of those, 21 classes with 321 students implemented the self-assessment strategy, and 16 classes with 260 students tested the peer-assessment strategy. While we could not compare the participants' profiles with the broader school population or clusters, because there are no topic-similar empirical studies, our work provides the opportunity for these comparisons in future. Practical reasons meant differences between the number of classes where teachers could implement self-assessment or peer-assessment strategy, with some teachers only able to carry out either self- or peer-assessment strategy in one class. Additionally, in some cases, teachers worked together in pairs within the same class due to the staffing structure of the schools involved. Table 1 shows the demographic and educational characteristics of students, split into the two formative assessment strategies.

To determine pre-existing differences, we measured the equivalence among groups (classes) regarding previous experiences with formative assessment strategies. The chi-square analysis showed that there were no differences among the classes involved in the

TABLE 1 Demographic and educational characteristics of participants.

Variable	Category	Count (%)	
		Self-assessment	Peer-assessment
Gender	F	188 (58.57%)	170 (65.38%)
	M	120 (37.38%)	82 (31.54%)
	I don't wish to say	13 (4.05%)	8 (3.08%)
Grade	10–11	124 (38.63%)	114 (38.63%)
	12–13	197 (61.37%)	146 (56.15%)
Previous experiences with formative assessment	Never	94 (29.28%)	33 (12.69%)
	Sometimes	214 (66.67%)	212 (81.54%)
	Often	13 (4.05%)	15 (5.77%)

study ($\chi^2 = 60.266$, $df = 40$, $p < 0.057$). Students who indicated that they had 'never', 'sometimes' and 'often' had experiences with formative assessment were equally distributed among the classes.

Procedure

Prior to conducting the study, the researchers trained and supported teachers in the preparation of self- and peer-assessment activities so teachers could maintain the same educational approach across all classes involved. The procedure was divided into two main phases. The first phase involved implementing a self-assessment strategy in 21 classes, structured according to the following steps.

1. Introduction: teachers informed students that the self-assessment activity included no formal grade and was aimed at reflecting on their skills in preparation for the next mid-term summative test.
2. Task: teachers prepared a subject-specific (maths, history, philosophy, etc.), 15- to 20-min task with characteristics similar to the mid-term test.
3. Self-assessment: after students completed the subject-specific task in class, teachers proposed eight guiding questions focused on the eight skills under study: emotional capacities; motivational capacities; resilience; self-efficacy; self-reflection; metacognitive awareness; self-regulation in time/study management; self-regulation in rehearsal, elaboration and organisation of learning materials. An example of a guiding question related to resilience was as follows: Did you experience trouble during the task? If so, did you find ways to overcome your difficulties? Students had to reflect on the guiding questions by submitting their thoughts anonymously, either on paper or digitally. Teachers then analysed the students' reflections, creating clusters around typical topics and main ideas.
4. Reflecting at home: teachers prepared two additional guiding questions focused on self-regulation in time/study management and metacognitive awareness. Students had to reflect on those questions at home.

One week after the self-assessment activity, students were required to complete a mid-term summative test. Two days after the summative test, students were asked to fill in a questionnaire designed to provide data about the self-assessment strategy.

The second phase consisted of a peer-assessment strategy, tested in 16 classes. The peer-assessment activity was structured as follows.

1. Introduction: Teachers informed students that the peer-assessment activity did not include any formal grade and was aimed only at reflecting on their skills, with the help of a peer, as they prepared for the next mid-term summative test.
2. Task: Teachers prepared an individual subject-specific task of 15–20 min with characteristics similar to the mid-term test.
3. Rubric: Before carrying out the task, teachers presented students with a rubric of three to five indicators focused on the key cognitive aspects of the task. The specific indicators varied according to the subject taught. An example of an indicator was as follows: Did your peer connect the content and information effectively? Additionally, the rubric included also a blank column designated for peers to provide written comments.
4. Peer-assessment: After completing the task, teachers randomly paired students; the pairs exchanged their completed work. Individually, students reviewed each other's tasks according to the rubric.
5. Peer feedback: After completing their reviews individually, pairs met to share peer feedback.

