Discover Education

Review

Innovative research methods in comparative education: emerging trends and applications

Mahendra Prasad 'Pandey'[1]

Received: 29 January 2025 / Accepted: 10 June 2025
Published online: 01 July 2025

Abstract
Comparative education is advancing with a growing emphasis on innovative research methodologies; however, integrating these approaches to address complex global education challenges remains difficult. While traditional qualitative methods are valuable, they often fail to capture the multifaceted nature of today's educational landscape. This review examines emerging trends that combine qualitative and quantitative approaches, such as mixed-methods research, big data analytics, longitudinal studies, and meta-analyses, to provide more comprehensive insights. These methodologies play a crucial role in uncovering patterns and supporting evidence-based policymaking by triangulating findings and capturing both the "what" and "why" of educational phenomena. However, their implementation faces significant challenges, including ethical concerns, data privacy issues and contextual disparities across diverse education systems. Resource constraints, particularly in low-income countries, further hinder the widespread adoption of data-intensive methodologies, while ensuring methodological rigor without compromising cultural relevance remains a persistent challenge. Synthesizing studies from 2000 to 2025, this review draws from sources such as Google Scholar, Scopus, Springer, PubMed Central and other journal databases to provide educators, policymakers, and researchers with a critical analysis of advancements in comparative education research, highlighting both their potential and limitations in shaping global educational policies.

Keywords Comparative education · Complex educational challenges · Big data analytics · Longitudinal studies · Meta-analyses

1 Introduction

Comparative education is an interdisciplinary field in the social sciences that examines the nature of educational systems in terms of socioeconomic and historical contexts. Researchers in this field draw from various areas such as psychology, sociology, history, philosophy, and economics to not only examine the operation of these different educational systems but also address inequalities and the education policies that support and sustain them [1]. In doing so, researchers in comparative education have discussed the creation, implementation, and sustainability of national identity, values associated with education and the role of schools in societies [2]. Comparativists also look deeply into how nation-states, as well as individual regions and cities within national states, use schools to meet the goal of social order [3].

One of the most important features of comparative research is to focus on educational phenomena occurring in distinct cultural and national contexts. The aim is to identify and comprehend the connections between such phenomena

✉ Mahendra Prasad 'Pandey', mahendra.prasad@iftmuniversity.ac.in | [1]School of Education and Humanities, IFTM University, Lodhipur Rajput, Moradabad, India 244102.

based on certain variables. It also seeks to build on good practices from around the globe and to establish powerful research networks. Why should this concern learning from educational systems in diverse national contexts? A major reason is that world educational disparities are huge and have yet to be satisfactorily explained in terms of major inequalities that still exist and continue to disadvantage most of mankind. Indeed, the rationale dates back to the field's seminal years when it relied on the critical realist project to adduce truths that were systemic in nature in order to guide policy. Comparative studies are necessary to build effective social policy.

Although comparative research methods have evolved and developed throughout the twentieth century, moving from a critical realist standpoint to a rather narrow methodological interest in measurement, many contemporary researchers in the field have begun to explore how mixed methodologies such as quantitative and qualitative methods can be implemented in simultaneous or sequential models. The calls for mixed methodologies are driven by the realization that positivist practices alone cannot address many of the most pressing concerns of national governments and international agencies whose overarching goal is to raise curriculum standards [4]. It is believed by many that mixed methodologies enable researchers to have a more comprehensive understanding of sociocultural phenomena as seen in case studies from diverse sites and macrolevels [5]. The objective of this review is to examine emerging trends and advancements in research methodologies within the field of comparative education. This highlights the shift from traditional qualitative methods to innovative approaches that integrate big data analytics, longitudinal studies, meta-analyses, and mixed methods.

2 Research design and methodological framework

This review adopts a qualitative interpretive approach, synthesizing scholarly literature from 2000 to 2025 to identify and analyze methodological trends in comparative education. Sources were selected based on relevance, citation frequency, methodological rigor, and coverage of key themes such as mixed methods, big data analytics, and meta-analysis. Databases such as Google Scholar, Scopus, PubMed Central, SpringerLink, and institutional repositories were systematically searched using keyword combinations (e.g., "comparative education", "mixed methods", "big data in education"). The inclusion criteria emphasized peer-reviewed journal articles, major institutional reports, and empirical studies with explicit methodological descriptions. Studies were thematically coded using a deductive-inductive approach to identify emergent categories around methodological innovations. Analytical frameworks included the use of triangulation to synthesize insights across qualitative and quantitative paradigms, and pattern-matching techniques to trace methodological evolution across contexts. This design ensures a robust and transparent foundation for the subsequent analysis of methodological advancements.

3 Definition and scope of comparative education

Comparative education is often understood as a systematic comparison of different educational systems. This focus on comparison provides a way to explore similarities and differences between educational systems. How they function, how they are similar or different, and the ways they influence and are influenced by each other are fundamental questions dealt with in this field [6]. Contextually, it provides links between various educational traditions with emphasis on the historical, political, and sociological dimensions of educational phenomena and their policy consequences rather than the potential causes and solutions of the issues and problems in economic and social development affecting mankind living in an increasingly globalized world [7, 8].

Nevertheless, while historical aspects cannot be disregarded, the present era of globalization, shared economic and environmental concerns, and the quest for interdependence make it imperative that geographical boundaries should be crossed to serve humanity irrespective of caste and creed [12, 13]. Comparative education can also be seen from the point of view of inquiry; improving education and social policy-making depends on our understanding of the broader global, regional, national, and local contexts within which these are framed [11, 12]. In this respect, comparative and international agencies might focus on the generation of new insights, coupled with policy inputs, developed through empirical research in different educational systems [16, 17].

Comparative education as a scholarly field is interdisciplinary and involves many disciplines including sociology, anthropology, political science, history, and policy studies. The scope of comparison can cover a wide range, such as

systems of education; subsystems of education, social systems of education, school structure, functions of education, educational problems among systems, curricula, educational ideals, performances, harmony and discord of schools, the control of education, and educational standards among nations [14, 15].

The categorization between 'comparative education' and 'comparative study of sociopolitical problems of education' is not so distinct but has nevertheless distinct characteristics because both are correlated. It will be impossible for the reconstruction of comparative education in the arena of education caused by globalization without the contribution of cross-country studies involving cultural, sociological, and applied policy perspectives. Since some features of one nation cannot be isolated from the mainstream of shared or similar characteristics of the remaining nations of the globe, this jeopardizes generalizations drawn on the basis of single-culture studies [9, 10]. In addition, this typical approach to social facts is available only in a comparative frame. The social sciences as a whole and sociology in particular are not interested in the social mystery given, but in the 'ways' through which this mystery can be unraveled. Thus, correlation to the most confounding social problems affecting humanity is a must [16].

These findings prove that comparative education, which has been hailed as the mother of educational inquiry, is a significant ingredient in the realm of globalization [10]. Comparative studies are significant not only in preventing more chaos in educational fields but also in erasing people's thoughts about science and racism prevailing in our education today [17].

4 Evolution of research methods in comparative education

The research methods used in comparative education—the way data are collected—have evolved [18]. Early scholars typically relied on qualitative methods to construct narratives on educational issues, drawing on data and stories from their case studies to compare their local settings with those of others [19, 20]. Descriptive and comparative perspectives were predominantly employed.

As the field became more professional and systematic, research methodologies that are commonly considered quantitative came to serve. The increasing influence of globalization and advances in technology also has also had an impact on research methods. Concerns arose regarding the extent to which interpretations of the life worlds of individuals and social practices and institutions could be related to broader socioeconomic and political global dynamics [9]. Qualitative data, which involve small numbers of participants, are increasingly being supplemented and supported by a quantitative approach providing information from broader data sets and statistical techniques in comparative education [19, 21].

Increasingly, comparative studies in education have begun to utilize combinations of qualitative and quantitative methods, often referred to as mixed methods, to address increasingly complex research questions focusing on policy impact or complex educational issues such as access to education, educational equity, or political transition in education [22].

In comparative education research, selecting between qualitative and quantitative methods—or combining both—depends on the research objectives, the nature of the data, and the context of the study. Table 1 compares these research methods.

A second significant innovative research development noteworthy for methods in comparative education is the changing method of data collection. Comparative studies in education have increasingly moved from predominantly cross-sectional data collection to longitudinal studies. The history of comparative education research methods traced the evolving practice of research methodologies and their development in comparative and international education research. This historical account has emphasized the professional need to justify the claims of research with the rigor of a scientific method. Each new departure in research approach is accompanied by a variety of reactions in the professional field [18].

Critics or doubters voice suspicions, complaints, and uncertainty, whereas others employ the new approach with enthusiasm. The use of concrete methods has been a defining element in the tacit conception of comparative research.

