

Is the Academic Performance of College Students Related to Their Academic Foundation? A Methodological Review of the Literatures

Lianchuan Xiao¹ and Fei Gao^{2,*}

¹ School of Transportation Information Engineering, Yunnan Communications Vocational and Technical College, Kunming, China

² School of Electrical and Information Technology, Yunnan Minzu University, Kunming, China
Email: 1592093078@qq.com (L.X.); gaofei@ymu.edu.cn (F.G.)

*Corresponding author

Abstract—Academic performance is a crucial indicator for evaluating college students' learning abilities and outcomes, which holds significant value for the design and improvement of course content and teaching methods. It is generally believed that there is a close relationship between college students' academic performance and their academic foundation, and the analysis of this correlation is an important field in educational research. This study focuses on the research findings and analytical methods of relevant literature published in this domain. Using Baidu Scholar and Google Scholar, we analyzed publication trends from 2013 to 2023 and selected 35 representative studies for detailed review. We found that research methods selected papers can be categorized into three types: quantitative analysis methods (including meta-analysis), qualitative analysis methods, and mixed analysis methods. The strengths and limitations of each approach were critically evaluated. Additionally, a keyword analysis using word cloud visualization revealed that meta-analysis is the most frequently employed technique, underscoring its growing prominence in this field. Based on these findings, we propose three fundamental principles for conducting correlation analyses between college students' academic performance and their academic foundation. Furthermore, we highlight three potential directions for innovative research in this area.

Keywords—college students' academic performance, academic foundation, literature analysis, research methods, research principles

I. INTRODUCTION

The definition of academic performance among college students varies across scholars, whereas exam scores are widely recognized as a standard measure of academic achievement. York *et al.* [1] identified six aspects of academic success for college students, one of which is academic performance. According to the definition retrieved from wikipedia.org, academic achievement or academic performance refers to the extent

to which a student, teacher, or institution has achieved their short or long-term educational goals. Completion of educational benchmarks, such as secondary school diplomas and bachelor's degrees, represents academic achievement [2]. Generally, academic performance in college is evaluated via diverse assessment methods, including exams, homework, projects, group discussions, and oral presentations, typically expressed in grades or levels.

Students' grades partially reflect their comprehension and application of course content during the basic education stage. College entrance examination scores serve as a crucial metric for assessing learning outcomes at this stage, providing insights into students' learning abilities, knowledge accumulation, and test-taking proficiency. These scores are a primary criterion for university admissions and are generally regarded as an indicator of students' academic foundation.

It is widely assumed that students' college entrance examination scores correlate with their learning potential in university. Specifically, a positive relationship is believed to exist between subject-specific scores in basic education and corresponding performance in higher education. Analyzing the relationship between college students' academic performance and their academic foundation is instrumental in understanding the factors influencing academic success. This analysis also supports educators in devising targeted educational interventions. Furthermore, students' academic performance often significantly influences their eligibility for advanced study opportunities. Research in this domain contributes positively to improving educational quality, promoting educational equity, and advancing personalized education.

This study examines trends in the volume of retrieved literature, selects representative studies for analysis, and evaluates the methodologies and conclusions presented in the reviewed literature. Finally, we propose fundamental principles for future research in this field and outline potential innovative directions for exploration.

II. MATERIALS AND METHODS

A. Literature Quantity

The volume of literature serves as a direct indicator of the research activity and significance of a given field. Baidu Scholar and Google Scholar are essential platforms for retrieving Chinese and English academic literature, respectively. Using the search phrases “academic performance of college students” (Baidu Scholar: College Students’ Academic Performance), “academic foundation of college students” (Baidu Scholar: College Students’ Academic Foundation), and “academic performance and academic foundation of college students” (Baidu Scholar: College Students’ Academic Performance + Academic Foundation), we conducted a search for documents published between 2013 and 2023 on both platforms. The trends in publication volume are presented in Figs. 1 and 2.