6. Teacher feedback: After students provided peer feedback, teachers provided additional feedback based on the indicators.
7. Reflecting at home: Teachers prepared eight guiding questions focused on the skills of peer-assessment under study. Students reflected on those questions at home.

Similar to the self-assessment phase, 1 week after the peer-assessment activity, students completed a mid-term summative test. Two days after the summative test, students were asked to fill in a questionnaire to provide data about the peer-assessment strategy.

Instrument

The research procedure involved two data collection points. After each formative assessment strategy, students were asked to fill in a questionnaire focused on the research questions. The instrument utilised a self-reporting strategy to highlight student perceptions of the self- and peer-assessment strategies. While we recognise limitations such as a lack of external measurement and the potential for low levels of student awareness regarding formative assessment strategy effectiveness, student perception data can also provide important insights. The questionnaire was composed of three sections. The first section included the demographic and educational characteristics of participants (see [Table 1](#)). The second section contained six areas. Two of these areas were split into two sub-areas for a total of eight areas related to the eight skills identified in the research questions. Students rated the items on a five-point Likert scale, from 5 'Yes, self- (or peer-) assessment activity has been very useful/effective' to 1 'No, self- (or peer-) assessment activity has not been useful/effective at all'. Items suitable for our research context were adapted from international instruments: [Table 2](#) shows the areas/sub-areas, number of items, topics and references to the corresponding international questionnaires.

Additionally, the questionnaire included a qualitative section composed of an open-ended question: 'Did the self- (or peer-) assessment activity help you in preparing for the mid-term summative test? If so, in what ways? If not, how not?' We decided to add an open-ended question for two main reasons. Firstly, it was important to allow students to provide their thoughts and feelings about what they experienced during the formative assessment activities. Secondly, the students could also write additional and overall comments regarding their formative assessment experience.

DATA ANALYSIS AND FINDINGS

The data analysis procedure

We performed the data analysis using both qualitative and quantitative methods. Specifically, the qualitative data were analysed with Nvivo 14, following the three phases suggested by Al-Eisawi (2022): open coding, axial coding and selective coding. The quantitative data analysis was performed with SPSS 29. We focused initially on reliability analyses, using the following coefficients: Cronbach's Alpha (α) and McDonald's Omega (ω). Then, we performed frequency analysis for an overview of the data and multivariate analysis of variance (MANOVA) to explore differences among the areas and between self- and peer-assessment. We sought to identify potentially statistically significant differences among participants considering the demographic and educational characteristics listed in [Table 1](#). Additionally, we completed a cluster analysis to identify groups of students relatively homogeneous within themselves and heterogeneous between themselves, based on their answers to the areas and sub-areas of

TABLE 2 Questionnaire's areas.

Area	Sub-area	Items	Topics	References
Emotional and motivational capacities	Emotional aspects	3	Comfortable activity Calm activity Nervous	Coryn et al. (2009)
	Motivational aspects	3	Learning Interest Involvement	De Araujo et al. (2023)
Resilience		3	Reacting difficulties Facing problems Facing anxiety	Lereya et al. (2016); Smith et al. (2008)
Self-efficacy		3	Managing problems Facing difficulties Knowledge awareness	Schwarzer and Jerusalem (1995)
Self-reflection		3	Studying awareness Recognising learning strategies	Song et al. (2021)
Metacognitive awareness		3	Awareness in self-monitoring Awareness of own skills/abilities	Sperling et al. (2002)
Self-regulation	Time/study management	3	Setting study times Materials organisation	Karaca and Bektas (2022); Pintrich et al. (1991)
	Rehearsal, elaboration and organisation of learning materials	3	Contents to be studied Connecting and mapping information	Lämsä et al. (2025)

the questionnaire. Both qualitative and quantitative data contributed to answer all research questions since, as indicated by Creswell and Clark (2011), there were no specific priorities between data types. The interpretation of findings was based on both qualitative and quantitative analyses, to gain a deep understanding of the questions under study.