Discover Education (2025) 4:210 | https://doi.org/10.1007/s44217-025-00616-1

Table 1 Comparison of Qualitative and Quantitative Research Methods in Comparative Education [23]

S.No	Aspect	Qualitative methods	Quantitative methods
1	Objective	Explore meaning, experiences, and concepts	Measure variables and analyze statistical relationships
2	Data type	Non-numerical (e.g., interviews, observations)	Numerical (e.g., surveys, tests)
3	Flexibility	High; research design can evolve during the study	Low; follows a structured design
4	Sample size	Typically small, focused on depth	Larger, aiming for representativeness
5	data analysis	Thematic analysis, coding, narrative descriptions	Statistical analysis, mathematical modeling
6	Outcome	Detailed understanding of specific contexts	Generalizable findings applicable to broader populations
7	Time and resources	Often requires more time for data collection and analysis	Generally more time-efficient, especially with large datasets
8	Bias and reliability	Potential for researcher bias; reliability depends on the researcher's skill	Minimizes researcher bias; reliability depends on instrument validity and reliability
9	When appropriate	Suitable for exploring new or complex phenomena, understanding processes, or gaining detailed insights into specific contexts	Appropriate for testing hypotheses, measuring variables, or generalizing findings to larger populations

5 Traditional research methods in comparative education

Comparative studies in education have a long history, and a variety of research methods and designs have been used to answer questions about schooling and schooling systems across time, space, and context. Essentially, two types of research methods are approached in comparative education: qualitative research techniques, and quantitative research methodologies [19, 24]. Frameworks for conducting primary research include extensive analyses of previous research and data. These traditional methods help determine trends, amplifications, and knowledge to contextualize the literature review through new studies [25].

Literature reviews and meta-analyses are two sides of a coin [26]. While literature reviews, including narrative and integrative studies, aim at combining all previously conducted research, meta-analyses look at analyses of existing data for a more profound investigation of the combined results. However, they indicate the type and significance of the outcomes described in the literature review. The advantage of literature reviews lies in their ability to reflect multiple conclusions and directions regarding research [27].

Meanwhile meta-analyses yield a solid statistic to sufficiently, objectively, and securely link academics' results. Both techniques play an important role in synthesizing well-founded and extensive learning from previous studies, providing opportunities for authentic research and conclusion-making [28]. In the quantitative domain, survey studies play a pivotal function in educational research [29]. Survey findings from studies conducted around the world are often used to draw more comprehensive, comparative cross-national estimates.

Surveys range from general ones for the entire population of a country to smaller ones directed at educators, students, and principals. These traditional research methods have clear advantages in producing robust and reliable knowledge in making sense of educational systems and outcomes [30]. Meta-analyses are renowned for their ability to gauge overall effect sizes, thereby averting biased results that may be due to individual research projects' inadequate sample sizes [31].

Several hundred countries participated in the various studies. Second, some comparative research designs generate more reliable results than others. Regional or international comparative studies usually prepare data that are collected simultaneously in a standardized manner at the system level across a group of participant countries or regions. The results can be used to inform national, regional, or international educational policies because results are expected to be strongly grounded in the science of measurement and epistemological theory of what is to be measured [32].

Third, and most importantly for the global transfer of results, are the results of cross-correlation studies between educational and economic outcomes and a range of system-level variables, such as teacher factors. These usually employ large-scale surveys with large samples. As such, no overarching or meta-relative conclusions can be made about this kind of research. Moreover, data may not always be available by countries, thus hampering researchers' ability to compare different educational systems.

5.1 Literature review and meta-analysis

The literature review and meta-analysis are two of the most recognized traditional research methods in comparative education, and they have played a vital part in informing contemporary studies and policy [15].

A literature review is a formal process of examining in detail the academic work in a chosen area, systematically collecting and critically evaluating existing studies to find the main trends, seminal articles, recent developments and, the most important findings in the area under investigation. Hence, a literature review allows researchers to move gradually from a broad idea of a field to a more in-depth understanding that is based on the selected variables of inquiry, methodologies, guiding concepts used, and the main finding [33]. The literature review is an interpretative and critical synthesis of this material in any area, and it should have the attributes of both an organized approach and a written document [34].

Meta-analysis is a statistical technique that combines the results of multiple studies that address a set of related research hypotheses. In comparative education, meta-analysis involves systematically aggregating findings from various studies to draw more robust conclusions about educational interventions, policies, or phenomena across different contexts. This method enhances the precision of estimates and resolve inconsistencies among individual studies, offering a clearer understanding of educational issues on a global scale. Meta-analysis is a valuable research tool for getting as strong as possible, statistically, an overall statement of a result common to several studies [35]. Combining datasets from several studies can result in a much more satisfactory power of analysis, and nearly all common least square consensus indicators are boosted by this technique [36].

Systematic literature reviews are plagued by several problems that mirror the problem with the construction and application of international databases for the behavioral sciences: notably, there is still a large amount of "grey literature" that will not come up in such databases or be usable in the end due to either considerations or because the databases are incomplete and/or skewed [26]. Because of the nature of globalization, more and more research is coming from unexpected places, sometimes from studies not conducted in the last years, but still relevant. The reliance on methodologically high-quality studies also leaves systematic literature reviews (or meta-analyses) liable to misleading results [37].

Finally, the inclusion of non-peer-reviewed material is often used as a subsequent "weak end" exercise designed to "test the strain of the results," without any necessary real reason as to why any effect, negative or positive, might be expected [38]. The focus on the material quality works in both ways. Most studies come "under the peer review radar"—including, for example, the now-told saga of tobacco studies, when journals refused over many years to publish negative findings until a class action lawsuit forced the publishing of the data. Therefore, one should be wary that if one dismisses a non-peer-reviewed study as "bad quality" or "biased," it is inherently irrational or illogical; one might miss important data that bring significant results.

Such an approach may also be neglect legacy research themes. To avoid these potential biases, there are higher quality standards and hence specific methods of conducting a literature review, which are identical for the purposes of this paper to those for conducting a meta-analysis [39].

5.2 Survey research

Survey research is considered too traditional a type of process for the comparative education community [40]. Surveys are mainly methodologies for data collection, with an accompanying method of analysis that has traditionally had the immediate purpose of describing an agenda prevailing prior to computer software that can run many regression controls at once, seemingly without a problem in terms of the amount of control [41].

One can, at the outset, see that for some purpose, the survey describes cross-sections of a collection that is larger than what is possible to make in most qualitative and case study work. They also collect data from individuals, as well as issues of setting in place the composite of responses for observations to generalize to a population of interest. It always consolidates to time series designs for those who constitute the bulk of the population of interest.

Survey research provides mainly two main strengths for comparative research. First, it gathers quantitative data because large populations will be represented by the designed samples, which are the main reasons for the ability to judge a representative set of people in a relevant unit, providing a wide range of applications for comparative research as well as statistical procedures for developing indicators [42].

Second, surveys can be applied to cross-sectional designs, including time series or trend analysis. These designs mainly serve to describe issues of attitudes, beliefs, and processes in the context of collection and selection of approaches, which is the question for the case of comparison [43]. Its parent post-stratification is according to the societal strata as per the units of observation at the beginning, and time or change checking occurs as those trends develop. The case study and the case study with rules are also among three key cases and areas of comparative investigation [44].

6 Emerging innovative research methods

Several innovative research methods and techniques are becoming more common in the field of comparative education, demonstrating the need to adapt research approaches to changing social, cultural, economic, and political contexts [45]. These new and emerging research methods and techniques is a focus on the development of new research tools and approaches to examine complex educational challenges while integrating a focus on methodological innovation [46].

One area of rapid growth in comparative education research has been the use of mixed-methods approaches that, draw on the strengths of qualitative and quantitative methodologies [47]. There are many areas of educational inquiry that require the complementarity of mixed methods, such as how and in what ways do families and communities interact with schools to support student learning [48]. In addition, mixed-methods research designs offer opportunities to integrate different kinds of research questions and data, yielding findings that together provide a more comprehensive understanding of complex educational phenomena that play out at a variety of educational levels and scales [49].

Another frontier for innovation in comparative education concerns big data, a term used to refer to data that are difficult to handle within the scope of classical statistical methods because of their volume, velocity, and variety. This data-intensive research is facilitated by progress in computer power and data storage, resulting in large-scale databases, often

called mega or international databases [50]. Even if there are some limitations to using such large datasets, particularly related to ethical dimensions of data privacy, comparisons and convergence in education are among the most common empirical inquiries in the field [51].

Big data and data analytics offer new opportunities, for example, to uncover patterns and trends hidden in the data and to support evidence-based decision-making and policymaking [52]. The combination of qualitative, quantitative, and big data research methods offers new and innovative possibilities to the field and scholarship in comparative education today. These new tools and instruments, as well as comparative and multi-method research approaches, are a response to the call of modern educational inquiries and theories [53].