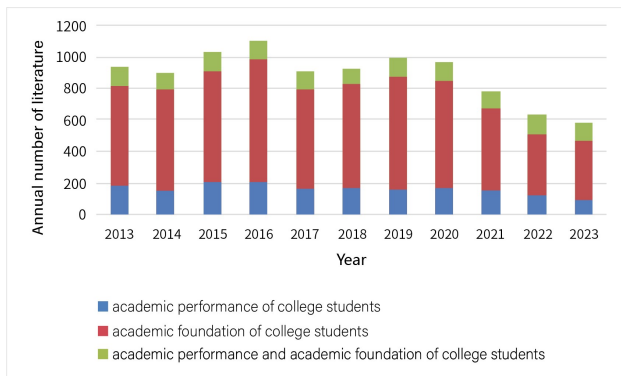


Fig. 1. Baidu Scholar literature stack bar graph (data as of September 30, 2024).

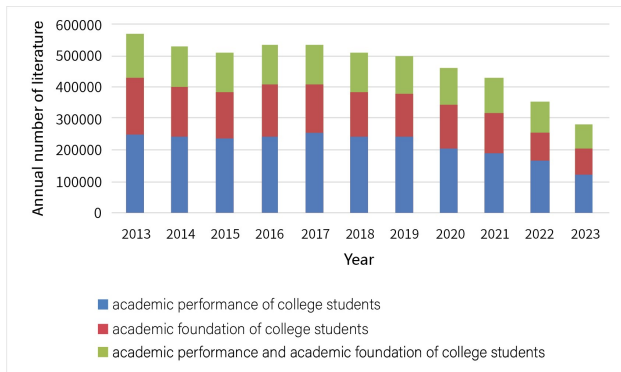


Fig. 2. Google Scholar literature stack bar graph (data as of September 30, 2024).

Over the past decade, the relationship between academic performance and academic foundation in college students has remained an ongoing and attractive research topic, as evidenced by the quantity of published studies. As shown in Fig. 1, from 2013 to 2023, approximately 1,259 Chinese-language articles (from Baidu Scholar) focused on the combined theme of academic performance and academic foundation of college students, which accounts for only 14.8% of the total literature on the two separate topics (i.e., College Students’ Academic Performance and College Students’ Academic Foundation). Fig. 2 illustrates that during the

same period, a total of 1,296,400 articles (from Google Scholar) were published on these topics in English, which accounts for 33.1% of the total literature in these two individual topics. The data demonstrates that the number of Chinese-language articles is lower than their English counterparts, which may reflect a smaller number of Chinese scholars publishing in this research field. Furthermore, the literature volume implies that studies on the relationship combined theme of academic performance and academic foundation are fewer compared to those focusing on the two topics separately, likely due to the complex nature of their interconnection.

Based on relevance rankings and citation volumes, we selected 35 papers for an analysis of their research methods and conclusions (excluding two wikipedia.org pages; see reference section). The reference section includes 30 English-language documents retrieved from Google Scholar using the combined theme “College Students’ Academic Performance + College Students’ Academic Foundation”. The citation volumes of these publications range from 115 to 1,602, with an average citation volume of 528 (as of September 30, 2024). Additionally, the reference section incorporates five Chinese-language publications from Baidu Scholar, each with titles directly related to the academic performance and academic foundation of college students.

B. Analysis of Main Research Methods

Research conclusions are inherently shaped by the methods employed. These methods provide the theoretical framework and contextual foundation necessary for understanding the key issues and findings within a study. Robust scientific research methods uncover relationships between variables, significantly influencing the accuracy and reliability of research outcomes. Moreover, recognizing the limitations of research methods helps to avoid misinterpretations and overgeneralizations.

The research methods identified in the literature are categorized into quantitative analysis, qualitative analysis, and mixed-methods approaches. These methodologies guide the collection, analysis, and interpretation of data, offering insights into the correlation between college students’ academic performance and their academic foundation. To ensure statistical robustness, we analyzed methods that appear in at least two publications (see Table I).

