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The Impact of Feedback on Supporting Students Accurately Predicts Their Performance in Primary Education

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Abstract

Feedback is a crucial component of educational practice. It provides students with valuable information about their progress and enhances their ability to predict their performance through self-regulation and metacognitive awareness. For feedback to be effective, it must be delivered promptly, be clear, and include specific suggestions for improvement. This systematic literature review, following the PRISMA 2020 methodology guidelines, analyzes 23 empirical studies from the last decade (2015-2025) and examines the impact of teacher feedback on primary school students' ability to predict their performance accurately. The findings indicate that feedback significantly improves the accuracy of students' performance predictions, particularly when the feedback is clear, timely, and personalized. This improvement is largely due to the enhancement of metacognitive skills and self-regulatory processes, especially in subjects like mathematics and language. Individual and cognitive factors, as well as self-assessment processes, play a vital role in minimizing performance overestimations, particularly among low-achieving students, which leads to more realistic and accurate predictions. Additionally, socio-emotional and school factors boost students' engagement in the learning process and their receptiveness to feedback. Moreover, the use of technology and collaboration between schools and families fosters the development of student autonomy and motivation. However, environmental and cultural factors, such as socioeconomic and linguistic backgrounds, can affect the effectiveness of feedback and, ultimately, the accuracy of performance predictions. Finally, the findings underscore the advantages of self-assessment over traditional forms of feedback and highlight the need for future longitudinal research, as well as greater integration of digital tools that can assist in accurately predicting student performance in primary education.

Keywords: feedback, performance prediction, self-assessment, primary education

1. Introduction

Feedback plays a crucial role in the educational process as it connects students' current performance with their learning objectives. It helps them gauge their abilities more accurately while offering insights into their mistakes and successes. This guidance not only enhances learning but also aids in the development of metacognitive skills (Hattie & Timperley, 2007). Additionally, the ability to predict performance is associated with metacognition theory, which suggests that students manage their cognitive functions through accurate self-assessments (Flavell, 1979).

In primary education, certain elements play a crucial role in establishing the foundations of self-regulation and self-perception. A student's ability to accept feedback has a direct impact on the accuracy of their predictions. Self-regulation theory suggests that students with developed metacognitive skills are better at utilizing feedback to adapt their learning (Zimmerman, 2002). Meanwhile, prediction theory emphasizes the importance of various cognitive, emotional, and environmental factors in determining the accuracy of assessments (Snow, 1994). Self-assessment is a key component of this process, as it encourages active participation and enhances self-regulation. By allowing students to identify their weaknesses and set realistic goals, self-assessment improves their receptivity to external feedback (Nicol & Macfarlane-Dick, 2006).

Previous research has demonstrated that formative feedback is an effective tool for enhancing learning, particularly when it emphasizes the learning process and self-regulation (Black & Wiliam, 1998). Models such as Hattie and Timperley (2007) outline levels of implementation necessary for achieving maximum effectiveness. Concurrently, studies on performance prediction have explored models that focus on cognitive abilities and the school environment (Fan & Chen, 2001), highlighting the importance of accurate metacognitive judgments at younger ages (Dunlosky & Rawson, 2012). However, much of the existing research has concentrated on secondary and tertiary education, resulting in a gap in knowledge regarding the relationship between feedback and performance prediction in primary education. This study aims to address this gap by investigating the roles of feedback and self-assessment in predicting student performance, while considering individual, cognitive, socio-emotional, family, school, and environmental-cultural factors.

2. Theoretical Framework

Feedback is one of the most essential practices in education, as it plays a significant role in the learning process. It is defined as information given to students about their progress, mistakes, or successes, aimed at improving their understanding and performance (Hattie & Timperley, 2007). Feedback goes beyond merely correcting errors; it provides guidance for further improvement and helps students transition to higher levels of understanding (Shute, 2008). Feedback can be categorized into two types: formative and summative. Formative feedback is provided during the learning process and supports students' reflection and adaptation, while summative feedback focuses on assessing performance at the end of a unit

or assessment (Black & Wiliam, 1998). Additionally, feedback can be positive or corrective (Brookhart, 2017) and can take different forms such as written or oral, as well as immediate or delayed (Shute, 2008).

Performance prediction is an important topic in educational psychology and is closely linked to metacognition theory. Flavell (1979) connected it to knowledge and the regulation of cognitive functions, highlighting students' ability to evaluate their own performance. Nelson and Narens (1990) introduced a two-level model, where metacognitive predictions at the meta-level guide learning at the objective level. Research indicates that students, particularly those with lower achievement levels, often overestimate their abilities due to limited metacognitive accuracy. However, recent studies show that engaging in systematic practice to make predictions can improve accuracy, enhance self-regulation, and lead to more effective long-term learning (Dunlosky & Rawson, 2012). The theory underlying accurate predictions of academic performance is based on the premise that performance is not solely determined by current knowledge but is influenced by a complex interplay of various factors (Snow, 1994). Achieving accurate predictions requires systematic data collection and analysis, which facilitate targeted interventions and differentiated teaching strategies (Fan & Chen, 2001; Denham, 2006).

Predicting performance in primary education is particularly complex due to the influence of multiple factors. Individual cognitive aspects, such as language and mathematical skills, memory, attention, motivation, study habits, and metacognitive skills, are critical. Feedback plays a vital role in enhancing the development of learning strategies and self-regulation (Zimmerman, 2002). Socio-emotional factors also affect how students respond to school demands. Elements such as self-esteem, self-efficacy, emotional regulation, and social skills are significant, with positive feedback helping to reduce anxiety and boost self-confidence (Denham, 2006). Family factors, including parents' educational levels, living conditions, and their involvement in the learning process, significantly impact a child's chances of academic success. Collaboration between school and family enhances the effectiveness of feedback (Fan & Chen, 2001). School-related aspects, such as the quality of teaching, classroom climate, and overall school culture, contribute to shaping student performance. Systematic feedback from teachers can improve students' self-concept and learning outcomes (Hattie, 2012). Lastly, environmental and cultural factors play a role as well. Aspects like language background, socio-economic inequalities, and access to educational resources affect learning opportunities. Tailored feedback can help reduce these inequalities and improve academic success (Gay, 2018).

3. Previous research - Contribution of this review

This review focuses on systematic reviews and meta-analyses from the last decade (2015–2025) that investigate the impact of feedback on learning, performance, and student motivation across various educational settings. It also explores the roles of clarity, personalization, technology, and active participation in enhancing the effectiveness of feedback. One notable meta-analysis by Van der Kleij, Feskens, and Eggen (2015) included

40 studies involving primary and secondary school students. It examined feedback in digital learning environments and found a positive but moderate effect on learning performance, highlighting that analytical and explanatory feedback is more effective than simple right/wrong feedback. Additionally, Liu and Brown (2015) analyzed 44 sources—32 published studies and 12 doctoral theses—on corrective feedback in second language writing, noting methodological limitations that impacted the comparability of the findings. Meanwhile, Chen (2016) conducted a comparative review of 20 articles on peer feedback in English writing instruction, identifying both benefits and challenges associated with its implementation. Lastly, the meta-analysis by Dignath and Büttner (2016) reviewed 58 intervention studies focused on primary and secondary school students in programs designed to enhance metacognitive abilities and self-regulated learning. The findings indicated a significant positive effect, particularly when cognitive and metacognitive strategies were combined with direct instruction.

Schneider and Preckel's (2017) systematic review of 38 meta-analyses focusing on higher education students investigated factors that influence academic performance. The findings revealed that cognitive abilities, motivation, and learning strategies have a stronger positive association with academic success than demographic factors. In a related study, Winstone et al. (2017) analyzed 51 studies that emphasized learners' active engagement with feedback. They found that understanding, applying, and adapting feedback to individual needs can significantly enhance its effectiveness. Furthermore, Koenka and Karabenick's (2018) meta-analysis, which included 40 studies on secondary and higher education students, indicated that written feedback promotes learning performance and motivation more effectively than grading alone. In contrast, Fong et al. (2019), in their meta-analysis of 78 studies, demonstrated that negative feedback can diminish intrinsic motivation, particularly when it threatens students' self-concept. Lastly, the systematic review by Laici and Pentucci (2019), based on 27 studies, highlighted the role of digital technologies in providing feedback. They found that digital tools can improve the learning process, enhance teacher-student interaction, and encourage greater active participation from students.

Haughney et al. (2020) reviewed 70 empirical studies and found that the effectiveness of feedback depends on several factors, including positivity, clarity, timeliness, and the active engagement of learners. Similarly, Wisniewski et al. (2020) conducted a meta-analysis of 435 studies, confirming the significant impact of feedback on learning, especially when it emphasizes process and self-regulation. Paterson et al. (2020) reviewed 36 studies and highlighted students' preference for clear, timely, and constructive feedback related to their academic work. Lipnevich and Panadero (2021), in their analysis of 14 publications, underscored the critical role of personalization in the effectiveness of feedback. Frantz et al. (2022) conducted a systematic review of 11 studies, revealing complex interactions among non-cognitive skills and related parameters. Meanwhile, Zynuddin et al. (2023) confirmed the relationship between school climate and the development of non-cognitive skills through an examination of 65 articles. Furthermore, Badrun (2024) analyzed 27 studies and emphasized the importance of self-assessment and peer assessment in enhancing student motivation. Nieminen and Carless (2023) explored feedback literacy in higher education, stressing the

need for a more precise theoretical definition and further research in this area. Finally, Cordovani et al. (2023) demonstrated that the acceptance of feedback by medical students depends on its quality and the way it is provided. Esmaeeli et al. (2023), in their review of 25 systematic reviews, highlighted the importance of feedback in learning and its varied applications.