To conclude, methodological innovation has the potential to promote and encourage research that seeks to contribute to the identification of solutions to the educational challenges and future educational scenarios of our times, and to divert new avenues of investigation and reflection.

6.1 Mixed methods research

Mixed methods research has been identified as an emerging and powerful approach to comparative education. As an approach to help bridge "two loved ones," the value of emphasizing integration can lead to a more comprehensive understanding of educational contexts [54].

It is acknowledged that in comparative effectiveness research, several designs for mixed methods research are used, depending on the nature of the topic to be researched and the underlying epistemic stance [55]. The most popular designs are the explanatory and exploratory mixed methods designs, which are often referred to as explanatory sequential designs and exploratory sequential designs. These designs allow the mixing of different data collection and analysis procedures—qualitative mixed within qualitative, quantitative, or the mix, and their after-specific procedures merged in data interpretation [56, 57].

The explanatory sequential mixed methods design begins with the collection and analysis of quantitative data that helps identify cases or sites for further qualitative data collection and analysis. The results of the second phase are then compared with the quantitative results [56]. In exploratory studies, qualitative data are acquired first and complemented with quantitative data during the second and often third phases [58]. A central feature of the appeal for many researchers has been the ability to integrate findings from both data sources to map these methodologically diverse research worlds and create new insights. The triangulation of quantitative and qualitative methodological sources allows validity to be achieved [59].

A key advantage of education is that many problems are multidimensional and require an in-depth understanding of not only 'what' and 'how much' questions typically addressed by quantitative research, but also 'why' and 'how' they occur (which thorough qualitative analysis can address) [60, 61]. The approach is systems-oriented. One of the challenges of mixed methods research is that combining qualitative and quantitative research competencies, knowledge, and skills has not been common practice [62].

The applications of mixed methods are also particularly relevant within the fields of comparative and international education [47]. Contemporary topics within CIE can be complex, multi-faceted, or multi-scalar in nature, where both qualitative and quantitative data are required to meet the diverse needs of sophisticated educational research and policy. There has been cross-fertilization between qualitative research, especially from special needs research and the field of psychology, and what was later to emerge within the broader field of comparative education across Europe and beyond, where qualitative research is considered to be a recent and expanding trend [63].

Mixed methods have then figured into this background, and the trend is for the same reason: the advantages of mixed methods research are such as its ability to meet a number of emerging specific research needs that have only recently been recognized [64]. Mixed methods research is therefore not only a bridge between the qualitative and the quantitative methodology that has been deeply established in the historiography of research but also an up-to-date innovative approach to educational research trends, needs, and current evidence [49].

Recognizing its significance, UNESCO has extensively employed mixed-methods research in its reports to provide comprehensive insights into various subjects, integrating both quantitative and qualitative approaches for a more nuanced understanding. The State of the Education Report for India 2024, authored by the Srishti Manipal Institute of Art, Design & Technology, utilizes a combination of secondary data analysis, policy reviews, research literature, interviews, and an online survey to highlight successful practices and innovative strategies in culture and arts education across India [65] Similarly, A Comparative Study on Hybrid Learning in Schools adopts a mixed-methods design to analyze relationships among variables on a broad scale while incorporating qualitative perspectives for deeper exploration [66]. Additionally,

the report Arts Education: An Investment in Quality Learning highlights the importance of qualitative and mixed-methods research, emphasizing the value of case studies, ethnographies, and firsthand accounts from artist-teachers and learners in shaping educational policies [67]. The World Bank has also emphasized the importance of mixed-methods research in monitoring and evaluating development projects. For instance, the report "Using Mixed Methods in Monitoring and Evaluation: Experiences from International Development" discusses how integrating qualitative and quantitative methods can enhance the assessment of development initiatives. This highlights the benefits of mixed-methods approaches, such as providing comprehensive insights and addressing the limitations inherent in singular methodologies. The report also suggests future research directions, including the application of mixed methods in constructing counterfactuals and conducting evaluations under tight time and budget constraints [68].

Additionally, the World Bank's Independent Evaluation Group employs mixed-methods approaches in its Project Performance Assessment Reports, which typically include literature reviews, portfolio analyses, and country missions involving site visits and semi-structured interviews with stakeholders. This methodology allows for a more nuanced understanding of complex social dynamics, thereby informing more effective interventions [69]. Collectively, these reports reflect the commitment of UNESCO and the World bank to leveraging mixed-methods research to inform policy development and enhance the understanding of educational frameworks in diverse contexts.

6.2 Big data and data analytics in comparative education

Big data analytics refers to the process of examining large and varied datasets—commonly known as big data—to uncover hidden patterns, correlations, and other insights. In comparative education, this involves collecting and analyzing extensive educational data from multiple sources and countries to identify trends, assess educational outcomes and, inform policy decisions. The goal is to enhance educational practices and outcomes by leveraging the vast amounts of data available in the educational sector [70].The dramatic increase in the amount and diversity of data available has contributed to the growing application of big data and data analytics in the educational field [50]. Big data extend the scope of datasets and analytical tools beyond the traditional scale [71]. The size of big data can be beyond human ability to collect, organize, and analyze; hence, it can be tapped directly into databases to extract information [72]. Big data are increasingly being used in utility-based and domain-specific contexts for evidence-based formulation and evaluation of educational policies and practices [50].

On a related note, the application of big data analytics, which is resourceful due to the huge size and various analyzable nature of datasets, has been rapidly emerging in the educational domain [73]. Big data in educational settings can be in the form of structured data such as administrative and census records, school registers, learning management systems, or web survey activities, or unstructured ones like information extracted from learning systems, virtual learning environments, webcams, radio-frequency identification, social networking software, and sensors [50, 74].

The promise of big data is that with analytics tools, researchers and policymakers can explore new paths and come to broader understandings of education by uncovering sometimes hidden connections in the data, capturing patterns and relationships between factors that had previously gone unnoticed or remained elusive when employing traditional statistics. Through big data analytics, it is now possible to analyze student learning by identifying patterns in large sets of information [75]. Big data and advanced data analytics, which are used and analyzed correctly, have the power to improve educational outcomes. However, there are stark ethical consequences. Analysts require data and large datasets to draw robust conclusions and recommend effective policy solutions. In a comparative education setting, applying big data and advanced analytics holds significant promise. UNESCO has explored the applications and broader implications of big data analytics across various sectors through several reports. The Higher Education Global Data Report contributes to Sustainable Development Goal 4.3 by providing comprehensive insights into global higher education trends, including enrollment statistics and equity considerations [76]. In alignment with this, the February 2025 UIS Data Refresh, released by the UNESCO Institute for Statistics, updates the global database of education indicators by incorporating newly available country-level data for Sustainable Development Goal 4, thereby strengthening global education monitoring [77]. The World Bank has also implemented initiative that leverage big data and advanced analytics to enhance comparative education. The Systems Approach for Better Education Results (SABER), launched in 2011, collects and analyzes comparative data on global education policies and institutions, aiding countries in systematically strengthening their education systems to promote learning for all [78]. Collectively, these reports highlight the commitment of both UNESCO and the World Bank to leveraging big data analytics for sustainable development, educational enhancement, and social equity, while also using data-driven insights to inform and improve educational policies and practices globally.

7 Case-based applications and methodological evaluation in comparative education

While broad trends in methodology are essential to understand, the impact of research methods is best appreciated through in-depth case-based analysis. This section focuses on two well-developed thematic areas—(1) cross-cultural studies of student engagement and (2) big data analytics in school performance evaluation—to explore how different methods perform in real-world educational contexts. These cases help illustrate both the strengths and limitations of emerging research designs.

7.1 Big data analytics in comparative education

7.1.1 Investigating school performance in South Africa and Sierra Leone

Researchers applied machine learning and educational data mining techniques to analyze extensive educational datasets from South Africa and Sierra Leone. The study aimed to identify determinants of high school performance by building predictive models and extracting significant community and school-level features. The findings highlighted that determinants of performance varied between the two countries, leading to different policy implications and resource allocation recommendations [79].

7.1.2 Bibliometric analysis of big data in education

A comprehensive bibliometric analysis examined trends and recommendations in the application of big data and learning analytics in education. The study analyzed publications from 2012 to 2021, identifying the most relevant journals, authors, countries, research keywords, and subject areas involved. The findings underscored the growing significance of big data and learning analytics in enhancing educational systems [80].

7.2 Mixed methods in comparative education

7.2.1 Integration strategies in educational research

A systematic review analyzed 119 mixed methods research articles in education to explore generic integration strategies. The study provided insights into how quantitative and qualitative data analyses are blended in educational research, highlighting the potential of mixed methods to address complex research questions and corroborate findings [81].