TABLE I. LITERATURE MAIN RESEARCH METHODS

Research Method	Typical Model	Number of References
Quantitative Analysis	Meta-Analysis	13
	Statistical Charts	13
	Multiple Linear Regression Analysis	5
	Observations	3
Qualitative Analysis	Case Studies	2
	Interviews	2
	Mixed Analysis	3

As can be seen from Table I, thirteen papers applied meta-analysis as part of quantitative analysis methods,

thirteen utilized statistical charts, and five employed multiple linear regression analysis. Qualitative analysis predominantly included case studies, participatory observations, and interviews. Case studies and interviews are referenced in two papers each, while participant observations are mentioned in three papers. Mixed-methods approaches were referenced in three papers.

1) *Quantitative analysis methods*

Meta-analysis is the most frequently used quantitative analysis method in the selected literature, appearing in thirteen references. According to wikipedia.org, meta-analysis synthesizes quantitative data from multiple independent studies addressing a common research question. A key component of this method is calculating the overall effect size across all studies. By extracting effect sizes and variance measures, meta-analysis combines data to enhance statistical power and address variability among individual studies. The term “meta-analysis” was introduced by statistician Glass in 1976, who described it as “an analysis of analyses”. The first meta-analysis model, published by Smith and Glass in 1978, examined the effectiveness of psychotherapy outcomes [3].

Meta-analysis provides a comprehensive synthesis of research findings on the academic performance and academic foundation of college students. For instance, MacCann *et al.* [4] found a moderate correlation between emotional intelligence and academic performance, with higher emotional intelligence associated with better exam scores. Dekker *et al.* [5] highlighted the positive effects of combining life-shaping activities and robotics on students’ academic outcomes. Banerjee [6] reported that poor academic performance in science and mathematics is often linked to adverse socioeconomic conditions, including language barriers, ethnic minority status, and temporary immigration. Steenbergen-Hu and Cooper [7] demonstrated the positive impact of Intelligent Tutoring Systems (ITS) on academic performance, noting ITS as more effective than traditional teaching methods, though less so than human tutoring. May and Elder [8] found that multitasking with multiple media negatively affects academic outcomes, including exam scores, memory, and reading comprehension. Li *et al.* [9] utilized a random effects model, concluding that self-regulated learning positively affects academic achievement among Chinese primary and secondary school students. Similarly, Liu *et al.* [10] found a moderate correlation between family socioeconomic status and academic performance in China’s basic education stage. However, Macnamara *et al.* [4] conducted a large-scale study of 97,672 students, finding that mindset interventions had limited effects on improving academic outcomes. Sisk *et al.* [11] also reported a weak correlation between growth mindset and academic performance, though targeted interventions may benefit underperforming students. Wolters and Brady identified time management as a critical self-regulatory process essential for achieving academic goals [12]. The impact of growth mindset interventions on students’ academic performance appears marginal and may have been overestimated due to research design

flaws and reporting biases [13]. A bidirectional relationship exists between academic achievement and cognitive abilities such as working memory, reasoning, and executive function, with significant influences from educational environments [14]. Metacognitive processes in self-regulated learning exhibit a strong positive correlation with academic performance, whereas their association with cognitive strategies is relatively weaker [15]. Creativity demonstrates a moderate positive correlation with academic achievement, though this relationship varies depending on the methods used to assess both creativity and academic performance [16].

Statistical charts serve as an intuitive means of presenting correlation analyses, utilized in thirteen references. For example, Crisp *et al.* [17] identified high school grades as a significant predictor of college academic performance. Similarly, Venezia and Jaeger [18] analyzed ACT and SAT results, concluding that many students lack the necessary knowledge, skills, and mindset for college-level studies. Learning analytics offers substantial benefits in education, such as enhancing student engagement and learning outcomes, yet it also presents ethical, privacy, and technological challenges [19]. Canadian higher education faces diversity-related challenges, necessitating supportive services and inclusive environments to foster student success [20]. Hitt and Tucker outlined five key domains influencing student achievement, providing a framework for educational leadership [21]. Snyder *et al.* [22] conducted a systematic review of undergraduate creativity assessments from 1984 to 2013, noting an increase in self-reported and product-based evaluation methods, alongside a decline in divergent and convergent thinking assessments. TIMSS and PISA data analyses indicate that self-efficacy and educational aspirations are among the strongest predictors of students’ mathematics performance [23]. Research further supports a positive correlation between self-efficacy, goal-setting, and academic achievement in university students [24]. Kusrkar *et al.* [25] found that learning strategies and study effort significantly influence medical students’ academic performance, with gender-based variations in this effect. Muenks *et al.* [26] demonstrated that effort and perseverance in learning are stronger predictors of high school and college students’ academic performance than interest alone, though other self-regulatory and engagement-related variables also serve as significant predictors. Remedial courses yield differential effects on students with varying levels of academic preparedness, proving particularly beneficial for underprepared students [27].