Dönmez & Aydın (2023) conducted a systematic review of 35 studies involving students at various educational levels. They examined different types of feedback and their impact on learning, demonstrating that detailed, clear, and timely feedback significantly improves performance and motivation. In contrast, general or vague feedback shows limited benefits. Similarly, Fleckenstein, Liebenow, and Meyer (2023) performed a multilevel meta-analysis of 20 studies focused on secondary and tertiary students. They found that automated writing feedback enhanced performance, particularly when accompanied by teacher guidance or explanatory comments. Liu (2024) carried out a systematic review of 64 studies involving tertiary students, assessing the reliability and effectiveness of automated feedback on writing. Kerman et al. (2024) explored the connection between online peer feedback and improved collaboration and learning, while acknowledging challenges related to quality and participation. Gao et al. (2024) analyzed key elements of online feedback—including structure, guidance, and quality—that influence its effectiveness. Cen and Zheng (2024) conducted a meta-analysis of 13 quantitative studies, revealing that feedback from multiple sources enhances students' motivation in second-language writing. Likewise, Criss et al. (2025) presented a systematic review of 24 studies involving teachers across various levels. They highlighted the role of technology in feedback on teaching practices, demonstrating that digital feedback improves teaching quality, fosters self-analysis, and promotes professional development. Finally, the systematic review by Brandmo & Gamlem (2025) examined 96 studies involving primary and secondary school students. It confirmed that clear, explanatory, and supportive feedback enhances learning and engagement, while vague or general feedback has a limited impact.

In recent years, literature has produced numerous systematic reviews regarding the prediction of student performance. A notable study by Debray et al. (2017) analyzed 54 studies and developed guidelines for conducting systematic reviews and meta-analyses of predictive models in clinical applications. They emphasized that transparency and consistency in reporting results enhance both reliability and generalizability. Hellas et al. (2018) conducted an analysis of 357 articles published between 2010 and 2018 that focused on predicting student academic performance in Computer Science and STEM fields. They identified a variety of predictive techniques based on score and mean indicators, although they noted a limited quality in the reporting. Additionally, the review by Rastrollo-Guerrero et al. (2020), which encompassed 240 articles, found that algorithms such as Decision Trees, Random Forests, and Support Vector Machines (SVMs) are effective. However, they also highlighted challenges associated with managing heterogeneous data. Nawang et al. (2021) examined 40 studies from 2016 to 2020 and underscored the importance of hybrid models for improving accuracy, with Random Forests and Decision Trees shown to be particularly effective. Following this, Alamri and Alharbi (2021) analyzed 54 studies from 2015 to 2020, stressing

the necessity for prediction models that are explainable and understandable to enhance user confidence. In a review of 78 articles published between 2009 and 2021, Albreiki et al. (2021) highlighted the limitations of small sample sizes and the absence of comprehensive metrics in research on high-risk students. Khan and Ghosh (2021) confirmed through their analysis of 140 studies that while high accuracy can be achieved during classes, there are significant challenges in predicting performance before they begin. Finally, Baashar et al. (2021) reviewed 30 studies from 2015 to 2019 and identified five primary methods for prediction: artificial neural networks, decision trees, SVM, K-nearest neighbors (KNN), and Naïve Bayes. Among these, neural networks demonstrated the highest accuracy, while factors such as demographic information, academic performance, family/personal data, and internal ratings were the most commonly considered variables.

The review by Rodrigues et al. (2022) analyzed 24 studies conducted between 2013 and 2021, focusing on predicting student performance in primary and secondary education. It identified grades, demographic factors, and socioeconomic data as key indicators; however, it noted limitations due to small or unbalanced samples. Following this, Roslan and Chen (2022) examined 58 articles from 2015 to 2021, emphasizing the use of educational data mining techniques, particularly Decision Trees. Chakrapani and Chitradevi (2022) reviewed 17 publications and 74 studies from 2015 to 2021, underscoring the necessity for interpretable models that improve the confidence and effectiveness of educational interventions. In a similar vein, Oppong's (2023) review highlighted artificial neural networks as the most accurate classifiers. Additionally, Al-Din and Al Abdulqader (2024) examined 17 reviews and 74 studies from 2015 to 2023, reiterating the importance of interpretable models. Furthermore, Kumari et al. (2024) analyzed trends and classification techniques, incorporating features such as cumulative averages, ratings, and demographic data. They primarily utilized Naïve Bayes and Decision Trees while addressing concerns about bias and ethical implications. Finally, Abd Rahman et al. (2024) conducted a review of 51 studies using the PRISMA methodology, which emphasized the widespread use of Decision Trees, Linear Regressions, and artificial neural networks, highlighting that the latter offers the highest accuracy. Their findings underscore the need for transparency, privacy protection, and the avoidance of bias in these educational models.

In summary, research indicates that feedback significantly influences learning, performance, and motivation, emphasizing the importance of clarity, personalization, timeliness, and student engagement. Various types of feedback—such as written, oral, digital, peer, and automated—are examined in relation to students' cognitive, metacognitive, and emotional development, while studies on predicting performance investigate models that consider skills, motivation, school climate, and technology. Despite the critical role of feedback in learning and self-regulation, few studies address the connection between feedback and students' ability to accurately predict their own performance. Moreover, previous research presents several limitations, including methodological heterogeneity, differences in sample sizes and educational contexts, limited representation of primary education, and a scarcity of longitudinal and qualitative studies. Furthermore, feedback, self-assessment, and performance prediction have often been examined separately rather than in relation to one another. These

gaps highlight the need for a systematic review focusing on the relationship between feedback and students' ability to accurately predict their performance in primary education, while considering cognitive, socio-emotional, family, school, environmental, and cultural factors, as well as students' self-assessment and receptivity to feedback.

4. Purpose - Research questions - Methodology

The primary aim of this paper is to investigate, through a systematic literature review, the impact of teacher feedback on primary school students' ability to accurately predict their performance. This paper specifically examines how prediction is influenced by individual and cognitive factors, socio-emotional factors, as well as family, school, and environmental-cultural factors. The analysis is based on research published between 2015 and 2025, with the goal of drawing conclusions, identifying research gaps, and suggesting directions for future studies. This literature review seeks to answer the following research questions: a) How do individual and cognitive factors influence the way students use feedback to predict their performance? b) In what ways do socio-emotional factors affect how feedback contributes to students' accurate prediction of their work performance? c) How do family and school factors relate to students' utilization of feedback in predicting their performance? d) What impact do environmental and cultural factors have on the relationship between feedback and predicting student performance? e) How prevalent are self-assessment procedures and tools in supporting primary school students to utilize feedback and accurately predict their performance? f) In what ways does the use of self-assessment procedures and tools enhance the effectiveness of feedback regarding students' ability to accurately predict their performance, compared to environments without such tools? Additionally, the analysis includes the fields of study, research focus, sample characteristics and size, nature of the data collected, and the research tools used. The review methodology followed the PRISMA 2020 guidelines established by Page et al. (2021), which outline the stages of identification, screening, suitability assessment, and final selection of studies (see Figure 1).

For data extraction, information from the included studies was systematically recorded in tables according to predefined categories, including author(s), publication year, country, research purpose, research type, sample size, subject area, data collection methods and tools, and key findings. The extracted data were then synthesized descriptively and organized according to the six research questions, focusing on individual and cognitive, socio-emotional, family and school, environmental and cultural factors, as well as the use and contribution of self-assessment procedures and tools to students' performance prediction accuracy.

The search keywords and phrases included the terms: "Feedback" AND "students' performance prediction" AND "students*" AND "instructors*" AND "primary education*", with combinations and substitutions, such as "learners*" instead of "students*" and "teachers*" instead of "instructors*", as well as variations with "primary school*". In addition, factors that influence the ability to predict student performance were explored, including individual cognitive, socio-emotional, family, school, and environmental-cultural factors. The search was mainly based on English terms, given the dominance of the literature in English,

including "self-assessment" AND "feedback" AND "primary education" to investigate the contribution of self-assessment to self-regulation and to more accurate prediction of student performance.