7.2.2 Reflections on mixed methods in comparative education

An article discussed the fit of mixed methods research within comparative education studies. It argued that mixed methods research aligns well with comparative education's goal of making meaningful comparisons about educational systems across different countries. The approach allows for the generation and testing of theory, addressing complex research questions, and corroborating findings through the integration of quantitative and qualitative data [47].

7.2.3 International scholars' experiences in the United States

A mixed-methods study investigated the professional and social experiences of international scholars participating in exchange programs at a U.S. university. Through surveys and individual interviews, the study revealed that scholars were most satisfied with work conditions and research experiences but least satisfied with professional development opportunities and cultural exchange. The findings highlighted correlations between research experiences and cultural exchange, as well as between professional development and work conditions[82].

7.2.4 Teacher care and student engagement in Iran and Poland

This cross-cultural study employed a convergent parallel mixed-methods approach to explore how teacher care and teacher-student rapport influenced university students' engagement in pursuing academic goals in a second language (L2) context. Quantitative data from surveys and qualitative data from interviews with students in Iran and Poland indicated that teacher care and rapport significantly predicted student engagement. The study also underscored the impact of cultural and instructional contexts on student engagement [83].

7.2.5 Additional opportunities for thematic deep dives

Future comparative education research would benefit from deeper investigations into thematic areas such as gender equity in education, hybrid learning models, and curriculum innovation in under-resourced settings. Case studies within these themes could further evaluate the utility and limitations of emerging methods in driving equitable and evidence-based policy solutions.

8 Applications of innovative research methods

The first practical use of innovative methodologies in comparative education is to assess the real needs of school systems when setting educational policy agendas, visions, and goals. To formulate a realistic agenda for educational system development, it is important to base policy options not on policy discourse, interest, or political power but on a combination of actual evidence-based practical school effects [84].

Another way in which educational researchers can derive practical use and benefit from innovative research methods is through curriculum development and design [85, 86]. For example, curriculum analysis can provide an opportunity for an evaluator to undertake a deep research-based exploration of the relationship between the different domains of a curriculum [88, 89]. Furthermore, two questions that have always been high on the agenda of researchers and policymakers are related to educational quality and equity for development [87]. The application of innovative research methods has been able to demonstrate to providers and beneficiaries of educational materials and services the requirements necessary for improving educational outputs [88]. In conclusion, collaborative research can go a long way toward resolving the mutual misunderstanding that exists between policymakers, teachers, and researchers.

8.1 Addressing global disparities in research capacity

In addressing global disparities in research capacity, particularly in low-income contexts, several international initiatives have emerged. For example, UNESCO's Capacity Development for Education (CapED) programme supports countries in Africa and Asia by strengthening national education planning and research systems through technical assistance and institutional partnerships. Similarly, the Global Partnership for Education (GPE) funds research and capacity-building projects in low-income countries, including initiatives in Sierra Leone and the Democratic Republic of Congo to improve data systems and empower local researchers. In Latin America, the Regional Comparative and Explanatory Study (ERCE) led by UNESCO's Latin American Laboratory for Assessment of the Quality of Education (LLECE) offers training and methodological support for national teams to participate in international assessments. In South Asia, collaborative platforms like the South Asia Assessment Alliance focus on building regional expertise in large-scale learning assessments and policy evaluation. These efforts collectively demonstrate that bridging the research capacity gap requires sustained investment, international collaboration, and locally grounded solutions.

9 Policy formulation and evaluation

A vital concern in the field of comparative education is how evidence-based policy interventions in education are implemented and evaluated [89]. A rich body of research convincingly shows that sound policy interventions based on empirical evidence can make a substantial difference [90]. Data-driven insights lead to a better understanding of practices and their underlying dynamics, empower policymakers, and contribute to creating an education system based on evidence [91].

Changing and reforming education systems, schools, or teaching preparation to reflect the newest research findings is one of the goals of education research. A study of the "what works" literature shows a rich mix of research approaches that reflect the diversity in educational research methodologies.

One may argue that educational programs and interventions can be studied using the policy science toolbox, and there is no need for specific innovative research methodologies. Evaluations can follow standard formative and summative evaluative scheme. At the outset, innovative methods may be missed when attempting to contribute. Education is a human, highly dynamic system that does not wait for researchers to finish their data collection and analysis and issue their findings [92].

Sufficient knowledge based on multiple analytical angles accumulated over time needs to inform ongoing management and modification. Every intervention that concerns about this system also needs data about ongoing developments. The research interests outlined above are related to empirical implementation and effects of policy guidelines, which can be formulated at the policy level, country, or system level, as well as at the specific program or school level [93]. Between both levels, new or innovative implementation in countries and systems can be empirically explored. The collection of different kinds of data on the same intervention provides triangulation of findings, which is instrumental for validity and reliability, and can also contribute to a deeper understanding of the impact of innovative research methods [94].

Data sources within one country or used in national or international surveys provide data to document policy decisions: their formulation, implementation, and effectiveness, for instance, their effect on marginalized groups. These data emerged from a close collaboration between educational researchers and stakeholders mapped within the policy cycle or development intervention. This provides a basis for the meaningful exchange of researchers with policymakers on how their research can contribute.

9.1 Enhancing accessibility of innovative methods

To make innovative research methods more accessible and impactful for educators and policymakers, several key supports and infrastructures are essential. First, investment in research training and methodological capacity-building programs—especially in low-resource settings—is critical. National education ministries, in collaboration with international organizations like UNESCO and the World Bank, should prioritize workshops, fellowships, and certification programs focused on mixed methods, big data analytics, and longitudinal research. Second, the development of open-access data repositories and collaborative research platforms can democratize access to educational datasets and analytical tools. Initiatives like the UNESCO Institute for Statistics (UIS) and the Global Education Monitoring Report DataLab serve as models for accessible data-sharing ecosystems. Third, institutional support for interdisciplinary research—such as research funding schemes, dedicated centers of excellence, and incentives for cross-sector collaboration—can foster innovation and encourage the practical use of research findings. Finally, translating research into user-friendly formats (e.g., policy briefs, dashboards, and infographics) ensures that insights are not only produced but also utilized effectively in real-world decision-making processes.

10 Curriculum development and improvement

Curriculum development and improvement are considered essential components of quality education in the field of comparative education [95]. In this context, it is important to pay due attention to the results of educational research and innovative methodological tools to develop students' cognitive and metacognitive skills successfully. Using data as a source leads to a description of the practices that educational systems have developed in response to challenges. When considering the different ways in which these data are used, decision-makers generally prefer practices that drive learning improvement. Rather than looking at the assessment data, they make context-sensitive interpretations of the findings, which lead them to seek explanations and solutions by asking students, parents, and educators about the reasons for these statistical associations.

In Finland, an innovative use of structural equation models has made it possible to propose new profiles of student learning styles, preferences, and motivation. A key approach to curriculum reform is the use of research methods to identify students' diverse needs [96]. The Dutch educational system made an innovative use of the monitoring sample data as it enabled an in-depth data-driven evaluation of the social, practical, and life skills cross-curricular module for students with disabilities, which was based on the educational standards for general high school students. The informal qualitative curriculum was perceived as beneficial. Systematic adaptations were made based on these findings. Data

on opportunities can also help ensure that teacher-researcher responsiveness does not concentrate on the most usual cases. Data has also been used to redefine the evaluation of curriculum and classroom variables [97].

11 Ethical considerations in comparative education research

The first ethical consideration when conducting comparative educational research is the consent to research [98]. While recent debates have focused on consent to privacy and data collection in educational studies, the fundamental initial consent to participate has received less attention. In comparative systems research, every individual (or parent) in school age interviewed for information on educational practices is a de facto educational participant [99]. Beyond differing national rules on protection for children and young people, their cultural provenance makes these participants an uneven group, over and above considerations of social class or gender [100], for example, studies addressing ethical dilemmas of field research have also noted the impact of cultural differences between those who conduct research and those who are the object of research. This discrepancy generally produces tensions that often characterize research processes and are particularly relevant for comparative researchers who step into other cultural worlds [101].

The principal output of a comparative education research process is the data it generates, which is taken to represent the views, experiences, and practices of the participants in the study. It is for this very reason that some have highlighted the urgent need for comparative educators to explicitly address their own subjectivities and "situate" themselves and their work more rigorously [102]. Encountering and dealing with biases relating to gender, race, class, nationality, and so on in the interpretation and presentation of data leads to the promotion of the degree of reflexivity that research in comparative education is said to require. These responsibilities are not simply individual, of course. Comparative researchers require ethical understandings and guidelines to characterize their methods and practices in the conduct of their research, and in the interpretation that they generate from them [103].