Multiple linear regression is a widely used research method in the selected Chinese literature. Liu [28] employed indicators such as College Entrance Examination (CEE) mathematics scores, total CEE scores, whether the student held a leadership position, and regular college grades to analyze data using a multiple linear regression model. The findings indicated that students’ CEE mathematics scores and regular grades were the most significant factors influencing their final mathematics grades in college. Sun and Cai [29] selected

twelve factors, including student gender, interest in advanced mathematics, the perceived utility of mathematics for professional knowledge, and CEE scores, to analyze students' grades in advanced mathematics through multiple linear regression. Their results showed that the time spent on autonomous learning after class was the most influential factor on students' advanced mathematics grades, with no significant impact from student gender or motivations for learning mathematics. Wang *et al.* [30] found a significant correlation between CEE scores and final college exam scores, noting that the influence of CEE scores on college grades varied across different major. Pennebaker *et al.* [31] analyzed students' admission essays and found that the use of "categorical language" positively correlates with academic performance, whereas "dynamic language" exhibits a negative correlation. Similarly, Kpolovie *et al.* [32] reported that students' interest in learning and their positive attitudes toward school serve as strong predictors of academic achievement.

Quantitative analysis methods, including well-established models such as clustering, are frequently employed in educational research. For instance, Alyahyan and Düştegör [33] applied educational data mining techniques to predict student academic achievement, offering a clear methodological framework for educators. Their study identified several key factors for predicting academic success, including previous academic performance.

Quantitative analysis plays a crucial role in exploring the relationship between students' academic performance and their academic foundation. However, several challenges remain. First, the use of different methods to analyze student performance has led to conflicting conclusions, resulting in some confusion. Yang *et al.* [34] used the Pearson product-moment correlation coefficient to analyze exam scores and concluded that the correlation between CEE scores and college course scores in the same knowledge domain is generally weak. On the other hand, Liu [28], using multiple linear regression, found that students' CEE mathematics scores and regular grades were the primary factors influencing their final mathematics grades. Similarly, Sun and Cai [29] discovered that the time spent on autonomous learning outside of class was the most influential factor in determining students' mathematics grades. Another concern is the lack of continuous empirical research on students' performance following interventions such as advancements in educational technology or personalized learning approaches. While many studies have identified various factors influencing students' academic performance, there remains a gap in follow-up empirical studies that examine the impact of these interventions, leaving previous research largely theoretical.

2) *Qualitative analysis methods*

Qualitative analysis methods are crucial for exploring the relationship between college students' academic performance and their academic foundation. The main qualitative techniques employed in the literature include observation, case studies, and interviews. For instance,

Crisp *et al.* [17] conducted interviews with students to gain insight into their experiences and perspectives, using in-depth research on individual or group experiences to provide a comprehensive understanding. Their findings suggest that academic performance in high school has a significant impact on college academic performance. Additionally, factors such as gender, family education level, and economic conditions were found to influence students' academic outcomes. Similarly, Harris and Wood [35] conducted in-depth interviews with African American male community college students to better understand their experiences and perspectives. Through the analysis of the collected data, they concluded that high school grades significantly impact the academic performance of students of color in community colleges.

Despite their value, qualitative analysis methods have certain limitations. For example, when interviewers and interviewees discuss exam scores, the responses may be influenced by social expectations, potentially undermining the credibility of the interview data. Furthermore, the design and implementation of interviews can sometimes introduce bias, leading to results that favor a particular outcome.

