International Journal of Education, Training and Learning
ISSN 2577-7688
Vol. 9, No. 1, pp. 1-14
2025
DOI: 10.33094/ijetl.v9i1.2375

Education research: A toolkit proposal

K. C. Koutsopoulos[1*]
Thomas Economou[2]

[1]*National Technical University of Athens, Greece.*
[1]*Email: koutsop@surveu.ntua.gr*
[2]*Doukas School, Athens Greece.*
[2]*Email: t.economou@doukas.gr*

Keywords:
Educational research
Research concepts
Research stages
Toolkit.

Received: *8 November 2025*
Revised: *3 December 2025*
Accepted: *22 December 2025*
Published: *31 December 2025*
(Corresponding Author)*

Abstract

The subject of this article is research in education whose aim is to develop best practices from/to students and improve their education. To achieve that goal, it recognizes the immense potential of a toolkit that should not only focused, on identifying content areas for examination and technical knowledge, but in enhancing educational stakeholders' confidence, self-reflective mindsets for all classroom activities, and mainly help learning and teaching based on such a toolkit for integrating innovations into classroom approaches. That is, the paper is addresses the urgent need for an effective and inclusive teaching and learning toolkit by describing a structured and detailed help, through research results, to all educational stakeholders aiming at providing a step-by-step instruction in the form of an educational instrument, which having specific guidelines , and characterized by feedbacks provides a toolkit for integrating needed educational activities, due to social, technological etc. changes, into classroom practices. The proposed toolkit is presented in the form of three stages, each one of which includes several steps, executing different activities. In addition, the paper serves as both a theoretical foundation and a practical guide by insisting on ethical, responsible, and inclusive implementation of the results of educational research through that multi-stage toolkit.

Funding: This study received no specific financial support.
Institutional Review Board Statement: Not applicable.
Transparency: The authors declare that the manuscript is honest, truthful and transparent, that no important aspects of the study have been omitted and that all deviations from the planned study have been made clear. This study followed all rules of writing ethics.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.

1. Introduction

1.1. Background and Rationale

Research or scientific inquiry is the same in all learning fields (e.g., education, physics, anthropology, molecular biology, economics etc.) and is described as a rigorous reasoning based upon the interplay of methods, theories, and findings that take the form of models or theories that can be tested. Moreover, as the National Research Council (2002) has stated "Advances in scientific knowledge are achieved by the self-regulating norms of the scientific community over time, not, as sometimes believed, by the mechanistic application of a particular scientific method to a static set of questions".

As a result, it is a common and accepted belief that landing to the Moon and hoping to visit Mars or saving lives from known and unknown diseases cannot be accomplished without research. In the same way, education stakeholders cannot expect reforms and changes in education to be achieved without research-based results that have to support them. Indeed, scientific research in education is the only way to successfully face the increasingly complex and competence-driven local, regional, national and international education systems (Koutsopoulos & Kotsanis, 2014).

Research in education has as its main objective to better educate future active citizens, responding to societal needs and utilizing modern technological tools, in order to develop best practices from/to students and improve their education. More specifically, the main purpose of education research is the development of

innovative educational services, competence capabilities (knowledge-skills-values based on digital literacies), methodologies of new practices, etc., that enrich the school learning ecosystem and enhance the experiential and interdisciplinary approaches, cultivating the advances of the 21st century. That is, to contribute to the all-round development of education stakeholders by: balancing between the ever-changing digital and real worlds; the integration of recent digital tools and practices in the learning process; and responding to the current and future needs of the educational community and the society as a whole.

Within this complexity, therefore, it is obvious that a methodological model or a toolkit is required, which allows the interested researcher to work on, have easy access to, and finally correct these issues. Such a toolkit of course, must be designed in such a way as to combine the experience in such matters, while allowing the skills of the researcher to evolve creatively, and to map out the basic axes of educational research, while at same time to be able to adapt to the particularities of individual educational problems and determine the final configuration of the research.

The subject of this article is exactly that. To create a methodological framework or a toolkit that serves as a background for any educational research. Such a framework is particularly important at this time, when the design and planning of educational activities, their relationship with social needs and technology (Koutsopoulos & Kotsanis, 2014) are becoming more and more decisive issues every day.

