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TECHNIQUES OF EDUCATIONAL ANALYSIS

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ABSTRACT

This study examines key techniques of educational analysis including Cost–Benefit Analysis (CBA), Planning, Programming and Budgeting System (PPBS), Programme Evaluation and Review Technique (PERT), and Cost-Effectiveness Analysis (CEA) with the aim of highlighting their relevance to educational planning, policy formulation, and resource allocation. The study adopts a qualitative and analytical research design, relying primarily on an extensive review of contemporary literature, policy documents, and empirical studies in educational economics, planning, and public sector management. Through systematic content analysis, the study synthesises theoretical perspectives and practical applications of each technique, identifying their core principles, methodological approaches, strengths, and limitations. The methodology involves comparative analysis to examine similarities and differences among the techniques, as well as contextual assessment to determine their situational suitability within educational systems. Emphasis is placed on understanding how each technique supports rational decision-making under conditions of limited resources, increasing accountability demands, and complex educational challenges. Rather than generating primary data, the study draws on established scholarly and institutional sources to ensure analytical depth, reliability, and relevance. The findings indicate that no single technique is sufficient for addressing all educational planning and management needs. Instead, the combined and context-sensitive application of multiple analytical tools enhances efficiency, transparency, and effectiveness in educational decision-making. The study contributes to existing knowledge by providing an integrated framework for understanding and applying educational analysis techniques, with practical implications for policymakers, administrators, and researchers seeking to strengthen evidence-based governance in education.

INTRODUCTION

Educational analysis constitutes a fundamental field of inquiry in contemporary educational research, management and policy, underpinning rational decision-making and systemic improvement. At its core, educational analysis refers to the systematic examination of educational processes, problems, policies and programmes with the aim of understanding, interpreting and improving the education system as a whole. This analytical focus is rooted in the broader philosophy of scientific enquiry, which Aristotle once described as the structured search for knowledge through reasoned and disciplined investigation (as cited in Biesta, 2020). In essence, educational analysis serves not merely as a descriptive activity but as a tool for generating actionable insights that inform policy and practice. As UNESCO's International Institute for Educational Planning emphasises, analytical techniques such as cost–benefit analysis provide frameworks that compare the returns on educational investments against the costs incurred, enabling planners to evaluate alternative uses of scarce resources in education systems, particularly in developing contexts where needs often exceed available funding (Woodhall, 2004).

The significance of educational analysis extends beyond mere assessment; it plays a central role in educational planning, policy formulation, and resource allocation. Educational planning itself is understood as a deliberate process of setting goals, visualising future needs, and outlining coherent strategies to achieve specified objectives within the education sector. Without analytical rigour, planning can become speculative or driven by unexamined assumptions, resulting in sub-optimal outcomes (Akpan, 2000; Ololube, 2013). In this context, analytical techniques serve as intellectual instruments that translate complex educational phenomena into comprehensible data and actionable plans. For example, Programme Evaluation and Review Technique (PERT) helps planners to map out critical activities, estimate timelines, and identify interdependencies that ensure smoother implementation of educational programmes. Similarly, cost-effectiveness and cost–benefit analyses provide quantified comparisons that guide decision-makers in allocating limited financial resources to maximize desired educational outcomes, aligning with the principles of economic appraisal used in public sector decision-making (Economic appraisal, 2025).

The role of analytical techniques in shaping educational policy cannot be overstated. Policy formulation is now widely recognised as an iterative process that relies on evidence, stakeholder feedback, contextual analysis, and outcome forecasting to define strategic directions capable of addressing contemporary educational challenges effectively. Recent scholarly attention underscores the importance of evidence-based policy analysis in improving educational access, equity and quality, thereby enhancing the ability of policymakers to respond to evolving societal needs (Studysa, 2025). Indeed, policy analysis integrates empirical research, theoretical insight and systematic evaluation to ensure that educational policies are not only conceptually sound but also realistically implementable and socially just. By embedding analytical rigor in the policy cycle, education stakeholders can anticipate unintended consequences, adjust strategies proactively and uphold accountability, thereby fostering transparency and trust in public education systems.