3) *Mixed analysis methods*

Mixed analysis methods integrate both quantitative and qualitative approaches to provide a comprehensive understanding. York *et al.* [1] discussed the definition of academic success and qualitatively evaluated the factors affecting it, specifically focusing on Astin's I-E-O model. Concurrently, they employed quantitative analysis to statistically examine measurement tools for academic success, determining the frequency and usage of these tools. Their findings highlighted that exam scores serve as a crucial indicator of academic success. Similarly, Liu employed both qualitative and quantitative methods to analyze academic performance. Through qualitative observations, Liu discovered that students with high College Entrance Examination (CEE) scores did not necessarily perform well in college mathematics finals. In addition, using a multiple linear regression model, Liu quantitatively analyzed the data and concluded that CEE mathematics scores and regular grades were the most significant factors influencing final college mathematics grades [28].

The strength of mixed analysis lies in its ability to combine diverse data analysis methods, providing a multifaceted view of the relationship between students' academic performance and their academic foundation. However, there are some potential limitations to this approach. For instance, the sample size and specific cultural contexts may influence the generalizability of the results. Future research should seek to verify these findings on a larger and more diverse scale to enhance the robustness of the conclusions.

C. *Evaluation of Research Methods*

Quantitative analysis methods play a crucial role in examining the relationship between college students' academic performance and their academic foundation, particularly meta-analysis and multiple linear regression

models. However, the research findings regarding the correlation between College Entrance Examination (CEE) scores and college course scores remain inconsistent across studies. This may be attributed to variations in research design, sample selection, and statistical methods. As noted in previous analyses, using a multiple linear regression model involves first selecting appropriate indicators, followed by data analysis to identify the ranking of factors influencing college students' academic performance. However, there has been little debate about the selection of these indicators, implying that this process is largely subjective. The Pearson correlation coefficient, which measures the "linear" relationship between two variables, is limited by its failure to account for the influence of other factors. Thus, a key question arises: Is the relationship between college students' academic performance and their academic foundation strictly linear? If not, what type of nonlinear relationship exists? Additionally, does meta-analysis, as a comprehensive evaluation method, offer greater advantages?

A limitation of meta-analysis is its inability to control for biases in the original studies, meaning it cannot address design flaws or biases in the data sources it analyzes. This highlights the need for researchers to critically assess the methodological soundness of meta-analysis studies.

Qualitative analysis methods, such as observation and interviews, play a vital role in gaining a deeper understanding of students' personal experiences and feelings, thereby complementing quantitative data. These methods can unveil the potential impact of factors such as gender and family background on academic performance. However, qualitative methods are not without their limitations. Interview responses may be influenced by social expectations, compromising the authenticity of feedback. Furthermore, the design and implementation of interviews may introduce bias, potentially steering the results toward a particular conclusion.

Mixed analysis methods combine the strengths of both quantitative and qualitative approaches, allowing for a multi-faceted evaluation of the relationship between academic performance and foundational factors. This method provides a more comprehensive analysis, thereby enhancing the credibility of research outcomes. Nonetheless, mixed analysis is still susceptible to limitations, such as the impact cultural background on the generalizability of results.

In conclusion, each analysis method—quantitative, qualitative, and mixed—offers distinct advantages and limitations. The integrated use of these approaches will allow for a more comprehensive understanding of the relationship between college students' academic performance and their academic foundation. On one hand, there is a need to strengthen research on educational technology, explore the synergistic effects of different methods, and provide theoretical support for the practical application of educational technology to improve students' academic performance. On the other hand, empirical research should be emphasized. While existing

literature primarily analyzes available data to uncover patterns, there remains a gap in the application of these findings, particularly the absence of long-term tracking studies that could provide deeper insights.

D. Literature Keyword Cloud Map

Based on the frequency of word appearance, a word cloud of keywords derived from 35 papers was generated using a Matlab program (Fig. 3), with all terms standardized to English, given the preponderance of English-language articles.