Quantitative findings

Reliability analysis and frequencies' distribution

First, we analysed the instrument reliability and frequency distribution, as shown in Table 3. The reliability shows a good level of instrument consistency. The frequencies were calculated in all areas and sub-areas to provide an overview of answer distribution. To do so, we aggregated students' positive answers categorised as 'The assessment activity has been very effective' and 'The assessment activity has been effective'. Similarly, we aggregated the negative answers that were categorised as 'The assessment activity has not been effective at all' and 'The assessment activity has not been effective'. All areas and sub-areas show positive percentages higher than 50% except for resilience in self-assessment. Similarly, negative percentages higher than 15% are shown in self-assessment for motivational aspects, resilience, self-reflection and time/study management. After peer-assessment, only resilience shows a percentage higher than 15.

Multivariate analysis of variance (MANOVA)

We performed the multivariate analysis of variance (MANOVA) to show potential statistically significant differences between self- and peer-assessment, focusing on all areas and sub-areas. Starting from an overall analysis, peer-assessment was rated higher than self-assessment ($MD=0.106$, $p<0.033$). Figure 1 shows the mean ratings given by the students to all areas/sub-areas. The differences between peer- and self-assessment are significant in the areas related to resilience ($MD=0.150$, $p<0.017$), self-efficacy ($MD=0.203$, $p<0.016$), and self-regulation in rehearsal, elaboration and organisation of learning materials ($MD=0.144$, $p<0.032$).

By analysing in detail the pairwise comparisons among all areas between self- and peer-assessment, we can state that the emotional sub-area shows the highest scores compared to all other areas during both self- and peer-assessment. Resilience received the lowest scores compared to all other areas during both self- and peer-assessment. However, as mentioned before, the scores for the resilience area increased in a significant way during the peer-assessment. The areas related to motivation, self-reflection and self-regulation in time/study management did not receive high scores from the students. Instead, self-efficacy, metacognitive awareness and self-regulation in rehearsal, elaboration and organisation of learning materials are the areas most valued by the students (except for emotional aspects). Specifically, the sub-area self-regulation in rehearsal, elaboration and organisation of learning materials is higher than self-regulation in time/study management, particularly during the peer-assessment ($MD=0.129$, $p<0.004$).

Differences among participant groups

The MANOVA helped us to identify the differences among participant groups. Regarding gender, female students gave all areas higher scores compared to male students during

TABLE 3 Reliability coefficients and frequencies' distribution.

Area	Sub-area	Cronbach α	McDonald ω	Self-assessment		Peer-assessment	
				Positive %	Negative %	Positive %	Negative %
Emotional and motivational capacities	Emotional aspects	0.747	0.767	79.42	9.61	83.01	7.02
	Motivational aspects	0.791	0.794	63.51	15.01	65.58	11.83
Resilience		0.829	0.841	47.84	30.18	55.68	22.73
Self-efficacy		0.812	0.818	71.67	11.14	75.93	6.24
Self-reflection		0.846	0.847	66.26	19.48	67.63	13.41
Metacognitive awareness		0.764	0.766	70.43	10.73	74.53	8.43
Self-regulation	Time/study management	0.753	0.757	63.91	18.45	65.82	13.43
	Rehearsal, elaboration and organisation of learning materials	0.763	0.765	65.44	14.91	70.69	9.41
Critical values							
						0.800	> α > 0.700 acceptable
						0.900	> α > 0.800 good
							α > 0.900 excellent