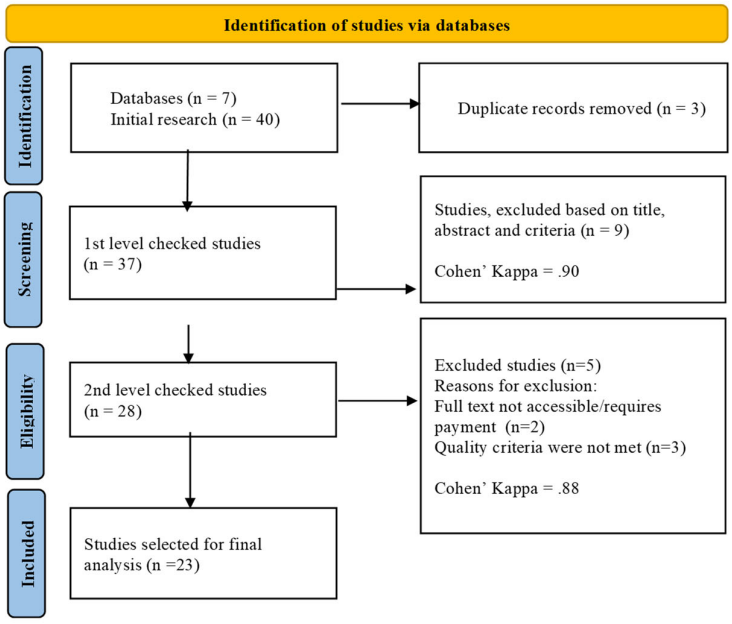

Figure 1. Flowchart of the Literature Review Following the PRISMA 2020 Guidelines (Page et al., 2021).

This review was conducted using seven databases. Scopus and IEEE Xplore were chosen for their broad subject coverage, while ScienceDirect and SpringerLink were selected for their focus on the social sciences and humanities. Additionally, SAGE Journals, ResearchGate, and Google Scholar were included. The search resulted in 40 studies; after excluding 3 duplicates, 37 studies were available for initial screening. During this first stage, the titles and abstracts were evaluated based on predefined criteria: a) language (English or Greek), b) relevance to education, c) reference to feedback and prediction of performance in primary education, d) information provided in the abstract, and e) publication date (2015–2025). To ensure consistency, a small sample of studies was assessed, and Cohen's kappa coefficient was calculated, with a value of .90 indicating almost perfect inter-rater agreement according to Landis and Koch's (1977) criteria, where values between .81 and 1.00 indicate almost perfect agreement (see Figure 1). Nine studies were excluded at this stage, leaving 28 for the second screening. During this phase, 2 additional studies were excluded because access to their full texts required payment. As full-text access was necessary to assess the studies against the predefined eligibility and quality criteria, these studies could not be adequately evaluated and were therefore excluded. The remaining 26 studies were evaluated for quality based on the following criteria: a) the context of the impact of feedback on predictions made by primary school students (field of study, type of study), b) methodological design (data type, sample),

and c) data collection methods and tools. Ultimately, 23 studies that met the criteria for the systematic review were selected, with consistency assessed again using Cohen's kappa, yielding a value of .88, which also indicates almost perfect inter-rater agreement according to the same criteria (see Figure 1).

5. Results

The following tables present studies that examine the relationship between feedback and primary school students' ability to accurately predict their performance. The data includes details about researchers, year of publication, country, purpose of the study, type of research, sample size, subject area, and key findings. The information is organized into categories: a) individual and cognitive factors of the student, b) socio-emotional factors, c) family and school factors, and d) environmental-cultural factors. In particular, Table 1 displays the results concerning the impact of feedback on the accuracy of students' performance predictions, focusing on cognitive characteristics such as language and math skills, memory, attention, as well as individual traits like motivation, study habits, self-regulation, metacognitive skills, accuracy in self-assessing performance, and prior performance (addressing the first research question).

Table 1. Results of Feedback's Effect on Accurately Predicting Student Performance in Primary Education, Considering Cognitive Factors and Individual Student Characteristics

Researchers **Year** **Country**	**Purpose of research**	**Research Type** **Sample Size** **Subject**	**Results**
Al-Harthy 2016 Oman	This study examined how feedback influences students' accuracy in making predictions.	Experimental 57 participants (27 males, 30 females) Elementary School All subjects Self-assessment (experimental and control groups)	Feedback enhanced prediction accuracy, as students in the experimental group demonstrated improved ability to make accurate predictions, with significant between-group differences observed in Trials 2 and 3, but not in Trial 1.
García, Rodríguez, González-Castro, González-Pienda & Torrance 2016 Spain	This study examines the relationship between accuracy in post-performance weighting and the metacognitive processes involved in solving mathematical problems.	Quantitative 524 participants Elementary School Mathematics Self-assessment (self-report questionnaires)	Students showed optimism and consistency in their judgments. Inaccurate judgments failed to represent information, relying instead on writing and error correction. The differences observed were related to performance and not to grade levels.

Table 1. Results of Feedback's Effect on Accurately Predicting Student Performance in Primary Education, Considering Cognitive Factors and Individual Student Characteristics(continued)

Researchers Year Country	Purpose of research	Research Type Sample Size Subject	Results
van Loon & Roebers 2017 Switzerland	Examining how feedback influences self-assessment and self-regulation in elementary school students to better understand its impact on their learning and behavior regulation.	Experimental 24 participants Elementary School All subjects Self-assessment (pre-test, post-test)	Fine-grained feedback significantly enhanced the accuracy of students' self-assessments and promoted self-regulation, particularly among younger students, by helping them identify commission errors and partially correct responses and modify their behavior accordingly.
Zhu & Mok 2018 Hong Kong	Investigating the impact of prior performance, interest, personal best goals, and teacher feedback on self-regulated learning.	Quantitative 1,200 participants Elementary School All subjects (questionnaires)	Previous performance, interest, personal best goal setting, and feedback are significant predictors of self-regulated learning, with personal best goal setting being the most influential.
Desoete, Baten, Vercaemst, De Busschere, Baudonck & Vanhaeke 2019 Belgium	Investigating the influence of metacognitive skills, motivation, and previous abilities as factors in the opportunity-predisposition model of learning.	Experimental 2,842 participants (1,477 boys, 1,365 girls) Elementary School Mathematics Self-assessment (Kortrijk Arithmetic Test Revision KRT-R)	Metacognitive skills related to mathematical accuracy in primary school. Internal drive was linked to accuracy but not to fluency. Students who struggled exhibited lower internal drive and metacognitive accuracy, causing them to overestimate their performance.
van Loon & van de Pol 2019 Switzerland	Investigating whether children are better at detecting errors in their own responses and those of their peers with feedback, and whether differences exist according to age and prior knowledge.	Experimental 97 participants (49 boys, 48 girls Elementary School All subjects Self-assessment (pre-test, post-test)	Error detection was more accurate for peer than self-judgments, with monitoring accuracy improving with age, whereas inaccurate prior knowledge was associated with less accurate self-monitoring.

Table 1. Results of Feedback's Effect on Accurately Predicting Student Performance in Primary Education, Considering Cognitive Factors and Individual Student Characteristics(continued)

Researchers Year Country	**Purpose of research**	**Research Type Sample Size Subject**	**Results**
Lara Nieto-Márquez, Baldominos & Pérez-Nieto 2020 Spain	Analyzes the implementation of the Smile and Learn platform and the relationship between feedback from digital activities and metacognitive knowledge and regulation.	Experimental (Smile and Learn digital teaching platform) 130 participants (72 boys, 58 girls) Elementary School Reasoning, Science, Literacy, Emotions, Arts Self-assessment (Metacognitive Awareness Questionnaire)	Digital activities incorporating feedback were associated with greater metacognitive knowledge, particularly through students' engagement in logical and spatial thinking activities, whereas no clear relationship was found with metacognitive regulation and overall improvement following the intervention was minimal.
Shao, Abdul Rabu & Chen 2025 China	Development and assessment of e-books featuring gamification to enhance movement, understanding, and performance in solving mathematical problems.	Experimental 60 participants Elementary School Mathematics Self-assessment (Yoya digital platform, metacognitive strategies)	Digital books that incorporate gamification and interactivity enhance motivation, comprehension, and performance while also aiding in predicting outcomes.

Table 2 displays the results regarding feedback and students' ability to accurately predict their performance. This is analyzed in relation to socio-emotional factors, including self-esteem, self-efficacy, and emotional regulation (specifically, stress and frustration management), as well as social skills such as collaboration, communication, and interpersonal relationships. This corresponds to the second research question.

Table 2. Results Showing How Feedback Impacts Accurate Prediction of Students' Performance in Primary Education, Based on Socio-Emotional Factors

Researchers Year Country	Purpose of research	Research Type Sample Size Subject	Results
Hier & Mahony 2018 USA	Analyzing how experiences with skills, performance feedback, and effort influence students' self-esteem in writing.	Experimental 117 participants Elementary School Language, writing Self-assessment (intervention, questionnaires)	Students demonstrated increased self-esteem following the intervention, with effort being a key predictor, whereas skills and positive feedback did not play a significant role.
Zedan 2021 Israel	Exploring how student feedback predicts learning motivation, academic performance, and classroom climate.	Quantitative 2,599 participants Elementary School, Senior School Language, Science, Mathematics, Computer Science (questionnaires)	Student feedback positively influences learning motivation, academic performance, and classroom climate, and is a predictor of academic success.
Smit, Dober, Hess, Bachmann & Birri 2023 Switzerland	Investigating the effects of formative feedback on students' mathematical reasoning and the mediating role of self-efficacy.	Mixed (quantitative, experimental) 1,261 participants Elementary School Mathematics (questionnaires, experiment)	Formative feedback significantly predicted self-efficacy (β=.62), while self-efficacy predicted mathematical reasoning (β=.49); the direct effect of feedback on reasoning was not significant. The model explained 84% of the variance in mathematical reasoning.
Eskelä-Haapanen, Pakarinen & Lerkkanen 2023 Finland	Investigating students' beliefs about their academic performance.	Quantitative 544 participants (270 boys, 274 girls) Elementary School All subjects Self-assessment (questionnaires)	More than one-third of children perceived themselves as performing well; teacher feedback was reported as infrequent and even less frequent among children who perceived poorer performance.