Resource allocation is one of the most tangible applications of educational analysis. As governments and institutions grapple with competing priorities, analytical tools become indispensable for ensuring that financial, human and material resources are allocated efficiently and equitably. Systematic approaches to resource allocation, which balance equity and efficiency,

are being developed and refined in contemporary research to address persistent disparities in education systems worldwide (e.g., in studies examining regional resource distribution in China). Such analytical frameworks enable policymakers to evaluate not only the magnitude of investment needed but also the equity implications of that investment, ensuring that educational opportunities are distributed fairly across populations and regions.

Against this backdrop, the present paper explores four principal techniques of educational analysis such as cost–benefit analysis, the Planning, Programming and Budgeting System (PPBS), Programme Evaluation and Review Technique (PERT), and cost-effectiveness analysis. The objectives of this study are threefold: first, to elucidate the conceptual foundations and practical applications of these techniques; second, to examine their relevance in educational planning, policy formulation and resource allocation; and third, to provide a structured comparison that highlights strengths, limitations and suitability in various educational contexts. The organisation of this paper reflects these objectives, beginning with detailed theoretical clarifications of each technique, followed by discussions of empirical utility, comparative analysis, and concluding with implications for educational administrators and policymakers.

Cost Benefits Analysis

Cost–Benefit Analysis (CBA) is a systematic analytical technique used to evaluate the economic desirability of a project, policy or programme by comparing its total expected costs with its total anticipated benefits over time. In the context of education, CBA provides a framework for assessing whether investments in educational programmes yield returns that justify the resources committed. According to Psacharopoulos and Patrinos (2018), cost–benefit analysis in education focuses on estimating the monetary value of educational outcomes relative to the costs incurred, thereby enabling policymakers to judge the economic efficiency of alternative educational interventions. The approach reflects the broader principles of welfare economics, which assume that rational decisions should maximise net social benefits.

The economic rationale behind CBA is grounded in the theory of human capital, which conceptualises education as an investment that enhances individuals' productivity and earnings while generating broader social returns. As Becker (1993) famously argued, expenditure on education should be analysed in the same manner as investment in physical capital, since both generate future streams of benefits. Within this framework, CBA allows education planners to compare present costs against discounted future benefits, ensuring that limited public resources are allocated to programmes with the highest potential returns. In an era characterised by fiscal constraints and increasing demand for accountability, the relevance of CBA in education has become even more pronounced (OECD, 2023).

Components of Cost–Benefit Analysis

A central feature of cost–benefit analysis is the comprehensive identification and valuation of costs associated with an educational intervention. These costs are typically categorised into direct, indirect and opportunity costs. Direct costs include expenditures such as teachers' salaries, instructional materials, infrastructure development and administrative expenses. Indirect costs refer to ancillary expenditures borne by learners or society, including transportation, accommodation and maintenance costs. Opportunity costs, which are particularly significant in education, represent the value of foregone alternatives, such as income lost by students who could

otherwise be employed while studying (Barr, 2020). Accurately accounting for these cost categories is essential for producing reliable estimates of the total economic burden of educational programmes. Equally important is the identification and valuation of benefits, which may accrue at both private and social levels. Private benefits primarily include increased lifetime earnings, improved employability and enhanced career mobility for individuals who receive education. Social benefits extend beyond individual gains to encompass wider societal outcomes, such as improved health, reduced crime rates, greater civic participation and enhanced economic growth. Recent empirical studies highlight that social returns to education often exceed private returns, particularly at the basic and secondary levels (McMahon, 2022). Incorporating both dimensions ensures that CBA captures the full contribution of education to societal development rather than restricting analysis to narrow financial outcomes.

Application of CBA in Education

Cost–benefit analysis is widely applied in the appraisal of educational projects to guide decisions on programme initiation, expansion or termination. Governments and international agencies frequently employ CBA to evaluate school construction projects, teacher training initiatives, curriculum reforms and technology-based learning interventions. By quantifying expected returns relative to costs, CBA supports transparent and evidence-based project appraisal, reducing the likelihood of politically motivated or inefficient investments (World Bank, 2024). This analytical clarity is particularly valuable in low- and middle-income countries, where competing development priorities necessitate careful scrutiny of public expenditure. Beyond project appraisal, CBA plays a critical role in strategic decision-making concerning educational investments. Policymakers use CBA to compare alternative policy options, such as investing in early childhood education versus tertiary expansion, or vocational training versus general education. Such comparisons enable decision-makers to prioritise interventions that yield the greatest social value per unit of expenditure. According to OECD (2023), the integration of CBA into education finance reforms has improved the efficiency and sustainability of education systems in several advanced and emerging economies.