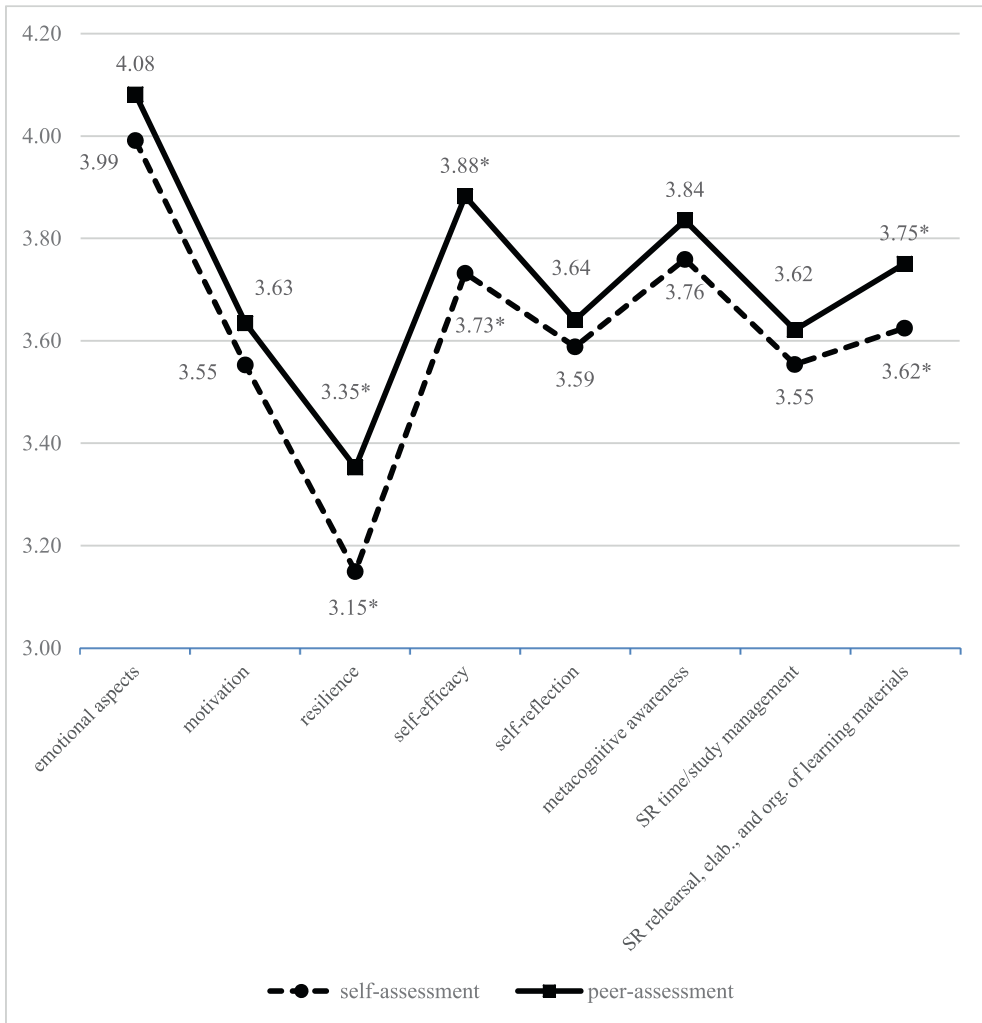


FIGURE 1 Differences between formative assessment strategy and areas/sub-areas.

the peer-assessment ($MD = 0.145, p < 0.019$). Male students valued the resilience area both in self- and peer-assessment ($MD = 0.192$ and $194, p < 0.033$ and 0.028) and the emotional aspects sub-area during self-assessment ($MD = 0.182, p < 0.038$). During peer-assessment, female students valued self-efficacy ($MD = 0.268, p < 0.012$) more when compared to male students. It is interesting to note that, during peer-assessment, resilience ($MD = 0.202, p < 0.045$), self-efficacy ($MD = 0.225, p < 0.004$) and self-regulation in rehearsal, elaboration and organisation of learning materials ($MD = 0.188, p < 0.022$) were valued higher by female students.