Table 3 presents the findings on how feedback influences the accurate prediction of student performance. This prediction is based on family factors, including parental education, living

conditions, parental involvement and support, as well as parental and community involvement. Additionally, it considers school factors such as teaching quality, teaching strategies, classroom climate, relationships with teachers and peers, school culture, and collaboration between school and family. This information addresses the third research question.

Table 3. Results of How Feedback Affects the Accurate Prediction of Student Performance in Primary Education, Considering Family and School Factors

Researchers **Year** **Country**	**Purpose of research**	**Research Type** **Sample Size** **Subject**	**Results**
Gabriele, Joram & Park 2016 USA	Assessing the accuracy of judgment and calibration of elementary school mathematics teachers and their relationship to student academic performance.	Quantitative 834 participants Elementary School Mathematics (accuracy of judgment and calibration test, student performance data)	Teachers' calibration accuracy explained 14% of the variance in subsequent student mathematics achievement, whereas task-specific judgment accuracy did not significantly predict achievement.
Yu & Wu 2016 Taiwan	Investigating how the quality of online peer feedback influences question quality and indirectly affects performance prediction through assignment quality.	Experimental 36 participants Elementary School All subjects Online learning environment (QuARKS)	Hierarchical regression showed that the quality of peer feedback provided and received significantly predicted students' question-generation quality, both separately and in combination.
Hirn, Hollo & Scott 2017 USA	Examining teaching practices (such as opportunities and feedback) and their impact on school performance in primary schools with high poverty rates.	Mixed (quantitative, qualitative) 530 teachers in 22 schools Elementary School All subjects (observations, questionnaires, interviews)	Variations in teaching methods correlate with differences in school performance, highlighting the importance of proactive classroom management strategies.
Lekwa, Reddy, Dudek & Hua 2019 USA	Evaluating teaching effectiveness by using feedback to enhance student academic performance in urban schools.	Quantitative 2,771 participants Kindergarten, Elementary School All subjects (questionnaires)	Higher-quality evidence-based instructional and behavior-management practices were associated with greater gains in students' reading and mathematics achievement.

Table 3. Results of How Feedback Affects the Accurate Prediction of Student Performance in Primary Education, Considering Family and School Factors(continued)

Researchers Year Country	Purpose of research	Research Type Sample Size Subject	Results
Zedan 2021 Israel	Exploring how student feedback predicts learning motivation, academic performance, and classroom climate.	Quantitative 2,599 participants Elementary School, Senior School Language, Science, Mathematics, Computer Science (questionnaires)	Student feedback positively influences learning motivation, academic performance, and classroom climate, and is a predictor of academic success.
Wilson, Ahrendt, Fudge, Raiche, Beard & MacArthur 2021 USA	The study qualitatively examines the attitudes and experiences of primary school writing teachers regarding the use of the automated writing assessment system MI Write.	Qualitative 90 teachers, 3,000 students Elementary School Language, writing Self-assessment (use of the automated writing assessment system MI Write)	The automated writing system significantly affects teachers and students, influencing motivation, independence, and performance predictions while creating new educational challenges within the broader educational context.
Glover, Reddy & Crouse 2023 USA	Examining the coaching actions that influence teachers' classroom practices and impact students' academic achievements.	Quantitative 133 teachers, 3,649 students Elementary School All subjects (observations, questionnaires)	Coaching feedback significantly predicted student ELA achievement, but not mathematics achievement; practice opportunities also significantly predicted teacher implementation fidelity and student achievement.
Brown, Andersson, Winberg & Palm 2023 Sweden	Examining the generalizability of the Teacher Conceptions of Feedback questionnaire and relating teachers' perceptions of feedback to self-reported feedback practices.	Quantitative 450 teachers Elementary School Educational Psychology Primary Self-assessment (questionnaires)	A six-factor model of TCoF was developed, revealing that students' perceptions of feedback—specifically, its potential to enhance learning and the likelihood of being ignored—account for significant variability in schema feedback practices.

Table 3. Results of How Feedback Affects the Accurate Prediction of Student Performance in Primary Education, Considering Family and School Factors(continued)

Researchers Year Country	Purpose of research	Research Type Sample Size Subject	Results
Li 2024 China	Examining how internal factors, such as teacher attitudes and knowledge, along with external factors, including social and educational challenges, as well as parental and community involvement, influence technology adoption.	Quantitative (questionnaires) 498 teachers Elementary School Mathematics (AI tools-(Baidu's Ernie Bot, ChatGPT, online learning platform)	Technology adoption is influenced by attitudes, social factors and challenges. Relevant knowledge had no direct effect. Parents/community had an indirect effect. Smart systems support teaching.
Chen 2025 China	Assessing the effectiveness of intelligent tutoring systems in teaching mathematics.	Experimental 80 participants Elementary School Mathematics (Intelligent Tutoring System-ITS)	Intelligent tutoring systems enhance student performance by providing automated feedback that improves the learning experience.

Table 4 presents the results regarding how feedback influences the accurate prediction of student performance. This analysis considers environmental and cultural factors, including linguistic and cultural backgrounds, educational inequalities, socio-economic contexts, policies, and available resources, which correspond to the fourth research question.

The data regarding the fifth and sixth research questions—specifically, the extent to which self-assessment procedures and tools are used and their impact on students' ability to accurately predict their performance—are integrated into all tables that present the results. This information is analyzed in detail in the discussion of the results that follows.

Table 4. Results of the Impact of Feedback on Accurately Predicting Student Performance in Primary Education Based on Environmental and Cultural Factors

Researchers Year Country	Purpose of research	Research Type Sample Size Subject	Results
Singh, Nagar & Sant 2016 India	Using data mining techniques to predict academic performance and identify patterns for timely student support.	Quantitative 1,000 participants Elementary School All subjects (questionnaires, data mining algorithms)	The predictive model achieved 85.53% accuracy; previous grades were important predictors, whereas school type did not significantly influence performance.

Table 4. Results of the Impact of Feedback on Accurately Predicting Student Performance in Primary Education Based on Environmental and Cultural Factors(continued)

Researchers Year Country	Purpose of research	Research Type Sample Size Subject	Results
Hirn, Hollo & Scott 2017 USA	Examining the differences in teaching practices, such as providing opportunities and feedback, and their impact on school performance in primary schools with high poverty rates.	Mixed (quantitative, qualitative) 530 teachers in 22 schools Primary All subjects (observations, questionnaires, interviews)	Differences in teaching practices are linked to variations in school performance, particularly emphasizing proactive classroom management strategies.
Wilson, Ahrendt, Fudge, Raiche, Beard & MacArthur 2021 USA	The study qualitatively examines the attitudes and experiences of primary school writing teachers regarding the use of the automated writing assessment system MI Write.	Qualitative 90 teachers, 3,000 students Elementary School Language, writing Self-assessment (use of the automated writing assessment system MI Write)	The automated writing system significantly affects teachers and students, influencing motivation, independence, and performance predictions while creating new educational challenges within the broader educational context.
Li 2024 China	Examining how internal factors, such as teacher attitudes and knowledge, along with external factors, including social and educational challenges, as well as parental and community involvement, influence technology adoption.	Quantitative (questionnaires) 498 teachers Elementary School Mathematics (AI tools-(Baidu's Ernie Bot, ChatGPT, online learning platform)	Technology adoption is influenced by attitudes, social factors and challenges. Relevant knowledge had no direct effect. Parents/community had an indirect effect. Smart systems support teaching.
Jin & Wang 2025 China	Exploring the significance of absolute versus relative feedback for children and their responses during the transition from kindergarten to 1st grade.	Experimental 72 kindergarten participants, 81 elementary school participants Kindergarten, Elementary School Developmental/Educational Psychology Self-assessment (prediction of absolute score and ranking)	Kindergarten children primarily respond to absolute feedback, such as satisfaction and grade predictions. By 1st grade, they also begin to show sensitivity to relative feedback, including emotional reactions and ranking predictions.