Finally, this paper serves as both a theoretical foundation and a practical guide. It recognizes the immense potential of a toolkit in educational research, but insists on ethical, responsible, and inclusive implementation. By presenting a three-step research toolkit, it equips stakeholders with a tool necessary to make informed, strategic decisions about improving teaching and learning.

1.2. Basic Concepts

Before proceeding to the presentation and explanation of the proposed toolkit, it is appropriate to refer to some basic concepts, which are fundamental components of it, and therefore are directly related to this paper. More specifically.

1.2.1. Educational Research vs Research in Education

The distinction between Educational Research and Research in Education has long been a topic of conceptual and methodological debate within the educational community (Ponce & Pagán-Maldonado, 2015; Ponce, Pagán-Maldonado, & Gómez Galán, 2017). It was considered that they represent different approaches toward the study of educational phenomena, reflecting the traditional tension between theory-driven and practice-oriented investigation that led not only to conceptual ambiguity, but the difference in the nature and intent of inquiry (Cohen, Manion, & Morrison, 2018; McMillan & Schumacher, 2021). Within this educational environment educational research refers to the development of theories, models, and frameworks that seek to explain learning processes, teaching methods, and educational systems and mainly to generalize knowledge that contributes to the theoretical advancement of education. In contrast, research in education is considered to be more applied and context-dependent, focusing on empirical investigations that address specific educational problems. In other words, this form of research seeks to improve teaching practices, curriculum design, policy implementation, and institutional management.

However, such a distinction illustrates three major challenges in researching the complexities of education. The first deals with how education are defined in researching educational matters. A second controversy deals with how to capture the complexity of educational phenomena, recognizing that quantitative and qualitative research methods are both important in educational research to capture the complexity of the field (Hammersley, 2007; Pring, 2000). The third controversy deals with the quality and utility of educational research to solve the problems of public education and to generate educational policies (Walters, 2009). That is, capturing the complexity of an educational phenomenon is practically impossible within this research dichotomy. Recent scholarship advocates a dialectical synthesis of the two approaches, arguing that neither in isolation can fully address the complexities of educational practice. The integration of theoretical and applied perspectives through design-based research, practitioner inquiry, and mixed-methods approaches offer a promising pathway toward a more holistic understanding of educational phenomena. Such integration acknowledges that theory and practice are not opposites, but interdependent dimensions of the same educational reality (Elliott, 1991; Zeichner, 1999).

In sum, the controversy between Educational Research and Research in Education reflects enduring philosophical questions about the nature, purpose, and methods of inquiry in education. A balanced perspective, is followed in this paper, recognizes the necessity of both theoretical reflection and empirical application, urging the need to transcend such dichotomies and engage in collaborative, context-sensitive approaches that advances both knowledge and practice.

1.2.2. Educational Research Changes

Educational research has undergone significant transformation over the past several decades, reflecting broader shifts in epistemological paradigms, technological advancements, and societal expectations related to

education. Such major paradigm shifts were: first, the traditional approach, which was rooted in positivist frameworks emphasizing measurement, objectivity, and quantifiable outcomes. Researchers sought to identify universal laws of learning and teaching through controlled experiments and statistical analyses. However, this perspective has gradually expanded to include interpretivist, critical, and postmodern approaches that acknowledge the complexity, context-dependence, and subjectivity inherent in educational processes (Creswell & Creswell, 2018) second, the appearance of the mixed-methods research, which combined quantitative and qualitative data to capture both measurable outcomes and the experiences of learners and educators. This approach recognizes that educational phenomena cannot be fully understood through numbers alone. Qualitative research, in particular, has gained legitimacy as a means of exploring issues such as equity, identity, and cultural context in learning environments (Denzin & Lincoln, 2017) third, the technological innovation, which provided digital learning environments, data analytics, and artificial intelligence (AI) tools and programs that enabled researchers to collect and analyze vast amounts of learner data in real time; fourth, the rise of learning analytics and educational data mining, which allow an evidence-based insights into student behavior, engagement, and performance (Siemens & Long, 2011). However, this shift raised ethical concerns regarding privacy, data ownership, and the potential for algorithmic bias in educational decision-making; fifth, the establishment of the interdisciplinary approach, which by drawing insights from psychology, sociology, neuroscience, computer science, and philosophy, encouraged a more holistic understandings of how learning occurs within both formal and informal contexts; sixth, the adaptation of participatory and action-oriented methodologies, which prioritized community engagement and social impact, leading to global challenges such as digital inequality, inclusive education, and sustainability; and seventh, the evolution of the dissemination and evaluation, which led on one hand, to open-access publishing, preprint servers, and digital repositories democratizing access to scholarly knowledge, and on the other hand to new metrics reflecting the diversification of academic influence. As a result, educational research is no longer confined to academia, but practitioners, policymakers, and learners themselves increasingly contribute to and utilize research findings to inform practice and reform.