There thus seem to be three principal spaces within which ethical considerations operate within the conduct and dissemination of comparative educational research. The first space relates to the researchers' relation to their subjects, the second space concerns their relation to the analysis and inference of their data, and the third space is one in which they are responsible for the representation and dissemination of their data in the research community [103]. Ethical research practices and attentiveness to the procedural particulars described here are crucial not only for safeguarding the interests and rights of the children and parents who are drawn into research, but also for ensuring the effective observation of educational sites and the integrity of any resulting comparative findings. While applying procedural ethics will never guarantee that research encounters will be without conflict and complexity, they are a necessary part of the conditions necessary for relatively open research practices to earn the trust of those into whose lives they delve.

11.1 Ethical issues in cross-cultural research

Comparative education research in cross-cultural settings presents ethical challenges arising from differences in societal norms, research traditions, and power dynamics. Researchers must navigate these complexities while maintaining ethical integrity by avoiding cultural imposition, ensuring respectful engagement, and addressing language barriers [103]. Applying Western-centric methodologies indiscriminately to non-Western educational contexts can lead to misrepresentations; therefore, research approaches should be adapted to local settings. Collaboration with educators, policymakers, and communities is essential to developing culturally appropriate methods that uphold mutual respect. Additionally, language and interpretation challenges must be carefully managed to prevent misinterpretations, emphasizing the need for accurate translation and culturally competent interpretation to enhance research validity [104].

11.2 Addressing power imbalances and research exploitation

A significant ethical concern in comparative education research is the power imbalance between researchers and participants, particularly in studies involving marginalized communities or developing nations. To prevent exploitative practices, researchers should adopt participatory methods that actively involve local communities in shaping the study rather than treating them as mere subjects. Ensuring equitable benefits for participants is essential, such as sharing research findings with local educators and policymakers to enhance educational practices. Additionally, recognizing and fairly representing the intellectual contributions of local scholars in academic publications is crucial for fostering ethical and collaborative research [15].

11.3 Ethical use of comparative data and responsible interpretation

Comparative education research relies on data-driven insights to inform policy and practice, however misrepresentation of findings can lead to unintended policy consequences. Ethical concerns in data interpretation and reporting include avoiding deficit framing by highlighting strengths alongside challenges rather than depicting certain education systems as fundamentally flawed. Findings should be contextualized with an understanding of historical, socioeconomic, and political factors that shape educational outcomes to ensure accurate representation. Additionally, preventing oversimplification is essential because, comparisons should not reduce complex educational realities to mere rankings or metrics without considering qualitative factors that provide deeper insights into educational contexts [105].

11.4 Data privacy concerns in big data analytics and the risk of algorithmic bias in artificial intelligence (AI)-driven education research

The increasing use of big data analytics and AI in comparative education research has led to new ethical dilemmas. Although, big data enable large-scale insights, they also raises concerns about data privacy, security, and bias in AI-driven decision-making [106].

11.4.1 Privacy and data protection

Big data research in education involves collecting large volumes of student and institutional data from learning management systems, standardized testing, and online learning platforms, necessitating strict ethical data governance. Ensuring anonymization is critical, and personally identifiable information is removed or masked to protect participants' identities. Researchers must also comply with global data protection regulations, such as General Data Protection Regulation in Europe, Family Educational Rights and Privacy Act in the U.S., and other national data privacy frameworks, to uphold legal and ethical standards. Additionally, securing data storage through encryption and protected environments is essential to prevent unauthorized access or breaches, ensuring the integrity and confidentiality of educational data [66, 92].

11.4.2 Algorithmic bias and ethical AI in education

AI-driven analytics are increasingly used to predict student performance, assess learning outcomes, and automate decision-making, however these systems risk perpetuating inequalities if not ethically designed. Bias in training data can reinforce disparities if AI models are developed using datasets skewed toward privileged student groups [107]. Additionally, the lack of transparency in AI decision-making, where many educational systems function as "black boxes," limits the ability of educators and students to understand or challenge recommendations. Overreliance on AI and big data may also contribute to digital exclusion, further marginalizing students from underprivileged backgrounds who lack digital access. To address these concerns, researchers must advocate for AI models that incorporate human oversight, fairness audits, and bias detection mechanisms, ensuring ethical and equitable integration of AI in education [108].

11.5 Ethical challenges in open access and research dissemination

The ethical responsibility of researchers extends beyond data collection to the publication and dissemination of findings, emphasizing transparency and accessibility. A key concern is the balance between open access and paywalls, as open-access publishing promotes global knowledge sharing; however, researchers must also uphold ethical citation and intellectual property rights. Additionally, preventing research misuse is essential to ensure that findings are not distorted to justify harmful education policies, such as exclusionary admission practices and funding cuts. Equally important is inclusive dissemination, in which research should be communicated in accessible formats, that enable educators, policymakers, and communities to engage with and benefit from the findings [109].

11.6 Researcher bias and subjectivity in comparative education research

In comparative education research, the researcher's personality, background, and experiences inevitably shape the way studies are designed, data are collected and analyzed, and findings are interpreted. Acknowledging this subjectivity is crucial for maintaining research integrity and minimizing personal biases. Reflexivity, or the critical examination of one's assumptions, values, and biases, is essential in cross-cultural research because, as researchers' cultural, linguistic, and disciplinary backgrounds influence data interpretation [110]. The key aspects of reflexivity include awareness of personal biases, continuous self-reflection, and engagement with local contexts to ensure accurate representation of educational systems. Biases can manifest in data collection and interpretation through selection bias, confirmation and linguistic bias, which can be mitigated by employing triangulation, interdisciplinary collaboration, and local stakeholder involvement. Additionally, power dynamics in researcher-participant interactions raise ethical concerns, particularly when researchers from high-income countries conduct studies in low-income settings [111]. Ethical considerations include ensuring fair representation, promoting reciprocity so that findings benefit local communities, and respecting cultural norms. To enhance transparency and accountability, comparative education scholars must explicitly document research processes, disclose funding sources, and provide detailed methodologies to allow replication and critique. While researcher subjectivity is inherent in comparative education, addressing it through reflexivity, ethical engagement, and transparency strengthens the credibility, rigor, and equity of research, ultimately contributing to more meaningful and impactful educational insights [105].

11.7 Ethical responsibilities in longitudinal and experimental research

Longitudinal studies on comparative education, which track students' progress over extended periods, introduce unique ethical concerns that require careful consideration. Ensuring informed consent over time is crucial, as participants must have ongoing opportunities to reassess and withdraw their consent as the study progresses [112]. Additionally, the risk of attrition and unequal representation poses a challenge, making it essential for researchers to actively promote diverse participation and prevent biased results due to participant dropout. Moreover, studies involving experimental interventions, such as new educational policies or teaching strategies, must be designed to minimize harm and ensure that all students benefit equally, upholding ethical integrity in long-term educational research [113].

Ethical considerations in comparative education research are complex and multifaceted, requiring a careful balance between rigorous academic inquiry, cultural sensitivity, participant rights, and responsible data use. As research methodologies evolve, particularly with the increasing reliance on big data and AI-driven analytics, ethical challenges will continue to expand. To promote equitable and responsible research, scholars must develop standardized ethical frameworks that guide cross-cultural and data-intensive methodologies, advocate for ethical AI in education to ensure fair, transparent, and bias-free algorithmic decision-making, and foster inclusive and reciprocal research practices that actively benefit local educators and communities. By adhering to ethical best practices, comparative education researchers can contribute to more just, transparent, and impactful educational policies and innovations worldwide [114].

11.8 Practical strategies for navigating ethical and cultural challenges

In practice, researchers in comparative education have employed various strategies to navigate ethical and cultural complexities effectively. For instance, in cross-cultural research with Indigenous communities in Australia, scholars adopted participatory action research (PAR) approaches, which emphasized co-designing the study with community members to ensure cultural relevance and respect for traditional knowledge systems. Similarly, in a comparative study on girls' education in South Asia, researchers engaged local female educators as cultural mediators to conduct interviews and interpret findings, thereby reducing power imbalances and enhancing trust. In sub-Saharan Africa, several education-focused NGOs have piloted ethics review boards that include community representatives to evaluate research protocols, ensuring alignment with local norms and values. Moreover, UNESCO's research on refugee education in the Middle East has integrated trauma-informed methods and multilingual consent processes, offering flexible participation options and safeguarding vulnerable populations. These examples demonstrate that ethical and cultural challenges can be effectively addressed through collaborative engagement, context-sensitive methodologies, and inclusive research governance structures.