6. Discussion

This systematic review identified a total of 23 empirical studies, none of which were published in conference proceedings. In terms of publication years, most of the studies were from 2016 (n=5) and 2023 (n=4), while 2018, 2019, and 2025 each had three studies. Fewer studies were recorded in 2021 (n=2), and the years 2017, 2020, and 2024 also had two studies each. Geographically, most of the studies were conducted in Asia (n=9, 39.1%) and Europe (n=8, 34.8%), followed by America (n=6, 26.1%). The USA had the highest number of studies (n=6, 26.1%), followed by China (n=4, 17.4%), Switzerland (n=3, 13.1%), and Spain (n=2, 8.7%). One study was conducted in each of the following countries: Oman, Hong Kong, India, Taiwan, Israel, Belgium, Finland, Kenya, Nigeria, Ghana, Nepal, and Russia. In terms of survey types, the studies utilized quantitative methods (n=10, 43.5%) and experimental approaches (n=10, 43.5%), with fewer studies using mixed methods (n=2, 8.7%) or qualitative methods (n=1, 4.3%). The number of participants varied significantly across studies. Most studies included more than 500 participants (n=12, 52.2%), followed by those with 101 to 500 participants (n=5, 21.7%) and 51–100 participants (n=4, 17.4%). Only two studies had samples of 21–50 participants (n=2, 8.7%). Overall, the number of participants ranged from 24 to 2,849, with quantitative studies having samples ranging from 133 to 2,849; mixed studies ranging from 530 to 1,261; and experimental studies ranging from 24 to 130 participants. It is noteworthy that only five studies (21.7%) reported the male-to-female ratio. Regarding education levels, the vast majority of the studies were implemented in primary schools (n=20). Two studies were conducted in both primary and kindergarten settings, and one study spans primary and high school. When examining subjects, general education-encompassing all subjects-had the largest representation, with 10 studies (43.5%). This was followed by Mathematics, which also had seven studies (30.4%), as well as Language (n=2) and Educational Psychology (n=2). Additionally, two combined studies focused on Mathematics-Informatics and Mathematics-Physics, respectively. Finally, the use of digital media was identified in 9 out of the 23 studies (39.1%).

The eight studies included in this review generally highlight a positive impact of feedback on improving the accuracy of performance predictions, addressing the first research question about the influence of individual and cognitive factors. Although the studies varied in the cognitive subjects examined, research frameworks, and methodologies employed, most findings suggest that feedback can enhance students' ability to align their predictions with their actual performance. This aligns with established theoretical perspectives on metacognition and self-regulated learning (Flavell, 1979; Zimmerman, 2002). Specifically, experimental studies focusing on calibration and self-assessment (Al-Harthy, 2016; van Loon & Roebers, 2017; van Loon & van de Pol, 2019) support the findings of large-scale quantitative research (García et al., 2016; Zhu & Mok, 2018; Desoete et al., 2019) indicating that the effectiveness of feedback is enhanced when it is combined with well-developed metacognitive skills, self-regulation processes, and prior performance as a reference point. However, the findings are not entirely consistent across all studies. For example, while Al-Harthy (2016) found that feedback improved students' prediction accuracy, Lara Nieto-Márquez et al. (2020) found that digital activities incorporating feedback were

associated with greater metacognitive knowledge, but no clear relationship was observed with metacognitive regulation, and overall improvement following the intervention was minimal. These differences suggest that the effects of feedback may vary depending on the type of feedback, the outcome being assessed, the intervention context, and students' characteristics. Nevertheless, the findings broadly support feedback models that emphasize the role of feedback in activating students' cognitive and metacognitive processes (Black & Wiliam, 1998; Hattie & Timperley, 2007). Moreover, several studies indicate that students with higher levels of intrinsic motivation and developed metacognitive awareness tend to overestimate their abilities less often and demonstrate greater accuracy in their self-evaluations. This finding aligns with previous research indicating that intrinsic motivation and effective learning strategies are important predictors of accurate performance predictions (Fan & Chen, 2001; Zimmerman, 2002). There is also evidence concerning the role of prior performance and pre-existing knowledge, with students demonstrating lower performance or poorer metacognitive accuracy being more likely to overestimate their abilities, particularly at younger ages (Dunlosky & Rawson, 2012). Additionally, studies employing digital interventions suggest that educational platforms and gamified digital resources may enhance metacognitive knowledge, motivation, and performance prediction accuracy, particularly in subjects such as mathematics and logic (Lara Nieto-Márquez et al., 2020; Shao et al., 2025). Overall, the findings suggest that formative feedback, whether traditional or technology-based, can contribute to self-regulated learning in primary education (Nicol & Macfarlane-Dick, 2006), although its effects may depend on the specific characteristics of the feedback, learners, and learning context. Further research is therefore needed on differentiated feedback, its relationship with individual and cognitive factors, and its long-term effects on prediction accuracy. Investigating age, cognitive subjects, and initial performance, as well as exploring combined interventions involving metacognitive strategies and digital tools using mixed methods, may deepen understanding of self-regulated learning.

The studies that address socio-emotional factors (the second research question) are limited in number (n=4), but they show a strong consensus that feedback plays a supportive role in enhancing students' self-esteem, self-efficacy, and learning motivation. Specifically, formative feedback and a focus on personal effort contribute to improved performance prediction and self-regulated learning (Hier & Mahony, 2018; Smit et al., 2023; Eskelä-Haapanen et al., 2023; Zhu & Mok, 2018). Additionally, peer feedback and the use of digital tools enhance the quality of questions, as well as social skills and learning performance (Yu & Wu, 2016; Jin & Wang, 2025). These findings align with previous research and systematic reviews that also highlight the positive impact of feedback on socio-emotional factors and performance prediction (Hattie & Timperley, 2007; Wisniewski et al., 2020; Lipnevich & Panadero, 2021; Frantz et al., 2022). Despite these consistent and positive results, further research is needed to explore different types of feedback and how they interact with socio-emotional factors across various age groups and educational contexts. This will help clarify the mechanisms through which feedback influences performance prediction and the development of self-regulated learning.

In the systematic review comprising 23 empirical studies, ten studies (n = 10) address family

and school factors (3rd research question) that affect students' ability to accurately predict their performance. The findings indicate that teaching quality, instructional strategies, and guidance are the most significant predictors of prediction accuracy (Gabriele et al., 2016; Lekwa et al., 2019; Glover et al., 2023). Teachers who provide clear, explanatory, and personalized feedback enhance students' metacognitive awareness, self-regulation, and their ability to realistically assess their performance. Additionally, teacher guidance improves teaching practices and fosters a positive learning environment, thereby increasing students' receptivity to feedback. These results align with the meta-analyses conducted by Van der Kleij et al. (2015) and Wisniewski et al. (2020), which demonstrate that the quality and clarity of feedback are directly linked to improved learning, self-regulation, and performance prediction. Furthermore, peer feedback and automated systems, such as MI Write and Intelligent Tutoring Systems (ITS), appear to improve motivation, independence, and predictive ability by offering personalized and adaptive support (Yu & Wu, 2016; Wilson et al., 2021; Chen, 2025). Students receiving this type of feedback also develop greater self-awareness and self-correction skills, leading to more accurate grading (Zedan, 2021). The positive impact of digital and collaborative feedback aligns with previous reviews that underscore technology's role in developing metacognitive and self-regulatory skills (Dignath & Büttner, 2016; Criss et al., 2025; Brandmo & Gamlem, 2025). Equally important, the indirect involvement of parents and the community significantly contribute to the adoption of technology and the establishment of a supportive learning environment (Li, 2024). Moreover, collaboration between schools and families enhances students' trust, communication, and active engagement, which in turn improves their self-regulation, self-concept, and accuracy in performance predictions (Hirn et al., 2017; Brown et al., 2023). Ongoing communication between schools and parents fosters mutual support and reinforces educational expectations. These findings are consistent with the theoretical frameworks proposed by Black & Wiliam (1998) and Hattie & Timperley (2007), as well as with the empirical studies conducted by Winstone et al. (2017) and Zynuddin et al. (2023), which highlight the importance of the school context and school-family collaboration in enhancing the effectiveness of formative feedback. Future research could explore the long-term impacts of guidance and school-family collaboration, conduct comparative investigations of different feedback forms, and examine the roles of socioeconomic and cultural factors, as well as artificial intelligence, in improving self-regulation and performance prediction among primary school students.

In the category of environmental and cultural factors, only four studies were identified (research question 4). The type of school does not seem to have a direct impact on performance; however, the school district and prior outcomes are linked to grade predictions (Singh, Nagar & Sant, 2016). The transition from absolute to relative feedback at the beginning of elementary school shows an age-related increase in sensitivity (Jin & Wang, 2025). Variations in teaching practices, as well as the use of automated writing systems or technology, influence motivation, independence, and prediction, with indirect contributions from parents and the community (Hirn, Hollo & Scott, 2017; Wilson et al., 2021; Li, 2024). These findings align with previous research, which emphasizes the positive influence of environmental and cultural factors, along with technology and teaching practices, on prediction accuracy (Van der Kleij et al., 2015; Schneider & Preckel, 2017; Laici & Pentucci,

2019; Fleckenstein, Liebenow & Meyer, 2023; Hellas et al., 2018). Further research is needed to explore the long-term effects of these factors to better understand the dynamic interactions among environmental, cultural, and technological variables and how they contribute to optimizing the learning process and predicting student performance across various educational settings.