With respect to student grade level, 10th–11th grade students generally appreciated peer-assessment more than self-assessment ($MD = 0.191, p < 0.014$); however, older students (12th and 13th grades) valued self-assessment higher ($MD = 0.131, p < 0.049$). Older students also gave higher scores to resilience ($MD = 0.219, p < 0.011$).

Regarding the variable related to ‘previous experiences with formative assessment strategies’, we found significant differences among the students who had ‘never’, ‘sometimes’ and ‘often’ had experiences with formative assessment strategies before this study. During self-assessment, students who had ‘never’ had previous experiences gave lower scores

than students who had 'sometimes' and 'often' had previous experiences with formative assessment. During peer-assessment, students with no experience gave lower scores compared to students who indicated that they had 'often' experienced formative assessment ($MD=0.481, p<0.026$). After analysing each area, it is interesting to note that, during self-assessment, negative significant differences are for motivational aspects ($MD=-0.669, p<0.000$), self-efficacy ($MD=-0.485, p<0.008$) and self-regulation in time/study management ($MD=-0.579, p<0.004$). During peer-assessment, we found negative differences for resilience ($MD=-0.594, p<0.017$) and self-reflection ($MD=-0.578, p<0.009$). Within the group of students who indicated they 'often' had previous experiences with formative assessment, peer-assessment was viewed more favourably than self-assessment ($MD=0.646, p<0.023$).

Cluster analysis

The two-step cluster analysis allowed us to identify homogeneous groups among the participants and within the self- and peer-assessment strategies and to focus on each area/sub-area. Regarding self-assessment, the analysis highlighted three clusters composed of: (SA_a) 130 students (40.49%); (SA_b) 150 students (46.73%) and (SA_c) 41 students (12.78%). Concerning peer-assessment, the analysis highlighted two clusters composed of: (PA_a) 172 students (66.15%) and (PA_b) 88 students (33.85%). Table 4 shows the characteristics and the distribution of areas and sub-areas between the formative assessment strategies. There are notable differences regarding the following areas: motivation, self-reflection and self-regulation in time/study management. In general, the overall quantitative data report the lowest means for these areas, so it seems that formative assessment did not affect them. Among the students grouped into the clusters, however, the cluster analysis indicates high mean differences for these areas. Specifically, the students, who are included in the clusters SA_c and PA_b, gave very low scores to motivation, self-reflection and self-regulation, as indicated in Table 4. Comparatively, students in the SA_a and PA_a clusters appreciated these areas, giving them high scores. For these reasons, motivation, self-reflection and self-regulation in time/study management are the most important predictors, as highlighted by the cluster analysis.

It is interesting to note that clusters did not show differences based on gender, but did show differences based on students' prior experiences with formative assessment. The clusters highlight significant differences considering the variable 'previous experiences with formative assessment'. In the self-assessment activity specifically, few students declared 'never' and 'sometimes' in the SA_a cluster, while many students declared 'often' in the cluster SA_c ($\chi^2=12.704, df=4, p<0.013$). Similarly, when considering the variable 'grade' in the cluster SA_c, we identified many younger students (grades 10–11). This difference was pinpointed by the value of adjusted standardised residuals (+2.51 with a critical value of 2.41) since the contingency table was not 3×2 .

Qualitative findings

The qualitative data analysis highlighted two main categories, named 'High effectiveness' and 'Low effectiveness', to describe how self- and peer-assessment activities related to student preparation for the mid-term summative test. Each category involves different codes, as shown in Table 5.

The category 'High effectiveness' includes around 80% of occurrences and describes six aspects that were enabled through self- and peer-assessment activities. For both

TABLE 4 The cluster analysis.