12 Limitations

Despite its contributions to the field of comparative education, this study has several limitations. First, while the work integrates various research methodologies, it does not empirically test their effectiveness in real-world educational settings, limiting its practical validation. Additionally, although the discussion on big data analytics and mixed-methods research is comprehensive, it does not fully address the practical challenges of implementation, such as data privacy concerns and resource constraints. The study also focuses largely on methodological advancements without extensively engaging with contextual variations in educational systems, which could impact the applicability of findings across diverse sociocultural settings. Lastly, while the study highlights the significance of interdisciplinary approaches, it does not propose specific frameworks for effectively integrating these methodologies. Future research should address these limitations by expanding the geographical scope of analysis and developing structured guidelines for methodological integration in comparative education research.

13 Conclusion and future directions

In recent years, the field of comparative education has experienced a paradigm shift, embracing innovative research methodologies to address the complexities of global education systems. This review has examined the evolution of research approaches, highlighting the transition from traditional qualitative and quantitative methods to the integration of big data analytics, longitudinal studies, meta-analyses, and mixed-methods research. These advancements have enhanced the depth and accuracy of educational research, allowing scholars to analyze large-scale datasets, uncover meaningful patterns, and generate insights that are more representative and actionable. By synthesizing studies from 2000 to 2025, this review demonstrates the growing importance of methodological diversity in comparative education. The findings reaffirm that mixed-methods approaches provide a balanced framework for investigating both the "what" and "why" of educational phenomena. In addition, big data analytics has emerged as a transformative tool, enabling researchers to process vast amounts of educational data and derive evidence-based policy recommendations. The adoption of longitudinal studies has further strengthened comparative education by offering a more dynamic perspective on educational trends and reforms over time.

Future research must continue to explore the ethical and practical implications of these emerging methodologies. Although big data and advanced analytics present unprecedented opportunities, they raise concerns regarding data privacy, accessibility, and equity in education. Scholars must also strive for methodological rigor by refining integration strategies in mixed-methods research and ensuring the responsible application of quantitative and qualitative techniques. Ultimately, this review underscores the necessity for a flexible, interdisciplinary, and data-driven approach to comparative education research. As the educational landscape continues to evolve, the effective use of innovative methodologies will play a crucial role in informing global education policies, reducing disparities, and fostering equitable learning opportunities across diverse contexts. This review serves as a foundation for further discourse, encouraging educators, policymakers, and researchers to collaboratively advance the field through methodological innovation and empirical inquiry.

Author contributions M.P.P: Review concept and design, Collection and assembly of data, Data analysis and interpretation, Writing the article, Critical revision of the article, Final approval of the article.

Funding No funding was received to assist with the preparation of this manuscript.

Data availability No datasets were generated or analysed during the current study.

Code availability Not applicable.

Declarations

Ethics approval and consent to participate Not applicable.

Consent for publication I declare that the author listed has approved the manuscript for submission and that the content has not been published or submitted elsewhere. The author consents to the publication of the manuscript in Discover Education upon acceptance by the Editor-in-Chief after completion of the refereeing process.

Competing interests The authors declare no competing interests.

References

1. Van De Werfhorst HG, Mijs JJB. Achievement inequality and the institutional structure of educational systems: a comparative perspective. Annu Rev Sociol. 2010;36(1):407–28. https://doi.org/10.1146/annurev.soc.012809.102538.
2. Hardwick SW, Marcus R, Isaak M. Education and national identity in a comparative context. Natl Identities. 2010;12(3):253–68. https://doi.org/10.1080/14608941003727932.
3. Mickelson RA, Nkomo M. Integrated schooling, life course outcomes, and social cohesion in multiethnic democratic societies. Rev Res Educ. 2012;36(1):197–238. https://doi.org/10.3102/0091732X11422667.
4. Kerkhoff SN, Cloud ME. Equipping teachers with globally competent practices: a mixed methods study on integrating global competence and teacher education. Int J Educ Res. 2020;103: 101629. https://doi.org/10.1016/j.ijer.2020.101629.
5. Silva E, Warde A, Wright D. Using mixed methods for analysing culture: the cultural capital and social exclusion project. Cult Sociol. 2009;3(2):299–316. https://doi.org/10.1177/1749975509105536.
6. Luoto JM. Comparative education and comparative classroom observation systems. Comp Educ. 2023;59(4):564–83. https://doi.org/10.1080/03050068.2023.2173917.
7. Busemeyer MR, Trampusch C. Review article: comparative political science and the study of education. Br J Polit Sci. 2011;41(2):413–43. https://doi.org/10.1017/S0007123410000517.
8. Brehm W. Comparative education as a political project. Comp Educ. 2023;59(3):362–78. https://doi.org/10.1080/03050068.2023.2193807.
9. Spring J. Research on globalization and education. Rev Educ Res. 2008;78(2):330–63. https://doi.org/10.3102/0034654308317846.
10. Carnoy M, Rhoten D. What does globalization mean for educational change? A comparative approach. Comp Educ Rev. 2002;46(1):1–9. https://doi.org/10.1086/324053.
11. Lingard B, Rawolle S. New scalar politics: implications for education policy. Comp Educ. 2011;47(4):489–502. https://doi.org/10.1080/03050068.2011.555941.
12. Dale R. Globalisation, knowledge economy and comparative education. Comp Educ. 2005;41(2):117–49. https://doi.org/10.1080/03050060500150906.
13. Niemann D, Martens K, Teltemann J. PISA and its consequences: shaping education policies through international comparisons. Eur J Educ. 2017;52(2):175–83. https://doi.org/10.1111/ejed.12220.
14. Liu X. A Comparative Study on the Roles of the World Bank, the OECD and UNESCO in Global Education Policy Making: Qingdao, China; 2022. https://doi.org/10.2991/aebmr.k.220404.103.
15. Powell JJW. Comparative education in an age of competition and collaboration. Comp Educ. 2020;56(1):57–78. https://doi.org/10.1080/03050068.2019.1701248.
16. Eftedal NH, Kleppestø TH, Czajkowski NO, Eilertsen EM, Sheehy-Skeffington J, Vassend O, et al. Causality and confounding between Right Wing Authoritarianism, education, and Socio-Economic Status; a twin study'. 2020. https://doi.org/10.31234/osf.io/vws83.
17. Sheth MJ. Grappling with racism as foundational practice of science teaching. Sci Educ. 2019;103(1):37–60. https://doi.org/10.1002/sce.21450.
18. Sidong G. Study on the Development Process and Trends of Comparative Education Research Methods. Proceedings of the 7th International Conference on Education, Management, Information and Computer Science (ICEMC 2017). Shenyang, China: Atlantis Press; 2017. https://doi.org/10.2991/icemc-17.2017.242.
19. Cilesiz S, Greckhamer T. Qualitative comparative analysis in education research: its current status and future potential. Rev Res Educ. 2020;44(1):332–69. https://doi.org/10.3102/0091732X20907347.
20. Leko MM, Cook BG, Cook L. Qualitative methods in special education research. Learn Disabil Res Pract. 2021;36(4):278–86. https://doi.org/10.1111/ldrp.12268.
21. Kelly P. Qualitative comparative research on teaching. Res Comp Int Educ. 2016;11(4):354–6. https://doi.org/10.1177/1745499916679556.
22. Sabharwal NS, Malish CM. Mixed Methods Approaches and Qualitative Methodology for Higher Education Policy Research. Oxford Research Encyclopedia of Education. Oxford University Press; 2018. https://doi.org/10.1093/acrefore/9780190264093.013.465.
23. Pregoner JD. Research approaches in education: a comparison of quantitative, qualitative and mixed methods. SSRN J. 2025. https://doi.org/10.2139/ssrn.5111007.
24. Reale E. Challenges in higher education research: the use of quantitative tools in comparative analyses. High Educ. 2014;67(4):409–22. https://doi.org/10.1007/s10734-013-9680-2.
25. Cumming MM, Bettini E, Chow JC. High-quality systematic literature reviews in special education: promoting coherence, contextualization, generativity, and transparency. Except Child. 2023;89(4):412–31. https://doi.org/10.1177/00144029221146576.