According to the results of the systematic review, self-assessment procedures and tools are utilized to a medium to high degree in primary education, with a noticeable upward trend in recent years (5th research question). Among the 23 empirical studies reviewed, 13 (56.5%) systematically incorporated self-assessment practices. Some studies employed traditional self-assessment methods, such as self-report questionnaires, pre/post-tests, and metacognitive tests like the Kortrijk Arithmetic Test Revision (KRT-R) (Al-Harthy, 2016; García et al., 2016; van Loon & Roebers, 2017; van Loon & van de Pol, 2019; Desoete et al., 2019). Additionally, other research included formative self-assessment interventions aimed at enhancing self-esteem and self-concept (Hier & Mahony, 2018; Eskelä-Haapanen et al., 2023), as well as a teacher self-assessment questionnaire called the Teacher Conceptions of Feedback (TCoF) (Brown et al., 2023). In terms of digital applications, various tools were used: the Smile and Learn platform helped develop metacognitive skills and self-regulation (Lara Nieto-Márquez et al., 2020), the automated writing assessment system MI Write improved performance prediction and student autonomy (Wilson et al., 2021), and the gamified Yoya platform featured e-books based on metacognitive strategies (Shao et al., 2025). Furthermore, Intelligent Tutoring Systems (ITS) provided personalized automated feedback (Chen, 2025). Li's (2024) research also highlighted the use of artificial intelligence tools, such as Baidu's Ernie Bot and ChatGPT, for personalized feedback and enhanced self-monitoring. Lastly, one study investigated the development of self-assessment at a young age through score prediction and ranking activities, demonstrating the growth of more realistic performance judgments (Jin & Wang, 2025).

Research incorporating self-assessment (6th research question) indicates several benefits for students, particularly those aged young children and older kids. In a study with a sample size of 12 participants (59.2%), findings suggest that self-assessment enhances performance prediction accuracy through feedback, behavioral adaptation, and self-regulation, especially when pre-tests and post-tests are utilized. The effectiveness of these assessments is greater in older children and when they are combined with prior knowledge (Al-Harthy, 2016; van Loon & Roebers, 2017; van Loon & van de Pol, 2019). Additionally, metacognitive awareness and regulation are improved through digital platforms like Smile and Learn, which offer activities that enhance logical and spatial thinking. Self-assessment is linked to stable and positive judgments, leading to better performance in mathematics through the use of metacognitive skills and intrinsic motivation. This process also boosts self-esteem, particularly from efforts made in writing interventions, and helps reduce overestimation of abilities in weaker students (García et al., 2016; Hier & Mahony, 2018; Desoete et al., 2019; Lara Nieto-Márquez et al., 2020; Wilson et al., 2021). Moreover, positive beliefs about performance, shaped by self-concept and the school environment, encourage adaptation and improvement. Digital books that incorporate gamification increase motivation,

comprehension, and performance prediction in mathematics, fostering a greater sensitivity to feedback, especially during the transition from kindergarten to elementary school. Furthermore, teachers' perceptions of feedback can predict practices that enhance learning (Brown et al., 2023; Eskelä-Haapanen et al., 2023; Shao et al., 2025; Jin & Wang, 2025). In contrast, research that does not use self-assessment methods relies on external approaches, such as data mining from previous results, teacher evaluations, peer feedback, and predictors like performance and interest. This reliance limits students' autonomy, metacognition, and internal adaptation (Singh et al., 2016; Gabriele et al., 2016; Yu & Wu, 2016; Zhu & Mok, 2018; Hirn et al., 2017; Lekwa et al., 2019; Zedan, 2021; Glover et al., 2023; Smit et al., 2023; Li, 2024; Chen, 2025).

7. Conclusions-Suggestions

This systematic review indicates that research on feedback, self-assessment, and the ability to predict performance in primary education has grown significantly in recent years. There is a notable geographical concentration of this research in Asia and Europe, while the United States continues to lead in terms of the number of publications. Most studies are quantitative or experimental and tend to involve relatively large sample sizes; however, there is limited attention given to demographic distributions, such as gender ratios. Moreover, research primarily focuses on primary schools and general education, particularly in the field of mathematics. There is also a scarcity of qualitative and mixed-methods studies, which suggests the need for a wider variety of methodologies and broader dissemination of findings. The use of digital media in education, while present, is relatively limited and categorized into three main areas: digital questionnaires, digital educational environments and platforms, and intelligent teaching systems employing artificial intelligence. There is a progression from simple data collection tools to more complex, personalized digital learning environments, indicating an increasing integration of technology into the educational process. Nevertheless, this technology remains underutilized and is mainly focused on specific applications.

Research has shown that individual and cognitive factors significantly influence how students utilize feedback to accurately predict their performance. Students who possess strong metacognitive skills, intrinsic motivation, and effective self-regulatory habits tend to respond more positively to feedback, enabling them to adjust their learning strategies accordingly. Furthermore, self-assessment and reflective practices help reduce the tendency to overestimate performance and improve prediction accuracy, particularly among low-achieving students. As a result, accurate performance predictions appear to depend directly on the combined development of cognitive and metacognitive skills, as well as students' ability to interpret and creatively apply the feedback they receive.

Socio-emotional factors, such as self-esteem, self-efficacy, and emotional regulation, play a significant role in shaping students’ relationships with feedback. Research has demonstrated that formative feedback, combined with active student engagement through self-assessment, enhances self-confidence and reduces anxiety related to failure. Additionally, other studies indicate that a positive self-concept and a supportive classroom environment contribute to

predictive accuracy and adaptation to learning challenges. Consequently, emotional security and trust in the teacher are essential prerequisites for effectively utilizing feedback.

Family and school factors play a significant role in how students use feedback to predict their performance. Research has demonstrated that high-quality teaching, collaboration between schools and families, and a positive classroom environment contribute to strengthening students' self-concept and enhancing their predictive abilities. Furthermore, the findings indicate that teachers who offer clear and supportive feedback help improve students' self-regulation strategies. Additionally, parental involvement provides consistency and continuity in the learning process. Overall, the coordinated efforts of teachers, schools, and families lead to more accurate predictions of student performance.

The analysis of the research indicates that environmental and cultural factors—such as socioeconomic context, access to technology, and language background—affect the effectiveness of feedback and prediction. The findings show that students from schools with limited resources tend to have lower prediction accuracy. However, when technology is available, it can help mitigate this issue. Additionally, some studies have emphasized the importance of cultural values and educational practices in shaping attitudes toward feedback. Therefore, effectively utilizing feedback requires adaptation to the sociocultural characteristics of the student population.

Numerous studies document the use of self-assessment processes and tools in primary education, revealing a medium to high level of implementation. The tools used include digital platforms, Intelligent Teaching Systems, artificial intelligence tools, as well as traditional models like self-report questionnaires, metacognitive tests, and predictive activities. Self-assessment, whether conducted digitally or through traditional methods, is consistently linked to improvements in self-regulation, metacognitive accuracy, and receptivity to feedback. Therefore, systematically implementing self-assessment is crucial for developing predictive capacity. The findings indicate that including self-assessment in learning processes offers numerous advantages for students. These benefits include improved accuracy in predicting performance, enhanced self-regulation, the development of metacognitive skills, increased self-esteem and intrinsic motivation, and better learning outcomes—particularly among older students and when connected to prior knowledge. Additionally, the use of digital platforms and gamified tools further amplifies these advantages by promoting motivation, understanding, and responsiveness to feedback. In contrast, research that relies solely on external feedback methods can hinder students' autonomy, metacognition, and their ability to adapt internally. This highlights the importance of self-assessment as a crucial tool in the learning process.

Further research is needed to optimize feedback strategies in primary education, focusing on factors such as type, timing, personalization, and format. It is also important to consider the interaction between these feedback strategies and individual factors like self-esteem, self-efficacy, and emotional regulation, as well as socio-cultural factors such as background and linguistic diversity. Specifically, research should prioritize understanding the long-term impact of feedback on students' self-prediction accuracy, the teacher-student relationship, and

the reduction of educational inequalities through digital tools. Key areas of focus should include improving the accuracy of students' performance predictions, enhancing the teacher-student relationship, advancing teacher training, and implementing tailored interventions. These insights should aim to inform evidence-based national policies and practices that promote self-regulation, metacognitive accuracy, and overall learning success.

References

Abd Rahman, N., Wang, S. L., Ng, T. F., & Ghoneim, A. S. (2024). Artificial Intelligence in Education: A Systematic Review of Machine Learning for Predicting Student Performance. *Journal of Advanced Research in Applied Sciences and Engineering Technology*, *54*(1), 198–221. https://doi.org/10.37934/araset.54.1.198221

Alamri, R., & Alharbi, B. (2021). Explainable student performance prediction models: a systematic review. *IEEE Access, 9,* 33132-33143. 10.1109/ACCESS.2021.3061368.