Self-assessment					
Area	Sub-area	Importance as predictor	Cluster		
			SA_a	SA_b	SA_c
Self-reflection		1.00	4.26	3.39	2.09
Metacognitive awareness		0.99	4.31	3.61	2.50
Self-regulation	Time/study management	0.91	4.18	3.32	2.34
Emotional and motivational capacities	Motivation	0.90	4.07	3.43	2.30
Self-efficacy		0.87	4.23	3.63	2.47
Self-regulation	Rehearsal, elaboration and organisation of learning materials	0.79	4.23	3.36	2.65
Resilience		0.71	3.85	2.87	1.91
Emotional and motivational capacities	Emotional aspects	0.12	4.17	3.97	3.45
Peer-assessment					
Area	Sub-area	Importance as predictor	Cluster		
			PA_a	PA_b	
Self-reflection		1.00	4.04	2.84	
Resilience		0.94	3.81	2.45	
Self-regulation	Time/study management	0.80	3.98	2.91	
Emotional and motivational capacities	Motivation	0.76	3.97	2.97	
Metacognitive awareness		0.74	4.16	3.19	
Self-regulation	Rehearsal, elaboration and organisation of learning materials	0.72	4.06	3.14	
Self-efficacy		0.55	4.14	3.37	
Emotional and motivational capacities	Emotional aspects	0.10	4.19	3.86	

self- and peer-assessment, the most commonly quoted code indicated by students was 'Overall learning preparation improvement'. In this case, students reported that formative assessment strategies enhanced their overall capacity to prepare for a mid-term summative test. Further important aspects are represented by the codes 'Improving time/study management' (between 15% and 20% of occurrences) and 'Learning preparation awareness' (between 10% and 15% of occurrences). The first code shows how formative assessment activities boosted students' organisational skills, indicating better planning and time management. The second code displays how formative assessment strategies helped students be more aware of their own mistakes, weaknesses and strengths during study time and test preparation. One student reported: 'Peer-assessment helped me a lot, especially to understand what I already knew and what I still had to integrate in order to prepare myself

TABLE 5 Qualitative findings.

Category	Code	Occurrences			
		Self-assessment		Peer-assessment	
		<i>n</i>	Count %	<i>n</i>	Count %
High effectiveness	Overall learning preparation improvement	201	31.40	166	36.01
	Improving time/study management	125	19.53	72	15.62
	Learning preparation awareness	75	11.72	72	15.62
	Visible learning goals	51	7.97	42	9.11
	Emotional issues	22	3.44	15	3.25
	Developing new learning strategies	41	6.41	14	3.04
Low effectiveness	No learning preparation improvement	64	9.84	49	10.63
	Low learning preparation improvement	18	2.66	19	4.12
	Needing something more	45	7.03	12	2.60
	Total	640	100.00	461	100.00

better'. Another student stated: 'Peer-assessment helped me to recognise and improve my learning strategies; it helped me to thoroughly study the subject, focusing on what I couldn't remember. In this way, I was able to decrease my anxiety and get well prepared for the test'.

'Visible learning goals' is another relevant code emphasised by participants. The self- and peer-assessment activities enabled students to clearly understand the learning outcomes set by the teachers. One student affirmed: 'Formative assessment helped me to understand what are the most important content and skills to be learnt. In this way, I could focus on them better for the test'. The last two codes are represented by 'Emotional issues' and 'Developing new learning strategies'. The first one indicates that formative assessment can reduce anxiety and pressure during test preparation, foster student motivation and support better concentration. The second code focuses on how students can discover new ways to learn through formative activities with peers and teachers.

The category 'Low effectiveness' comprises approximately 20% of occurrences. Within this category, students indicated the weaknesses of self- and peer-assessment activities. The category was split into three codes: 'No learning preparation improvement', 'Low learning preparation improvement' and 'Needing something more'. The first code underscores that a small group of students did not have a positive view of the formative assessment activities and, specifically, students did not feel that their capacity to prepare for a summative test was improved. Most of the students in the 'low effectiveness' category declared that they already had effective learning preparation strategies: 'I was already able to prepare for a summative test, so I didn't feel the need to change anything'. The second code is focused on students who perceived a low level of learning preparation improvement, indicating that formative assessment activities just confirmed the effectiveness of their pre-existing learning preparation strategies. The code-named 'Needing something more' reveals that students perceived some positive insights from the formative assessment experience, but they needed something more to make the self- and peer-assessment actually effective. For instance, these students indicated that formative assessment should be experienced calmly and without pressure in order for it to improve their preparation.