26. Harari MB, Parola HR, Hartwell CJ, Riegelman A. Literature searches in systematic reviews and meta-analyses: a review, evaluation, and recommendations. J Vocat Behav. 2020;118: 103377. https://doi.org/10.1016/j.jvb.2020.103377.
27. Linnenluecke MK, Marrone M, Singh AK. Conducting systematic literature reviews and bibliometric analyses. Aust J Manag. 2020;45(2):175–94. https://doi.org/10.1177/0312896219877678.
28. Nguyen N, Singh S. A primer on systematic reviews and meta-analyses. Semin Liver Dis. 2018;38(02):103–11. https://doi.org/10.1055/s-0038-1655776.
29. Hutchinson SR, Lovell CD. A review of methodological characteristics of research published in key journals in higher education: implications for graduate research training. Res High Educ. 2004;45(4):383–403. https://doi.org/10.1023/B:RIHE.0000027392.94172.d2.
30. Douglass JA, Thomson G, Zhao C-M. The learning outcomes race: the value of self-reported gains in large research universities. High Educ. 2012;64(3):317–35. https://doi.org/10.1007/s10734-011-9496-x.
31. Lin L. Bias caused by sampling error in meta-analysis with small sample sizes. PLoS ONE. 2018;13(9): e0204056. https://doi.org/10.1371/journal.pone.0204056.
32. Broadfoot P. Educational policy in comparative perspective. Comp Educ. 2002;38(2):133–5. https://doi.org/10.1080/03050060220140539.
33. Xiao Y, Watson M. Guidance on conducting a systematic literature review. J Plan Educ Res. 2019;39(1):93–112. https://doi.org/10.1177/0739456X17723971.
34. Paul J, Criado AR. The art of writing literature review: what do we know and what do we need to know? Int Bus Rev. 2020;29(4): 101717. https://doi.org/10.1016/j.ibusrev.2020.101717.
35. Schulze R. Current methods for meta-analysis. Zeitschrift für Psychologie / J Psychol. 2007;215(2):90–103. https://doi.org/10.1027/0044-3409.215.2.90.
36. Makinde FL, Tchamga MSS, Jafali J, Fatumo S, Chimusa ER, Mulder N, et al. Reviewing and assessing existing meta-analysis models and tools. Brief Bioinform. 2021;22(6):bbab324. https://doi.org/10.1093/bib/bbab324.
37. Welsh EJ, Normansell RA, Cates CJ. Assessing the methodological quality of systematic reviews. npj Prim Care Resp Med. 2015;25(1):15019. https://doi.org/10.1038/npjpcrm.2015.19.
38. Luo J, Ma L, Shankar K. Does the inclusion of non-academic reviewers make any difference for grant impact panels? Sci Public Policy. 2021;48(6):763–75. https://doi.org/10.1093/scipol/scab046.
39. Pigott TD, Polanin JR. Methodological guidance paper: high-quality meta-analysis in a systematic review. Rev Educ Res. 2020;90(1):24–46. https://doi.org/10.3102/0034654319877153.
40. Milošević D, Maksimović J. Methodology of comparative research in education: role and significance. IJCRSEE. 2020;8(3):155–62. https://doi.org/10.23947/2334-8496-2020-8-3-155-162.
41. Lumley T, Scott A. Fitting regression models to survey data. Statist Sci. 2017. https://doi.org/10.1214/16-STS605.
42. Seixas BV, Smith N, Mitton C. The qualitative descriptive approach in international comparative studies: using online qualitative surveys. Int J Health Policy Manag. 2017;7(9):778–81. https://doi.org/10.15171/ijhpm.2017.142.
43. Lindell MK, Whitney DJ. Accounting for common method variance in cross-sectional research designs. J Appl Psychol. 2001;86(1):114–21. https://doi.org/10.1037/0021-9010.86.1.114.
44. Breidt FJ, Opsomer JD. Endogenous post-stratification in surveys: classifying with a sample-fitted model. Ann Stat. 2008. https://doi.org/10.1214/009053607000000703.
45. Bray M, Adamson B, Mason M, editors. Comparative Education Research: Approaches and Methods'. Cham: Springer International Publishing; 2014. https://doi.org/10.1007/978-3-319-05594-7.
46. Jacobson MJ, Levin JA, Kapur M. Education as a complex system: conceptual and methodological implications. Educ Res. 2019;48(2):112–9. https://doi.org/10.3102/0013189X19826958.
47. Zha Q, Tu D. Doing mixed methods research in comparative education: some reflections on the fit and a survey of the literature. In: Wiseman AW, Anderson E, editors. International perspectives on education and society. Emerald Group Publishing Limited; 2016. p. 165–91.
48. Epstein JL. School, family, and community partnerships in teachers' professional work. J Educ Teach. 2018;44(3):397–406. https://doi.org/10.1080/02607476.2018.1465669.
49. Corr C, Snodgrass MR, Love H, Scott IM, Kim J, Andrews L. Exploring the landscape of published mixed methods research in special education: a systematic review. Remedial Special Edu. 2021;42(5):317–28. https://doi.org/10.1177/0741932520924030.
50. Baig MI, Shuib L, Yadegaridehkordi E. Big data in education: a state of the art, limitations, and future research directions. Int J Educ Technol High Educ. 2020;17(1):44. https://doi.org/10.1186/s41239-020-00223-0.
51. Florea D, Florea S. Big data and the ethical implications of data privacy in higher education research. Sustainability. 2020;12(20):8744. https://doi.org/10.3390/su12208744.
52. di Berardino D, Vona S. Discovering the relationship between big data, big data analytics, and decision making: a structured literature review. ESJ. 2023;19(19):1. https://doi.org/10.19044/esj.2023.v19n19p1.
53. Sandelowski M. Combining qualitative and quantitative sampling, data collection, and analysis techniques in mixed-method studies. Res Nurs Health. 2000;23(3):246–55. https://doi.org/10.1002/1098-240X(200006)23:3%3c246::AID-NUR9%3e3.0.CO;2-H.
54. Suárez-Orozco C. Reflections on the promise of mixed-methods research in education. Teach Coll Rec. 2019;121(10):1–4. https://doi.org/10.1177/016146811912101011.
55. Armstrong K. Methods in comparative effectiveness research. JCO. 2012;30(34):4208–14. https://doi.org/10.1200/JCO.2012.42.2659.
56. Ivankova NV, Creswell JW, Stick SL. Using mixed-methods sequential explanatory design: from theory to practice. Field Methods. 2006;18(1):3–20. https://doi.org/10.1177/1525822X05282260.
57. Fetters MD, Curry LA, Creswell JW. Achieving integration in mixed methods designs—principles and practices. Health Serv Res. 2013;48(6):2134–56. https://doi.org/10.1111/1475-6773.12117.
58. Mason P, Augustyn M, Seakhoa-King A. Exploratory study in tourism: designing an initial, qualitative phase of sequenced, mixed methods research. J Tour Res. 2010;12(5):432–48. https://doi.org/10.1002/jtr.763.
59. Santos KDS, Ribeiro MC, Queiroga DEUD, Silva IAPD, Ferreira SMS. O uso de triangulação múltipla como estratégia de validação em um estudo qualitativo. Ciênc saúde coletiva. 2020;25(2):655–64. https://doi.org/10.1590/1413-81232020252.12302018.