Albreiki, B., Zaki, N., & Alashwal, H. (2021). A systematic literature review of student' performance prediction using machine learning techniques. *Education Sciences, 11*(9), 552. https://doi.org/10.3390/educsci11090552

Al-Din, M. S. N., & Al Abdulqader, H. A. (2024). Students' Academic Performance Prediction Using Educational Data Mining and Machine Learning: A Systematic Review. *International Journal of Research and Innovation in Social Science*, *VIII*(VIII), 1264–1291. https://doi.org/10.47772/ijriss.2024.808095

Al-Harthy, I. S. (2016). Prediction Accuracy: The Role of Feedback in 6th Graders' Recall Predictions. *International Education Studies, 9*(3), 212–216. https://doi.org/10.5539/IES.V9N3P212

Baashar, Y., Alkawsi, G., Ali, N., Alhussian, H., & Bahbouh, H. T. (2021). Predicting student's performance using machine learning methods: A systematic literature review. *International Conference on Computer and Information Sciences*, 357–362. https://doi.org/10.1109/ICCOINS49721.2021.9497185

Badrun, B. (2024). A Systematic Review of the Nexus between Teacher Feedback and Student Motivation. *Education Studies and Teaching Journal (EDUTECH), 1*(1), 70-79. https://journal.ppipbr.com/index.php/edutech/article/download/237/220

Black, P., & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in Education: Principles, Policy & Practice, 5*(1), 7–74. https://doi.org/10.1080/0969595980050102

Brandmo, C., & Gamlem, S. M. (2025). Students' perceptions and outcome of teacher feedback: A systematic review. *Frontiers in Education, 10,* Article 1572950. https://doi.org/10.3389/feduc.2025.1572950

Brookhart, S. M. (2017). *How to give effective feedback to your students* (2nd ed.). ASCD.

Brown, G. T., Andersson, C., Winberg, M., & Palm, T. (2023). Predicting formative feedback practices: improving learning and minimising a tendency to ignore feedback. *In Frontiers in* Education (Vol. 8, p. 1241998). Frontiers Media SA. https://doi.org/10.3389/feduc.2023.1241998

Cen, Y., & Zheng, Y. (2024). The motivational aspect of feedback: A meta-analysis on the effect of different feedback practices on L2 learners' writing motivation. *Assessing Writing, 59*, 100802. https://doi.org/10.1016/j.asw.2023.100802

Chakrapani, P., & D, C. (2022). *Academic Performance Prediction Using Machine Learning: A Comprehensive & Systematic Review*. 335–340. https://doi.org/10.1109/ICESIC53714.2022.9783512

Chen, T. (2016). Technology-supported peer feedback in ESL/EFL writing classes: A research synthesis. *Computer Assisted Language Learning, 29*(2), 365-397. https://doi.org/10.1080/09588221.2014.960942

Chen, Y. (2025). Evaluation of the Application Effect of Intelligent Teaching Systems in Mathematics Education. *International Journal of Web-Based Learning and Teaching Technologies (IJWLTT)*, *20*(1), 1-19. https://doi.org/10.4018/IJWLTT.368027

Cordovani, L., Tran, C., Wong, A., Jack, S. M., & Monteiro, S. (2023). Undergraduate learners' receptiveness to feedback in medical schools: A scoping review. *Medical Science Educator, 33*(5), 1253-1269. https://doi.org/10.1007/s40670-023-01858-0

Criss, C. J., Carreon, A. C., Massey, C. C., & Davis, A. (2025). The role of technology in performance feedback on teacher practice: A systematic review. *International Journal of Professional Development, Learners and Learning, 7*(1), Article e2501. https://doi.org/10.30935/ijpdll/15690

Debray, T. P. A., Damen, J. A. A. G., Snell, K. I. E., Ensor, J., Hooft, L., Reitsma, J. B., Riley, R. D., & Moons, K. G. M. (2017). A guide to systematic review and meta-analysis of prediction model performance. *BMJ*, *356*. https://doi.org/10.1136/BMJ.I6460

Denham, S. A. (2006). Social-emotional competence as support for school readiness: What is it and how do we assess it? *Early Education and Development, 17*(1), 57–89. https://doi.org/10.1207/s15566935eed1701_4

Desoete, A., Baten, E., Vercaemst, V., De Busschere, A., Baudonck, M., & Vanhaeke, J. (2019). Metacognition and motivation as predictors for mathematics performance of Belgian elementary school children. *ZDM*, *51*(4), 667-677. https://doi.org/10.1007/s11858-018-01020-w

Dignath, C., & Büttner, G. (2016). Components of fostering self-regulated learning among students. A meta-analysis on intervention studies at primary and secondary school level. *Metacognition and Learning, 11*(3), 401–429. https://doi.org/10.1007/s11409-015-9140-5

Dönmez, A., & Aydın, İ. S. (2023). Review of studies on feedback types: Systematic review study. *Osmangazi Journal of Educational Research, 10 (Special Issue),* 293-317. https://doi.org/10.59409/ojer.1369117

Dunlosky, J., & Rawson, K. A. (2012). Overconfidence produces underachievement: Inaccurate self-evaluations undermine students' learning and retention. *Learning and Instruction, 22*(4), 271–280. https://doi.org/10.1016/j.learninstruc.2011.08.003

Eskelä-Haapanen, S., Pakarinen, E., & Lerkkanen, M. K. (2023). Children's beliefs concerning their school performance at the end of the first grade in Finland. *Early Child Development and Care*, *193*(3), 305-318. https://doi.org/10.1080/03004430.2022.2089132

Esmaeeli, B., Esmaeili Shandiz, E., Shojaei, H., Fazli, B., & Ahmadi, R. (2023). Feedback in Higher Education: An Overview of Reviews and Systematic Reviews. *Medical Education Bulletin*, *4*(2), 745-764. https://doi.org/10.22034/meb.2023.405421.1080

Fan, W., & Chen, M. (2001). Parental involvement and students' academic achievement: A meta-analysis. *Educational Psychology Review, 13*(1), 1–22. https://doi.org/10.1023/A:1009048817385

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry. *American Psychologist, 34*(10), 906–911. https://doi.org/10.1037/0003-066X.34.10.906

Fleckenstein, J., Liebenow, L. W., & Meyer, J. (2023). Automated feedback and writing: A multi-level meta-analysis of effects on students' performance. *Frontiers in Artificial Intelligence, 6,* Article 1162454. https://doi.org/10.3389/frai.2023.1162454

Fong, C. J., Patall, E. A., Vasquez, A. C., & Stautberg, S. (2019). A meta-analysis of negative feedback on intrinsic motivation. *Educational Psychology Review, 31*(1), 121–162. https://doi.org/10.1007/s10648-018-9450-6

Frantz, J., Cupido-Masters, J., Moosajee, F., & Smith, M. R. (2022). Non-cognitive support for postgraduate studies: A systematic review. *Frontiers in Psychology, 12,* 773910. https://doi.org/10.3389/fpsyg.2021.773910

Gabriele, A. J., Joram, E., & Park, K. H. (2016). Elementary mathematics teachers' judgment accuracy and calibration accuracy: Do they predict students' mathematics achievement

outcomes? *Learning and Instruction*, *45*, 49-60. https://doi.org/10.1016/j.learninstruc.2016.06.008

Gao, X., Noroozi, O., Gulikers, J., Biemans, H. J., & Banihashem, S. K. (2024). A systematic review of the key components of online peer feedback practices in higher education. *Educational Research Review, 42,* 100588. https://doi.org/10.1016/j.edurev.2023.100588

García, T., Rodríguez, C., González-Castro, P., González-Pienda, J. A., & Torrance, M. (2016). Elementary students' metacognitive processes and post-performance calibration on mathematical problem-solving tasks. *Metacognition and Learning*, *11*(2), 139-170. https://doi.org/10.1007/s11409-015-9139-1

Gay, G. (2018). *Culturally responsive teaching: Theory, research, and practice* (2nd ed.). Teachers College Press.

Glover, T. A., Reddy, L. A., & Crouse, K. (2023). Instructional coaching actions that predict teacher classroom practices and student achievement. *Journal of School Psychology*, *96*, 1-11. https://doi.org/10.1016/j.jsp.2022.10.006

Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning*. Routledge.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77*(1), 81–112. https://doi.org/10.3102/003465430298487

Haughney, K., Wakeman, S., & Hart, L. (2020). Quality of feedback in higher education: A review of literature. *Education Sciences, 10*(3), 60. https://doi.org/10.3390/educsci10030060

Hellas, A., Ihantola, P., Petersen, A., Ajanovski, V. V., Gutica, M., Hynninen, T., ... & Liao, S. N. (2018). Predicting academic performance: a systematic literature review. *In Proceedings companion of the 23rd annual ACM conference on innovation and technology in computer science education* (pp. 175-199). https://doi.org/10.1145/3293881.3295783

Hier, B. O., & Mahony, K. E. (2018). The contribution of mastery experiences, performance feedback, and task effort to elementary-aged students' self-efficacy in writing. *School psychology quarterly: the official journal of the Division of School Psychology, American Psychological Association, 33*(3), 408–418. https://doi.org/10.1037/spq0000226

Hirn, R. G., Hollo, A., & Scott, T. M. (2017). Exploring instructional differences and school performance in high-poverty elementary schools. *Preventing School Failure: Alternative Education for Children and Youth, 62*(1), 37–48. https://doi.org/10.1080/1045988X.2017.1329197

Jin, Y., & Wang, H. (2025). The impact of absolute and relative feedback on children's self-evaluation: Transitioning from kindergarten to first grade. *Journal of Experimental Child Psychology*, *252*, 106157. https://doi.org/10.1016/j.jecp.2024.106157