In sum, educational research has transitioned from a predominantly positivist enterprise to a dynamic, technology-enhanced, and socially responsive field. This evolution underscores the importance of adaptability and ethical reflection as researchers continue to navigate the rapidly changing educational landscape and represents a fundamental principle of the proposed toolkit.

1.2.3. Methodology vs Technic

Methodology as a concept is always found as a tool of science in the examination of various phenomena. The need in resolving problems by following certain rules (having a specific methodology), became evident long time ago and today, with the rapid development of sciences, including education, is even more important. As a concept, however, it must be clearly separated from a technique. Methodology is the way of a scientific approach, a clearly defined direction of the mental process and examination according to certain rules. Technique is simply the means by which the above are achieved. In general, it can be declared that technology is a dynamic, flexible process, a tool of scientists in describing, analyzing and interpreting the phenomena or issues that concern them, as opposed to technic, which is practically a rigid static "recipe" for any research effort.

Within this dichotomy, research in education is the expression of the concept of methodology in the examination of problems, which allows the application of the expression of educational theories and laws in teaching and learning, inside and outside the classroom. The understanding of today's educational issues requires its use in order to examine, in the context of specific educational approaches, the factors that act within them and shape them. In addition, research in education is activated whenever there is a need for an educational approach to any domain and content. That is, each time any research in education has a specific goal, which of course varies, because the subject of education is complex, so its methodology is appropriately differentiated.

1.2.4. Data vs Information

Another determining dichotomy refers to these two concepts and their differences. Data, are a series of numerical, quantitative or qualitative characteristics of a specific problem or issue in an unprocessed form at a specific stage of analysis. On the other hand, when such characteristics go through an analysis process and answer a specific question, information is created (Koutsopoulos, 1979). That differentiation refers to each specific stage of analysis, which means that information at one stage may be data for another. For example, the observations in a theodolite are data for a topographer, while the elevation curves derived from the above measures are information. However, the elevation curves of a topographic map are data for a planner who calculates the volume of earth from excavation for the foundations, or the location of houses, and any other infrastructure, which constitute information.

1.2.5. Feedback Role in Educational Research

The educational research is characterized by feedback relationships that govern not only the processes within itself, but also its relationship with education. That is, every intervention in the education environment requires an educational study of the specific teaching and learning problem that the intervention aims to solve. Such an intervention, however, results in the creation of new or the change of previous teaching and learning processes, which may in turn create other educational problems and thus their study leads to further research in education and the beginning of another feedback. In general, educational research is linked bidirectionally with the teaching and learning, whose results shape it, and the interventions in the education environment that determine them.

The previous concepts were presented to emphasize that the proposed toolkit is based upon them and substantiate its role in educational research.

2. The Research Toolkit

Research in education is essential because among others it can: generate new knowledge; improve classroom practice; promote innovation; ensure educational quality and equity; and mainly bridge the gap between theory and practice, helping education stakeholders to make informed, effective, and ethical decisions enhancing educational outcomes. That is, there is a need for a toolkit that has specific characteristic in order to help educational stakeholders to enhance learning and teaching based on integrating innovations into classroom approaches as well as it should not be focused only on identifying educational knowledge, but in enhancing educational stakeholders' confidence, self-reflective mindsets and wiliness to apply new classroom activities. However, a research toolkit is an important and necessary educational tool because of its role, importance, and emphasis.