60. Beloglazov IN. Multidimensional analysis in problems of education qualimetry. J Comput Syst Sci Int. 2006;45(6):881–93. https://doi.org/10.1134/S1064230706060049.
61. Zuzevičiūtė V, Butrimė E, Vitkutė-Adžgauskienė D, Vladimirovich Fomin V, Kikis-Papadakis K, editors. E-Learning as a Socio-Cultural System: A Multidimensional Analysis'. IGI Global; 2014. https://doi.org/10.4018/978-1-4666-6154-7.
62. Almalki S. Integrating quantitative and qualitative data in mixed methods research—challenges and benefits. JEL. 2016;5(3):288. https://doi.org/10.5539/jel.v5n3p288.
63. Del Rio CM, Tseliou E. Mapping qualitative research in psychology across Europe: contemporary trends. Qual Res Psychol. 2019;16(3):325–35. https://doi.org/10.1080/14780887.2019.1605276.
64. Ivankova N, Wingo N. Applying mixed methods in action research: methodological potentials and advantages. Am Behav Sci. 2018;62(7):978–97. https://doi.org/10.1177/0002764218772673.
65. Srishti Manipal Institute of Art, Design & Technology. State of the Education Report for India 2024 | UNESCO'.
66. UNESCO International Bureau of Education. Research report: a comparative study on hybrid learning in schools—UNESCO Digital Library'. p. 226.
67. Arts education: an investment in quality learning—UNESCO Digital Library'. p. 26.
68. Bamberger M, Rao V, Woolcock M. Using mixed methods in monitoring and evaluation : experiences from international development'.
69. The Project Performance Assessment Report | Independent Evaluation Group'.
70. Wilmers A, Jornitz S, editors. International Perspectives on School Settings, Education Policy and Digital Strategies: A Transatlantic Discourse in Education Research'. 1st ed. Verlag Barbara Budrich; 2021. https://doi.org/10.2307/j.ctv1gbrzf4.
71. Liu R, Simon E, Amann B, Gançarski S. Discovering and merging related analytic datasets. Inf Syst. 2020;91: 101495. https://doi.org/10.1016/j.is.2020.101495.
72. Madden S. From databases to big data. IEEE Internet Comput. 2012;16(3):4–6. https://doi.org/10.1109/MIC.2012.50.
73. Bai X, Zhang F, Li J, Guo T, Aziz A, Jin A, et al. Educational big data: predictions, applications and challenges. Big Data Res. 2021;26: 100270. https://doi.org/10.1016/j.bdr.2021.100270.
74. Prahani BK, Dawana IR, Jatmiko B, Amelia T. Research trend of big data in education during the last 10 years. Int J Emerg Technol Learn. 2023;18(10):39–64. https://doi.org/10.3991/ijet.v18i10.38453.
75. Maldonado-Mahauad J, Pérez-Sanagustín M, Kizilcec RF, Morales N, Munoz-Gama J. Mining theory-based patterns from Big data: identifying self-regulated learning strategies in Massive Open Online Courses. Comput Hum Behav. 2018;80:179–96. https://doi.org/10.1016/j.chb.2017.11.011.
76. authorCorporate:UNESCO, authorPerson:Detmer A, authorEvent:World Conference on Higher Education 3rd. Higher education global data report, working document'. UNESCO; 2022.
77. February 2025 UIS Data Refresh: New Data and Expanded Coverage for Global Education Monitoring'. 2025.
78. Systems Approach for Better Education Results (SABER)'.
79. Wandera H, Marivate V, Sengeh D. Investigating similarities and differences between South African and Sierra Leonean school outcomes using Machine Learning. arXiv; 2020. https://doi.org/10.48550/ARXIV.2004.11369
80. Samsul SA, Yahaya N, Abuhassna H. Education big data and learning analytics: a bibliometric analysis. Humanit Soc Sci Commun. 2023;10(1):709. https://doi.org/10.1057/s41599-023-02176-x.
81. Zhou Y, Zhou Y, Machtmes K. Mixed methods integration strategies used in education: a systematic review. Methodol Innov. 2024;17(1):41–9. https://doi.org/10.1177/20597991231217937.
82. Krsmanovic M. When experts become novices: a mixed-methods exploration of international scholars' experiences at a US university. J Comp Int Higher Educ. 2022. https://doi.org/10.32674/jcihe.v14i3a.4119.
83. Derakhshan A, Doliński D, Zhaleh K, Enayat MJ, Fathi J. A mixed-methods cross-cultural study of teacher care and teacher-student rapport in Iranian and Polish University students' engagement in pursuing academic goals in an L2 context. System. 2022;106: 102790. https://doi.org/10.1016/j.system.2022.102790.
84. Borhan M, Jemain AA. Assessing schools' academic performance using a belief structure. Soc Indic Res. 2012;106(1):187–97. https://doi.org/10.1007/s11205-011-9803-z.
85. Gottipati S, Shankararaman V. Competency analytics tool: analyzing curriculum using course competencies. Educ Inf Technol. 2018;23(1):41–60. https://doi.org/10.1007/s10639-017-9584-3.
86. Levander LM, Mikkola M. Core curriculum analysis: a tool for educational design. J Agric Educ Ext. 2009;15(3):275–86. https://doi.org/10.1080/13892240903069785.
87. Kyriakides L, Creemers B, Charalambous E. Equity and Quality Dimensions in Educational Effectiveness. Cham: Springer International Publishing; 2018. https://doi.org/10.1007/978-3-319-72066-1
88. Ratnawati N, Idris I. Improving student capabilities through research-based learning innovation on e-learning system. Int J Emerg Technol Learn. 2020;15(04):195. https://doi.org/10.3991/ijet.v15i04.11820.
89. Wiseman AW. The uses of evidence for educational policymaking: global contexts and international trends. Rev Res Educ. 2010;34(1):1–24. https://doi.org/10.3102/0091732X09350472.
90. Drèze J. Policy beyond evidence. World Dev. 2020;127: 104797. https://doi.org/10.1016/j.worlddev.2019.104797.
91. Williamson B. Digital education governance: data visualization, predictive analytics, and 'real-time' policy instruments. J Educ Policy. 2016;31(2):123–41. https://doi.org/10.1080/02680939.2015.1035758.
92. Koopmans M. Education is a complex dynamical system: challenges for research. J Exp Educ. 2020;88(3):358–74. https://doi.org/10.1080/00220973.2019.1566199.
93. Torenvlied R, Akkerman A. Theory of 'Soft' policy implementation in multilevel systems with an application to social partnership in the Netherlands. Acta Polit. 2004;39(1):31–58. https://doi.org/10.1057/palgrave.ap.5500046.
94. Noble H, Heale R. Triangulation in research, with examples. Evid Based Nurs. 2019;22(3):67–8. https://doi.org/10.1136/ebnurs-2019-103145.
95. Sabrina E, Giatman M, Ernawati E. Development of curriculum management in the world of education. Fair Value Jurnal Ilmiah Akuntansi Dan Keuangan. 2022;4(10):4691–6. https://doi.org/10.32670/fairvalue.v4i10.1741.
96. Nordlund H, Piiroinen J. Digivisio 2030: Finland as a model country for flexible learning. pp. 159–149. https://doi.org/10.29007/9687.

97. Straub R. The student, the text, and the classroom context: a case study of teacher response. Assess Writ. 2000;7(1):23–55. https://doi.org/10.1016/S1075-2935(00)00017-9.
98. Felzmann H. Ethical issues in school-based research. Res Ethics. 2009;5(3):104–9. https://doi.org/10.1177/174701610900500304.
99. David M, Edwards R, Alldred P. Children and School-based Research: 'informed consent' or 'educated consent'? Br Educ Res J. 2001;27(3):347–65. https://doi.org/10.1080/01411920120048340.
100. Akilapa R, Simkiss D. Cultural influences and safeguarding children. Paediatr Child Health. 2012;22(11):490–5. https://doi.org/10.1016/j.paed.2012.06.008.
101. Honan E, Hamid MO, Alhamdan B, Phommalangsy P, Lingard B. Ethical issues in cross-cultural research. Int J Res Method Educ. 2013;36(4):386–99. https://doi.org/10.1080/1743727X.2012.705275.
102. Takayama K. Engaging with the more-than-human and decolonial turns in the land of Shinto cosmologies: "negative" comparative education in practice. ECNU Rev Educ. 2020;3(1):46–65. https://doi.org/10.1177/2096531120906298.
103. McMahon E, Milligan LO. A framework for ethical research in international and comparative education. Compare J Comp Int Educ. 2023;53(1):72–88. https://doi.org/10.1080/03057925.2021.1876553.
104. Machin L, Richardson T, Ryan M. Delivery of a western-centric initial teacher education award in a Chinese-centric context. What constitutes good practice? J Educ Teaching. 2020;46(2):170–83. https://doi.org/10.1080/02607476.2020.1717936.
105. Oyinloye B. Reimagining the researcher-participant ethics relationship: a participant-centred, values-based ethics approach in comparative and international education. Compare J Comp Int Educ. 2024;54(4):646–60. https://doi.org/10.1080/03057925.2022.2116929.
106. Holmes W, Porayska-Pomsta K, Holstein K, Sutherland E, Baker T, Shum SB, et al. Ethics of AI in education: towards a community-wide framework. Int J Artif Intell Educ. 2022;32(3):504–26. https://doi.org/10.1007/s40593-021-00239-1.
107. Reidenberg JR, Schaub F. Achieving big data privacy in education. Theory Res Educ. 2018;16(3):263–79. https://doi.org/10.1177/1477878518805308.
108. Duin AH, Pedersen I. Autonomous writing futures. Writing Futures: Collaborative, Algorithmic, Autonomous. Cham: Springer International Publishing; 2021. pp. 85–107. https://doi.org/10.1007/978-3-030-70928-0_4
109. Ross MW, Iguchi MY, Panicker S. Ethical aspects of data sharing and research participant protections. Am Psychol. 2018;73(2):138–45. https://doi.org/10.1037/amp0000240.
110. Bierema A, Hoskinson A-M, Moscarella R, Lyford A, Haudek K, Merrill J, et al. Quantifying cognitive bias in educational researchers. Int J Res Method Educ. 2021;44(4):395–413. https://doi.org/10.1080/1743727X.2020.1804541.
111. Perkowska-Klejman A. Reflexivity as a methodological category in educational research. Studia z Teorii Wychowania. 2023. https://doi.org/10.5604/01.3001.0054.1197.
112. Twine R, Lewando Hundt G, Kahn K. Dilemmas of ethics in practice in longitudinal health research: identifying opportunities for widening participation of residents. Front Sociol. 2019;4:33. https://doi.org/10.3389/fsoc.2019.00033.
113. Weidmann B, Miratrix L. Missing, presumed different: quantifying the risk of attrition bias in education evaluations. J Royal Stat Soc Ser A Stat Soc. 2021;184(2):732–60. https://doi.org/10.1111/rssa.12677.
114. Butterwick S, Head G, Madalinska-Michalak J, Raykov M, Taylor A, Taylor-Neu R, et al. Introduction: ethical issues in educational research. Eur Educ Res J. 2020;19(1):3–9. https://doi.org/10.1177/1474904119896506.