Advantages and Limitations

One of the principal strengths of cost–benefit analysis lies in its ability to translate complex educational outcomes into a common monetary metric, facilitating comparison across programmes and sectors. CBA promotes rational allocation of scarce resources, enhances accountability, and supports long-term planning by incorporating future benefits through discounting techniques. Moreover, it encourages a holistic perspective by recognising both private and social returns to education (Psacharopoulos & Patrinos, 2018). Despite these strengths, CBA in education faces notable challenges and criticisms. Quantifying intangible benefits such as social cohesion, democratic participation and cultural enrichment remains methodologically difficult. Additionally, results can be sensitive to assumptions regarding discount rates, earnings projections and labour market conditions, potentially limiting reliability. Critics also argue that excessive reliance on monetary valuation risks undervaluing equity considerations and non-economic goals of education (Unterhalter, 2019). Consequently, while CBA is a powerful analytical tool, it is most effective when complemented by qualitative analysis and broader policy judgement.

Planning, Programming and Budgeting System (PPBS)

The Planning, Programming, and Budgeting System (PPBS) is a comprehensive management and decision-making framework designed to improve the efficiency and effectiveness of public sector planning and financial management. In its broadest sense, PPBS integrates long-term planning objectives with systematic programme analysis and budgetary allocation in order to ensure that public resources are directed towards clearly defined goals. According to Wildavsky and Caiden (2019), PPBS represents a shift from traditional incremental budgeting towards a rational and analytical approach that emphasises outcomes, performance, and strategic coherence across government activities.

Historically, PPBS originated in the United States during the early 1960s, first gaining prominence within the Department of Defence before being extended to other public sectors, including education. The system was formally institutionalised under President Lyndon B. Johnson as part of broader public sector reforms aimed at enhancing accountability and evidence-based decision-making (Schick, 2017). Its adoption reflected growing dissatisfaction with conventional budgeting systems that focused primarily on inputs rather than results. Over time, PPBS has influenced contemporary performance-based and programme-based budgeting reforms across both developed and developing countries (OECD, 2022). The primary objectives of PPBS are to improve the rational allocation of scarce resources, align expenditures with strategic priorities, and enhance transparency in public administration. By linking planning with budgeting through systematic programme analysis, PPBS seeks to ensure that financial decisions are grounded in clear objectives and empirical evidence. In education, these objectives are particularly significant, as systems are required to balance expanding access, improving quality, and ensuring equity within constrained fiscal environments (UNESCO, 2023).

Major Elements of PPBS

The effectiveness of PPBS rests on the integration of three interrelated elements: planning, programming, and budgeting. Planning constitutes the first stage and involves the identification of long-term educational goals, priorities, and desired outcomes. This stage requires an assessment of current conditions, future needs, and policy alternatives, providing a strategic framework within which decisions are made. Educational planning under PPBS is therefore forward-looking and policy-oriented, rather than reactive. Programming translates broad plans into specific, structured programmes designed to achieve stated objectives. At this stage, alternative strategies are analysed, costs are estimated, and expected outcomes are defined. Programmes are often organised around functions or policy areas, such as teacher development, curriculum reform, or infrastructure expansion. According to Robinson (2020), programming enables decision-makers to compare competing interventions systematically and select those that offer the greatest value in relation to policy goals. Budgeting represents the final stage of the PPBS process and involves the allocation of financial resources to approved programmes. Unlike traditional line-item budgeting, PPBS budgeting emphasises programme outputs and outcomes, linking expenditure directly to performance. This approach strengthens financial discipline and enhances the capacity of educational authorities to monitor spending in relation to results.

Application of PPBS in Education

In educational systems, PPBS is primarily applied to improve resource allocation and policy planning. By structuring expenditures around programmes rather than administrative units, PPBS allows education authorities to assess how resources contribute to specific policy objectives, such as improving learning outcomes or reducing regional disparities. According to UNESCO (2023), programme-based approaches have supported more equitable distribution of educational resources, particularly in decentralised education systems. PPBS also plays a critical role in strengthening policy planning and financial control. Through its emphasis on analysis and evaluation, the system enhances budget transparency and accountability, enabling policymakers to track expenditures and assess programme performance over time. Recent studies suggest that countries adopting programme-based budgeting frameworks inspired by PPBS have improved fiscal oversight and reduced inefficiencies in education spending (OECD, 2022).