Kerman, N. T., Banihashem, S. K., Karami, M., Er, E., Van Ginkel, S., & Noroozi, O. (2024). Online peer feedback in higher education: A synthesis of the literature. *Education and Information Technologies*, *29*(1), 763-813. https://doi.org/10.1007/s10639-023-12273-8

Khan, A., & Ghosh, S. K. (2021). Student performance analysis and prediction in classroom learning: A review of educational data mining studies. *Education and information Technologies*, *26*(1), 205-240. https://doi.org/10.1007/s10639-020-10230-3

Koenka, A. C., & Karabenick, S. A. (2018). A meta-analysis on the impact of grades and comments on academic motivation and achievement: A case for written feedback. *American Educational Research Journal,* *55*(1), 60–97. https://doi.org/10.3102/0002831217739094

Kumari, V., Meghji, A. F., Qadir, R., Gianchand, U., & Shaikh, F. B. (2024). Predicting Student Performance Using Educational Data Mining: A Review. *KIET Journal of Computing and Information Sciences*. https://doi.org/10.51153/kjcis.v7i1.212

Laici, C., & Pentucci, M. (2019). Feedback with technologies in higher education: a systematic review. *Form@re - Open Journal Per La Formazione in Rete, 19*(3), 6–25. https://doi.org/10.13128/form-7698

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33*(1), 159–174. https://doi.org/10.2307/2529310

Lara Nieto-Márquez, N., Baldominos, A., & Pérez-Nieto, M. Á. (2020). Digital teaching materials and their relationship with the metacognitive skills of students in primary education. *Education Sciences, 10*(4), 113. https://doi.org/10.3390/educsci10040113

Lekwa, A. J., Reddy, L. A., Dudek, C. M., & Hua, A. N. (2019). Assessment of teaching to predict gains in student achievement in urban schools. *School Psychology, 34*(3), 271–280. https://doi.org/10.1037/spq0000293

Li, M. (2024). Integrating artificial intelligence in primary mathematics education: Investigating internal and external influences on teacher adoption. *International Journal of Science and Mathematics Education,* 1-26. https://doi.org/10.1007/s10763-024-10515-w

Lipnevich, A. A., & Panadero, E. (2021). A review of feedback models and theories: Descriptions, definitions, and conclusions. In *Frontiers in Education,* 6, 720195). Frontiers Media SA. https://doi.org/10.3389/feduc.2021.720195

Liu, Q., & Brown, D. (2015). Methodological synthesis of research on the effectiveness of corrective feedback in L2 writing. *Journal of Second Language Writing, 30,* 66-81. https://doi.org/10.1016/j.jslw.2015.08.011

Liu, W. (2024). A systematic review of automated writing evaluation feedback: Validity, effects and students' engagement. *Language Teaching Research Quarterly, 45,* 86–105. https://doi.org/10.32038/ltrq.2024.45.05

Nawang, H., Makhtar, M., & Hamzah, W. M. A. F. W. (2021). A systematic literature review on student performance predictions. *International Journal of Advanced Technology and Engineering Exploration*, *8*(84), 1441-1453. http://dx.doi.org/10.19101/IJATEE.2021.874521

Nelson, T. O., & Narens, L. (1990). Metamemory: A theoretical framework and new findings. *The Psychology of Learning and Motivation, 26*, 125–173. https://doi.org/10.1016/S0079-7421(08)60053-5

Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in Higher Education, 31*(2), 199–218. https://doi.org/10.1080/03075070600572090

Nieminen, J. H., & Carless, D. (2023). Feedback literacy: A critical review of an emerging concept. *Higher Education*, *85*(6), 1381-1400. https://doi.org/10.1007/s10734-022-00895-9

Oppong, S. O. (2023). Predicting Students' Performance Using Machine Learning Algorithms: A Review. *Asian Journal of Research in Computer Science*. https://doi.org/10.9734/ajrcos/2023/v16i3351

Paterson, C., Paterson, N., Jackson, W., & Work, F. (2020). What are students' needs and preferences for academic feedback in higher education? A systematic review. *Nurse Education Today, 85,* 104236. https://doi.org/10.1016/j.nedt.2019.104236

Rastrollo-Guerrero, J. L., Gómez-Pulido, J. A., & Durán-Domínguez, A. (2020). Analyzing and predicting students' performance by means of machine learning: A review. *Applied sciences*, *10*(3), 1042. https://doi.org/10.3390/app10031042

Rodrigues, L. S., dos Santos, M., Costa, I., & Moreira, M. A. L. (2022). Student performance prediction on primary and secondary schools-a systematic literature review. *Procedia Computer Science*, *214*, 680-687. https://doi.org/10.1016/j.procs.2022.11.229

Roslan, M. H. B., & Chen, C. J. (2022). Educational Data Mining for Student Performance Prediction: A Systematic Literature Review (2015-2021). *International Journal of Emerging Technologies in Learning (Ijet)*, *17*(05), 147–179. https://doi.org/10.3991/ijet.v17i05.27685

Schneider, M., & Preckel, F. (2017). Variables associated with achievement in higher education: A systematic review of meta-analyses. *Psychological Bulletin, 143*(6), 565–600. https://doi.org/10.1037/bul0000098

Shao, J., Abdul Rabu, S. N., & Chen, C. (2025). The impact of gamified interactive e-books incorporating metacognitive reading strategies on Chinese elementary students' mathematical reading comprehension, word problem-solving performance, and general reading motivation. *Education and Information Technologies*, 1-37. https://doi.org/10.1007/s10639-025-13660-z

Shute, V. J. (2008). Focus on formative feedback. *Review of Educational Research, 78*(1), 153–189. https://doi.org/10.3102/0034654307313795

Singh, M., Nagar, H., & Sant, A. (2016). Using data mining to predict primary school student performance. *IJARIIE, 2*(1), 43-46.

Smit, R., Dober, H., Hess, K., Bachmann, P., & Birri, T. (2023). Supporting primary students' mathematical reasoning practice: the effects of formative feedback and the mediating role of self-efficacy. *Research in Mathematics Education*, *25*(3), 277-300. https://doi.org/10.1080/14794802.2022.2062780

Snow, R. E. (1994). Abilities in academic tasks. In R. J. Sternberg & R. K. Wagner (Eds.), *Mind in context: Interactionist perspectives on human intelligence* (pp. 3–37). Cambridge University Press.

Van der Kleij, F. M., Feskens, L., & Eggen, T. J. H. M. (2015). Effects of feedback in a computer-based learning environment on students' learning outcomes: A meta-analysis. *Review of Educational Research, 85*(4), 475–511. https://doi.org/10.3102/0034654314564881

van Loon, M. H., & Roebers, C. M. (2017). Effects of feedback on self-evaluations and self-regulation in elementary school. *Applied Cognitive Psychology, 31*(5), 508-519. https://doi.org/10.1002/acp.3347

van Loon, M., & van de Pol, J. (2019). Judging own and peer performance when using feedback in elementary school. *Learning and Individual Differences*, *74*, 101754. https://doi.org/10.1016/j.lindif.2019.101754

Wilson, J., Ahrendt, C., Fudge, E. A., Raiche, A., Beard, G., & MacArthur, C. (2021). Elementary teachers' perceptions of automated feedback and automated scoring: Transforming the teaching and learning of writing using automated writing evaluation. *Computers & Education*, *168*, 104208. https://doi.org/10.1016/j.compedu.2021.104208

Winstone, N. E., Nash, R. A., Parker, M., & Rowntree, J. (2017). Supporting learners' agentic engagement with feedback: A systematic review and a taxonomy of recipience processes.

Educational Psychologist, 52(1), 17–37. https://doi.org/10.1080/00461520.2016.1207538

Wisniewski, B., Zierer, K., & Hattie, J. (2020). The power of feedback revisited: A meta-analysis of educational feedback research. *Frontiers in Psychology, 10,* Article 3087. https://doi.org/10.3389/fpsyg.2019.03087

Yu, F. Y., & Wu, C. P. (2016). Predictive effects of the quality of online peer-feedback provided and received on primary school students' quality of question-generation. *Journal of Educational Technology & Society, 19*(3), 234-246. http://www.jstor.org/stable/jeductechsoci.19.3.234

Zedan, R. (2021). Student feedback as a predictor of learning motivation, academic achievement and classroom climate. *Education and self-development*, *16*(2), 27-46. https://doi.org/10.26907/esd.16.2.03

Zhu, J., & Mok, M. M. C. (2018). Predicting primary students' self-regulated learning by their prior achievement, interest, personal best goal orientation and teacher feedback. *Educational Psychology, 38*(9), 1106-1128. https://doi.org/10.1080/01443410.2018.1497775

Zimmerman, B. J. (2002). Becoming a self-regulated learner: An overview. *Theory Into Practice, 41*(2), 64–70. https://doi.org/10.1207/s15430421tip4102_2

Zynuddin, S. N., Kenayathulla, H. B., & Sumintono, B. (2023). The relationship between school climate and students' non-cognitive skills: A systematic literature review. *Heliyon, 9*(4), e14773. https://doi.org/10.1016/j.heliyon.2023.e14773

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