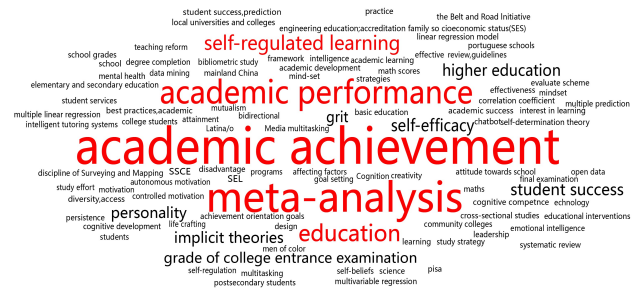


Fig. 3. Literature keyword cloud map

According to the Fig. 3, the top five keywords are “academic achievement, meta-analysis, academic performance, self-regulated learning, education”. The analysis of the word cloud reveals several insights. First, the inclusion of the terms “academic achievement”, “academic performance”, and “education” aligns with the research focus of the authors. However, the phrase “college students’ academic foundation” does not appear among the top five, which is consistent with previous findings from the literature review—there is relatively less scholarly attention on the correlation between college students’ academic performance and their academic foundation. Additionally, the terms “academic achievement” and “academic performance” are often used interchangeably, which may suggest a lack of distinction between these concepts that warrants further clarification within the academic community. Secondly, the prominence of the term “meta-analysis” highlights the growing value of this research method in the field. Lastly, the term “self-regulated learning” underscores the significance of students’ ability to regulate their learning behaviors and strategies, which plays a critical role in enhancing academic performance.

III. PRINCIPLES

To address the issues in research methods and analysis results identified in the existing literature, we propose three fundamental principles for research in this field.

A. Principle of Consistency

The principle of consistency ensures uniformity in research subjects and processes. First, it is essential to maintain consistency in research subjects. For example, when investigating the relationship between college students’ academic performance and their academic foundation, the focus must remain consistent across

different stages of student performance. Second, consistency in data collection must be ensured. When comparing student performance at various stages, the tools and procedures used for data collection should remain consistent. For instance, if surveys are used to collect student data, the questions, format, and distribution methods should all be uniform to improve comparability. Third, the consistency of data analysis methods and the presentation of research results must be maintained. As previously discussed, methods like meta-analysis, statistical charts, and multiple linear regression models are commonly used. Therefore, when analyzing student performance over time, it is important to use consistent data analysis methods (models) and present the results in a consistent format.

B. Principle of Credibility

The principle of credibility ensures the trustworthiness of the research process and results. Student performance data can be sourced from the academic affairs office, while non-numeric data can be gathered through surveys. The flexibility, speed, anonymity, and timeliness of surveys make them a valuable tool for data collection. However, as shown by Sun and Cai [15], their study lacked a clear explanation of the reliability and validity of the survey data collection process.

To address this, methods like exploratory factor analysis and confirmatory factor analysis can ensure the reliability and validity of survey data. Researchers can refer to established theories in the design of questionnaires, define the number and types of questions clearly, and enhance the reliability and validity of the questionnaire through pre-tests and expert reviews. For example, statistical methods like Cronbach's alpha can be used to assess the internal consistency of the questionnaire, ensuring its reliability.

C. Principle of Comprehensiveness

The principle of comprehensiveness ensures the thoroughness and depth of research methods and conclusions. First, it is crucial to integrate multiple analysis methods. A combination of quantitative methods (e.g., meta-analysis, multiple linear regression) and qualitative methods (e.g., observation, case studies, interviews) is necessary for comprehensive data analysis. Quantitative methods provide rich attribute information, while qualitative methods can offer insights into non-numeric data, such as students' attitudes, beliefs, and motivations. When using multiple methods to analyze student performance, the number and practicality of the methods employed should be balanced. Second, a multidimensional approach is essential. Research should account for factors at both the individual level (e.g., students, teachers) and the systemic level (e.g., schools, educational policies), understanding the interaction between these dimensions. Research conducted from both a horizontal perspective (comparing the performance of different students or groups at the same stage) and a vertical perspective (comparing the performance of the

same students or groups across different stages) will offer a more comprehensive analysis of the relationship between college students' academic performance and their academic foundation.