Merits and Demerits of PPBS

One of the key merits of PPBS lies in its capacity to promote rational and evidence-based decision-making in educational administration. By linking objectives, programmes, and budgets, PPBS improves coordination, reduces duplication, and enhances the strategic use of limited resources. The system also supports long-term planning and performance monitoring, thereby strengthening accountability within education ministries and institutions (Robinson, 2020). However, PPBS is not without limitations. Its implementation requires substantial technical capacity, reliable data, and strong institutional coordination, which may be lacking in some educational contexts. The system can also be administratively complex and time-consuming, potentially leading to resistance among stakeholders accustomed to traditional budgeting practices. Moreover, critics argue that excessive emphasis on quantifiable outcomes may undervalue qualitative aspects of education, such as cultural development and social cohesion (Schick, 2017). Consequently, while PPBS offers significant advantages, its effectiveness depends on contextual adaptation and sustained institutional support.

Programme Evaluation and Review Technique (PERT)

Programme Evaluation and Review Technique (PERT) is a project management and analytical tool designed to plan, schedule, coordinate and control complex activities within a defined timeframe. Originally developed for managing large-scale defence projects, PERT has since been adapted to various public sector domains, including education. According to Kerzner (2022), PERT is based on the principle that projects consist of interdependent activities whose timing and sequencing determine overall project completion. The technique emphasises uncertainty management by using probabilistic time estimates rather than fixed durations, making it particularly suitable for projects characterised by complexity and innovation. The importance of PERT lies in its capacity to support systematic planning and timely execution of programmes such as curriculum reforms, infrastructure development, teacher training initiatives and technology integration projects. Educational projects often involve multiple stakeholders, overlapping tasks and limited resources, increasing the risk of delays and inefficiencies. PERT provides a structured framework that enables education administrators to visualise project activities, anticipate bottlenecks and allocate resources more effectively, thereby enhancing project reliability and

accountability (Nicholas & Steyn, 2020).

Steps in PERT Analysis

The first step in PERT analysis involves the identification of all activities required to complete a project. These activities are defined clearly and arranged in a logical sequence, ensuring that dependencies between tasks are recognised. In educational projects, activities may include needs assessment, policy approval, staff training, procurement of materials and programme implementation. Precise activity identification is essential for accurate scheduling and performance monitoring.

The second step is the construction of a network diagram, which graphically represents the sequence and interrelationship of project activities. The network illustrates the flow of tasks from project initiation to completion, highlighting critical paths that determine the minimum project duration. According to Heagney (2022), network diagrams enhance managerial understanding of project structure and facilitate communication among stakeholders.

The final step involves time estimation and scheduling. PERT employs three time estimates for each activity optimistic, most likely and pessimistic to calculate expected durations and assess uncertainty. This probabilistic approach allows education managers to identify activities with the greatest risk of delay and develop contingency plans. Effective scheduling ensures that projects remain on track and that corrective actions can be taken promptly when deviations occur.

Uses of PERT in Education

PERT is widely used in planning educational projects that require careful coordination and time management. It supports systematic planning by enabling administrators to break complex initiatives into manageable components, estimate timelines and allocate responsibilities. For instance, large-scale school construction projects or national curriculum overhauls benefit from PERT's capacity to integrate planning with monitoring (UNESCO, 2023). Beyond planning, PERT is also instrumental in monitoring and controlling academic programmes. By tracking progress against planned schedules, educational institutions can identify delays early and implement corrective measures. This monitoring function enhances transparency, strengthens managerial control and contributes to the successful completion of educational initiatives within stipulated timeframes (OECD, 2022).

Strengths and Weaknesses of PERT

One of the major advantages of PERT is its ability to handle uncertainty in project timelines, making it particularly useful for innovative or non-routine educational projects. The technique improves coordination, supports informed decision-making and enhances efficiency by focusing attention on critical activities. Additionally, PERT facilitates communication among stakeholders through its visual representation of project processes. However, PERT also has limitations in educational settings. The technique requires technical expertise and reliable data, which may not always be available. Its emphasis on time management may overlook qualitative dimensions of education, such as pedagogical quality and learner engagement. Furthermore, the complexity of network construction can discourage consistent application in resource-constrained educational systems (Kerzner, 2022).