DISCUSSION

The quantitative and qualitative data from our research combine to provide an important overview of students' perceptions regarding the effectiveness of formative assessment strategies in upper secondary schools. The findings of this study, particularly the areas and sub-areas, indicate the development of students' skills through formative assessment. The data told us that all areas except resilience were rated positively by students during both self- and peer-assessment, indicating a high level of effectiveness. We can state that the skills analysed in this study were perceived in both self- and peer-assessment. This first result reinforces the studies carried out by Lee et al. (2020), Xuan et al. (2022) and Archer (2017).

Our findings also indicate that formative assessment strategies positively affected students' development of self-efficacy, metacognitive awareness and self-regulation in rehearsal, elaboration and organisation of learning materials. While at first glance, formative assessment strategies were not perceived as effective for motivation, self-reflection and self-regulation in time/study management, the cluster analysis, however, showed groups of students indicating a high level of effectiveness regarding these areas. Even resilience, an area that appeared less affected by formative assessment, showed a higher level of effectiveness during peer-assessment, specifically for female students. In general, the effectiveness of formative assessment strategies is highly perceived by about two-thirds of students; however, it is crucial to note that one-third did not perceive self- and peer-assessment to be effective in many areas. This observation confirms some of the practical limitations of formative assessment, as indicated by Brown (2019) and Parmigiani et al. (2025) and addressed earlier in this paper.

In addition to our findings on students' perceptions of effectiveness of formative assessment overall, we want to emphasise the differences between self- and peer-assessment. Students in this study assigned higher value to the peer-assessment strategy, similar to Kumar et al. (2023). Specifically, students positively valued peer-assessment to develop resilience, self-efficacy and self-regulation in rehearsal, elaboration and organisation of learning materials. This result underscores the importance of collaboration among students during formative assessment activities designed to support students' preparation for a mid-term summative test, as affirmed by Jurkowski et al. (2024). It is curious that younger and older students preferred, respectively, peer- and self-assessment. Peer-assessment may be more valued by younger students because they perceive good support from and enjoy interacting with their peers while preparing for a summative test. Conversely, older students may have already developed a good level of self-regulation and be more focused on individual achievement. This result aligns with observations reported by Sebba et al. (2008), who did not find differences between students.

It is important to highlight the differences between students who had few previous experiences with formative assessment and those who had many prior experiences. Students with less formative assessment experience tended not to value it and had fewer opportunities to develop the skills useful for summative test preparation. If the students had more exposure to several forms of formative assessment, greater familiarity might support their understanding of its value and role in developing self-regulation competencies. This point is demonstrated by the fact that students who had never experienced formative assessment gave the lowest scores for motivation, resilience, self-efficacy, self-reflection and self-regulation in time/study management. This correlation is an important finding and indicates that students who do not use formative assessment may not have the same skill levels for study preparation. Training on formative assessment reinforces the perception of formative assessment effectiveness. We argue that the success of formative assessment strategies is neither immediate nor direct; rather students need exposure over time to understand and recognise the efficacy of formative assessment. This observation can be considered the

most innovative result of this study because, from an empirical perspective, it indicates that teachers must be educated to create and integrate several forms of formative assessment strategies into everyday classroom activities. In this way, the consistent use of formative assessment can support students' learning processes and summative test preparation.

The qualitative data stressed the importance of an integrated combination of formative and summative assessment. Most participants clearly indicated that formative assessment strategies helped them to effectively prepare for a summative mid-term test, confirming the studies of Nazeef and Fareed (2024) and Asún-Dieste et al. (2023).