IV. DISCUSSION

Analyzing the correlation between students' entrance examination scores and their academic performance in higher education is a complex and multifaceted research topic. Therefore, selecting appropriate methods for analyzing the relationship between college students' academic performance and their academic foundation, or even developing a comprehensive set of analytical methods, holds substantial value. In this context, we propose three valuable research directions.

A. Extending Meta-Analysis Research

Meta-analysis adheres to the principles of consistency, credibility, and comprehensiveness. It allows researchers to synthesize findings from various studies regarding academic foundation (e.g., college entrance exam scores, standardized test results) and academic performance (e.g., GPA, SAT scores), thereby identifying key factors that affect the relationship between the two. Several directions can enhance the application of meta-analysis. First, improving heterogeneity testing is crucial for identifying variations across studies and understanding how differences in research contexts, sample characteristics, and analytical methods influence results. Second, optimizing moderation effect analysis can help explore how variables such as gender and academic discipline moderate the relationship between academic foundation and performance. Third, refining publication bias testing is essential for ensuring result accuracy by detecting biases in research, especially those favoring positive findings. Although meta-analysis offers robust statistical conclusions, its reliability heavily depends on the quality of the original studies. Optimizing the meta-analysis model in the near future is an achievable goal.

B. Diversifying Applications of Analysis Results

Meta-analysis has demonstrated significant versatility and depth in exploring the link between college students' academic performance and academic foundation. This method could be applied in various scenarios. First, it can optimize university admission criteria by assessing the predictive power of entrance scores on subsequent academic performance, offering a scientific basis for selection processes across diverse institutions. Second, in the realms of teaching quality evaluation and curriculum reform, meta-analysis can elucidate the relationship between instructional methods and student outcomes, assisting educators in refining curriculum designs. To support academically underprepared students, universities have implemented remedial courses and academic support programs. However, their effectiveness varies depending on students' backgrounds and preparedness levels, underscoring the need for a redesigned approach to remedial education [36]. In local institutions,

engineering education faces challenges such as uneven program quality, poor adaptability to industrial changes, and insufficient faculty capabilities, necessitating improvements in teaching methodologies and assessment frameworks [37]. Third, meta-analysis addresses the limitation of small sample sizes in individual studies, providing broader theoretical support that enhances understanding of the complex relationship between academic foundation and performance. Furthermore, meta-analysis can be used to identify students' learning characteristics, facilitating personalized learning interventions and offering a scientific foundation for tailored academic support.

C. In-depth Integration of AI Technology with Research Methods

While ensuring compliance with AI ethics and data privacy, AI can play a transformative role in enhancing research methodologies in the following ways. First, AI-driven algorithms can significantly improve the accuracy of predictive models in quantitative research. These models can analyze patterns in students' performance fluctuations and identify potential learning barriers, enabling educators to provide timely, personalized interventions. AI can also predict students' future performance in specific subjects, helping optimize learning trajectories. Second, AI technologies such as Natural Language Processing (NLP) can deepen qualitative research by transforming textual feedback from students into valuable insights. This allows for a more thorough analysis of students' experiences with courses, helping educators adjust teaching methods to improve educational quality. Third, AI can enrich mixed-method research by combining quantitative data (e.g., surveys, test scores) with qualitative data (e.g., open-ended feedback), yielding a more comprehensive understanding of the factors influencing academic performance. The integration of AI provides educational researchers with an advanced framework, promoting more scientific and precise advancements in educational practice. Furthermore, AI holds promising potential for enhancing meta-analysis models in the future.

V. CONCLUSION

To conclude, personalized education is an inevitable trend in the intelligent era and a necessary component of educational reform. Understanding the correlation between academic foundation and academic performance is crucial for developing effective personalized education programs. This study provides valuable insights into the basic principles and methods for conducting research in this field. The principles and future research directions outlined in the previous sections are significant for advancing research methodologies and promoting interdisciplinary approaches, ultimately leading to more effective personalized teaching practices.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Both authors contributed equally to this work. Lianchuan Xiao and Fei Gao wrote, reviewed, and commented on the manuscript; both authors have read and agreed to the published version of the manuscript.

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