Cost-Effectiveness Analysis (CEA)

Cost-Effectiveness Analysis (CEA) is an analytical technique used to compare the relative efficiency of alternative interventions by examining the costs incurred in achieving a specific non-monetary outcome. Unlike cost–benefit analysis, which converts both costs and benefits into monetary terms, CEA measures outcomes in natural or educational units such as test score gains, graduation rates or years of schooling completed. According to Levin, McEwan and Belfield et al. (2021), CEA is particularly appropriate in education because many educational outcomes are difficult to monetise yet remain central to policy objectives. The distinction between CEA and cost–benefit analysis lies in their treatment of outcomes. While cost–benefit analysis asks whether the total benefits exceed total costs, CEA focuses on identifying which intervention achieves a given objective at the lowest cost. This distinction makes CEA especially useful in education systems where goals such as equity, access and learning quality cannot be easily expressed in monetary terms (OECD, 2023).

Measurement of Cost-Effectiveness

Measurement of cost-effectiveness typically involves calculating the cost per unit of educational output. This may include cost per student enrolled, cost per graduate, or cost per unit improvement in learning outcomes. Accurate measurement requires careful identification of all relevant costs, including direct expenditures and opportunity costs, as well as reliable outcome indicators. According to Levin et al. (2021), transparent measurement enhances the credibility and policy relevance of CEA findings. CEA also enables the comparison of alternative educational strategies aimed at achieving similar objectives. For example, policymakers may compare different teacher training models, instructional technologies or class-size reduction initiatives to determine which option delivers the greatest educational impact for a given level of expenditure. Such comparative analysis supports evidence-based prioritisation and rational decision-making in education planning.

Application of CEA in Education

Cost-effectiveness analysis plays a vital role in improving efficiency within educational systems. By identifying interventions that produce desired outcomes at lower cost, CEA supports optimal use of limited resources and reduces wastage. Recent international studies demonstrate that CEA-informed reforms have contributed to improved learning outcomes and fiscal sustainability in both developed and developing education systems (World Bank, 2024). CEA is also extensively applied in policy formulation and educational planning. Policymakers use CEA to assess reform options, allocate budgets and justify investment decisions. The technique enhances transparency and accountability by providing clear evidence on the relative efficiency of competing policy alternatives, thereby strengthening public confidence in education governance (UNESCO, 2023).

Advantages and Limitations

The primary strength of cost-effectiveness analysis lies in its focus on outcomes rather than monetary valuation, making it highly suitable for education. CEA facilitates comparison across interventions, supports equity-oriented decision-making and enhances policy relevance. It also

complements other analytical tools by providing a pragmatic approach to efficiency assessment. Nevertheless, CEA faces methodological challenges. Results are sensitive to the choice of outcome indicators, time horizons and cost assumptions. Additionally, CEA does not indicate whether an intervention is socially worthwhile in absolute terms, only whether it is more efficient relative to alternatives. Critics also caution that excessive reliance on quantitative indicators may overlook broader educational values such as social inclusion and cultural development (McMahon, 2022).

Comparative Analysis of Educational Analysis Techniques

Educational systems increasingly rely on analytical techniques to support rational decision-making, efficient resource utilisation, and effective programme implementation. Cost–Benefit Analysis (CBA), Planning, Programming and Budgeting System (PPBS), Programme Evaluation and Review Technique (PERT), and Cost-Effectiveness Analysis (CEA) share a common purpose in promoting evidence-based educational planning, yet they differ significantly in scope, methodology, and practical application. According to OECD (2023), the effectiveness of these techniques depends largely on how well they are aligned with the specific decision context and policy objectives.

A key similarity among the four techniques lies in their emphasis on systematic analysis and rational choice. CBA and CEA both adopt an economic perspective, focusing on efficiency and optimal use of scarce resources. While CBA compares costs and benefits in monetary terms to determine overall economic viability, CEA evaluates the relative efficiency of alternatives based on non-monetary educational outcomes (Levin, McEwan and Belfield et al., 2021). In contrast, PPBS and PERT are primarily managerial and administrative tools. PPBS integrates planning and budgeting processes to ensure that financial allocations reflect policy priorities, whereas PERT concentrates on time management and coordination of project activities (Kerzner, 2022).