In 'The effectiveness of formative assessment strategies' section, we identified a series of limitations associated with self- and peer-assessment practices. These constraints are reflected in both the quantitative and qualitative analyses. From a quantitative perspective, the most critical points appear in the development of resilience, motivation and self-regulation in time/study management. As already stated by Yin et al. (2008) and Wu and Yu (2025), the improvement of these skills can be impacted by difficulties in applying formative assessment in complex school contexts (large class sizes, lack of time and space, etc.). From the qualitative data, 64 and 49 students (for self- and peer-assessment, respectively) associated formative assessment strategies with low learning effectiveness. As noted earlier, this can be attributed to insufficient experience with formative techniques.

LIMITATIONS OF THE STUDY

Several limitations of this study should be acknowledged. First, due to the constraints of real-world classroom settings, we were unable to employ a fully experimental research design (e.g., random assignment of students and teachers to strategies implemented) and instead relied on a quasi-experimental design. Second, the strong focus on upper secondary schools limits, to some extent, the generalisability of the findings to other educational levels. As indicated in the study context section, lower secondary and primary levels are located within comprehensive schools. For this reason, we concentrated our study within grades at the upper secondary level. Third, while space limitations preclude the inclusion of the complete study questionnaire and guiding questions, these materials are available upon request. Fourth, the scope of this study focused primarily on measures capturing students' perceptions of the process; to capture additional relevant aspects, additional instruments are needed to assess broader cognitive, behavioural and affective effects on learning. Finally, the sampling procedure and research design impose further constraints on the generalisability of the results, since teachers had to agree to participate in the study, and participant self-selection might introduce biases. Additionally, a longitudinal design conducted over a semester or academic year, incorporating multiple measurement points for both students and teachers and including diverse learning indicators, would provide deeper insights into self- and peer-assessment behaviours and their influence on learning. Future research can address these limitations by adopting experimental research designs, integrating additional data sources and extending the study duration to produce more robust and generalisable findings.

CONCLUSION AND IMPLICATIONS FOR POLICY AND PRACTICE

In conclusion, this study reveals important answers to our research questions and prospective policy implications for teacher education. Regarding (RQ #1), (RQ #2) and (RQ #3), we can affirm that formative assessment strategies are perceived as particularly effective for developing emotional capacities, self-efficacy, metacognitive awareness and self-regulation,

especially in relation to rehearsal, elaboration and organisation of learning materials. Students perceived formative assessment strategies positively, and after the activities, became more aware of their own capacity to effectively prepare for a summative test. Concerning other skills (resilience, motivation, self-reflection and SRL in time/study management), around two-thirds of students were positively affected by formative assessment strategies, while the remaining students struggled to develop these aspects. Incorporating workshops and practice-based activities into pre- and in-service teacher training programmes is essential to ensure that teachers recognise the need for sustained formative assessment interventions to support students in the development of these capacities. Finally, the student data confirmed that formative assessment strategies supported a higher level of preparation for summative tests, showing a clear link between formative and summative assessment.

Concerning the last research question (RQ #4), we can state that peer-assessment was more positively regarded by upper secondary students than self-assessment. A similar result was found by Parmigiani et al. (2024) at the higher education level. Evidently, students of both secondary and higher education levels give a high value to the learning opportunities afforded by cooperation among peers. Of course, this finding does not mean that self-assessment is not useful. It does, however, suggest the need for additional and early focus on self-assessment strategies to familiarise students with formative assessment, followed by the creation of interactive conditions among students to benefit from the advantages of peer-assessment. A combination of self- and peer-assessment should help students in making their internal feedback explicit (Nicol & McCallum, 2022).

These conclusions suggest implications for teacher education programmes and professional learning for both pre- and in-service teachers. Our main recommendation is an emphasis on the implementation of courses and workshops where pre- and in-service teachers can learn, practice and combine different forms of formative and summative assessment strategies. Finally, we stress the need for continuing professional development programmes for in-service teachers, based on the action research framework (Johannesson & Olin, 2024), to give them the chance to plan, act, observe and reflect on their own teaching and assessment strategies.

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The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of UNIVERSITY OF GENOVA, ITALY (2024/32 of 24 April 2024).

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