The techniques also differ in their analytical focus and decision level. CBA and CEA are most effective at the policy and strategic planning levels, where choices must be made between competing programmes or investments. PPBS operates at both strategic and operational levels by linking long-term goals with programme structures and budgetary control. PERT, however, is predominantly operational, supporting the implementation and monitoring of specific educational projects rather than broad policy decisions (Nicholas and Steyn, 2020).

In terms of situational suitability, each technique offers distinct advantages. CBA is particularly appropriate when policymakers need to assess the overall economic justification of major educational investments, such as expanding tertiary education or large-scale infrastructure projects. CEA is better suited to contexts where objectives are clearly defined but difficult to monetise, such as improving learning outcomes or reducing dropout rates. PPBS is most effective in systems seeking to strengthen accountability, coordination, and performance-based budgeting, especially within centralised or reform-oriented administrations. PERT is ideal for managing complex educational projects with multiple interdependent activities and strict timelines, such as curriculum reforms or digital learning initiatives (UNESCO, 2023). Collectively, these techniques are complementary rather than competing, and their combined use enhances the robustness of educational decision-making.

Conclusion

This study has examined four major techniques of educational analysis including Cost–Benefit Analysis, Planning, Programming and Budgeting System, Programme Evaluation and Review Technique, and Cost-Effectiveness Analysis highlighting their conceptual foundations, applications, strengths, and limitations. The analysis demonstrates that each technique offers a distinct yet interrelated contribution to educational planning and management. CBA provides a framework for assessing the economic viability of educational investments, while CEA supports efficiency-focused comparisons where outcomes are non-monetary. PPBS strengthens strategic alignment between planning and budgeting, and PERT enhances the effective implementation and monitoring of educational projects. The study underscore the critical importance of analytical techniques in educational planning, particularly in contexts characterised by limited resources, rising demand, and increasing accountability pressures. Analytical tools enable policymakers and administrators to move beyond intuition and incremental decision-making towards evidence-based approaches that prioritise efficiency, equity, and effectiveness. As noted by Levin et al. (2021), the systematic use of analytical techniques enhances transparency and improves the likelihood that educational investments will achieve their intended outcomes.

For educational administrators and policymakers, the implications are clear. No single technique is sufficient to address the complexity of educational decision-making. Instead, a balanced and context-sensitive application of multiple analytical approaches is required. Administrators must invest in analytical capacity, reliable data systems, and institutional coordination to maximise the benefits of these techniques. Policymakers, on the other hand, should integrate analytical findings into policy cycles while remaining attentive to qualitative educational values that may not be easily quantified. Ultimately, the strategic use of educational analysis techniques strengthens governance, improves resource allocation, and supports sustainable development of education systems in a rapidly changing global environment.

Recommendations

Based on the findings of this study, several recommendations are proposed:

First, it is recommended to educational policymakers at national and regional levels that cost–benefit analysis and cost-effectiveness analysis be systematically integrated into education policy design and evaluation. Policymakers should rely on these techniques when making large-scale investment decisions, such as funding reforms, infrastructure development, or expansion of access, in order to ensure economic efficiency and maximise social returns.

Second, it is recommended to educational administrators and planners that the Planning, Programming and Budgeting System be adopted or strengthened within ministries of education and related agencies. Administrators should align strategic plans with programme objectives and budgetary allocations to improve coherence, accountability, and transparency in education financing. Capacity-building initiatives should be prioritised to enhance technical skills required for programme-based budgeting and performance monitoring.

Third, it is recommended to school leaders, project managers, and institutional heads that Programme Evaluation and Review Technique be employed in the management of complex educational projects. The use of PERT can support effective scheduling, coordination of activities,

and timely completion of initiatives such as curriculum reforms, digital learning projects, and staff development programmes.

Finally, it is recommended to researchers and academic institutions that further empirical studies be conducted to assess the contextual effectiveness of these analytical techniques across different educational systems. Future research should combine quantitative and qualitative approaches to address limitations associated with data availability and the measurement of non-economic educational outcomes. Such studies will contribute to refining analytical frameworks and improving evidence-based decision-making in education.

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