2.1. Role of Research in Education

An educational toolkit can contribute in many and different ways towards: Advancing knowledge by contributing to building theories of learning, motivation, and assessment. Which in turn, help educators understand how students learn, what methods are most effective, and how educational environments can be improved. That is, teachers can use research findings to refine instructional strategies, adopt evidence-based practices, and address classroom challenges, while action research allows teachers to investigate their own classrooms, make data-driven decisions, and informs about policy and decision-making by providing empirical evidence that guides policymakers in designing effective curricula, assessment methods, and resource allocation, ensuring that decisions are grounded in data, rather than intuition or tradition. In addition, research in education by identifying what content and skills are most relevant for students in a changing world, supports continuous curriculum improvements, as well as ensuring cultural and contextual relevance of educational materials. Moreover, develops assessment and evaluation by providing effective tools and techniques to measure learning outcomes and program effectiveness that support accountability that help institutions meet quality standards. Finally, research is fostering educational innovation by exploring new technologies, methodologies, and learning models (e.g., AI in education, blended learning, personalized instruction).

2.2. Importance of Research in Education

Educational research is extremely important in that it provides the basis for evidence-based practice by ensuring that teaching and administrative practices are supported by solid evidence rather than assumptions, as well as professional development by engaging in or understanding that research enhances teachers' reflective thinking and professional competence. In addition, it provides: first, equity and inclusion by highlighting disparities in educational access and outcomes, helping design interventions to promote equality; and second, adaptation to change in a rapidly changing world by helping education systems to remain relevant and responsive to social, technological, and economic shifts. Finally, it promotes global competitiveness by promoting innovation and continuous improvement, that strengthens the quality of education and societal progress around the world.

2.3. Toolkit Emphasis

Because of the research role and importance, the toolkit should be emphasizing the following.

- Any educational research is not an isolated independent study, which provides solutions in the form of a specific proposal for interventions in education. It is part of a complex research process, whose functionally is multidisciplinary, where each action is an activity that develops by drawing and providing information from and to others, and all together converge on a common solution to a teaching and learning problem.
- Educational research has been utilized in education not just as another innovative tool, but mainly as a reliable and responsible instrument, which is good for all education stakeholders, who have the responsibility to carefully select classroom activities to help children and teachers use them profitably.

- The intervention of research in education is a multi-disciplinary and multi-level affair and therefore is a complicated and arduous undertaking.
- Educational research is fundamentally altering the way teaching and learning is accomplished by providing a set of innovations, but it also creates a series of challenges that need to be considered.
- Educational research is not only focused on educational knowledge, but also in enhancing innovation comprehension for all classroom activities.

3. Description of the Proposed Toolkit

The proposed toolkit, as it should, is not only focused, on identifying content areas for examination and technical knowledge, but in enhancing effectiveness for all classroom activities, by applying all the necessary concepts identified (Sections 1.2.1-1.2.5), as well as the educational research objectives (Sections 2.1-2.3). That is, the paper is addresses the urgent need for an effective, and inclusive teaching and learning instrument by describing a structured and detailed help, through research results, to all educational stakeholders. As a result, it presents a stakeholder-oriented educational research (Not simple research in education) aiming at providing a step-by-step guideline in the form of a holistic educational toolkit. Today's world radical changes such as the AI impact, the economy, the environmental crisis and of course the education to address them, for which this evolving landscape opens new areas of research demands a clear, effective, efficient, and applicable guidelines in order to provide structured support to classroom activities.

A toolkit, such as the proposed, must out of necessity in scientific ethics, constitute a system. Therefore, any educational research as a means of examining education and resolving teaching and learning issues, should be seen as a system where: stages, steps, activities and interconnections should be clearly defined. A schematic illustration of the proposed toolkit of an educational research system is shown in Figure 1. This figure clearly shows or implies the toolkit mechanism, as well as the application of the basic concepts required to bring to a successful conclusion any educational research. That is, the proposed educational toolkit is presented in the form of three stages, each one of which includes several steps, executing different activities (e.g., the activity of data collection method, part of the step data collection, referred to the stage from data to information) and which satisfy the necessary set of toolkit concepts (e.g., the presence of feedbacks) that determine or clarify the major steps and activities of the three stages: determination of research; the process from data to information; and the application of the research results, that are presented next.

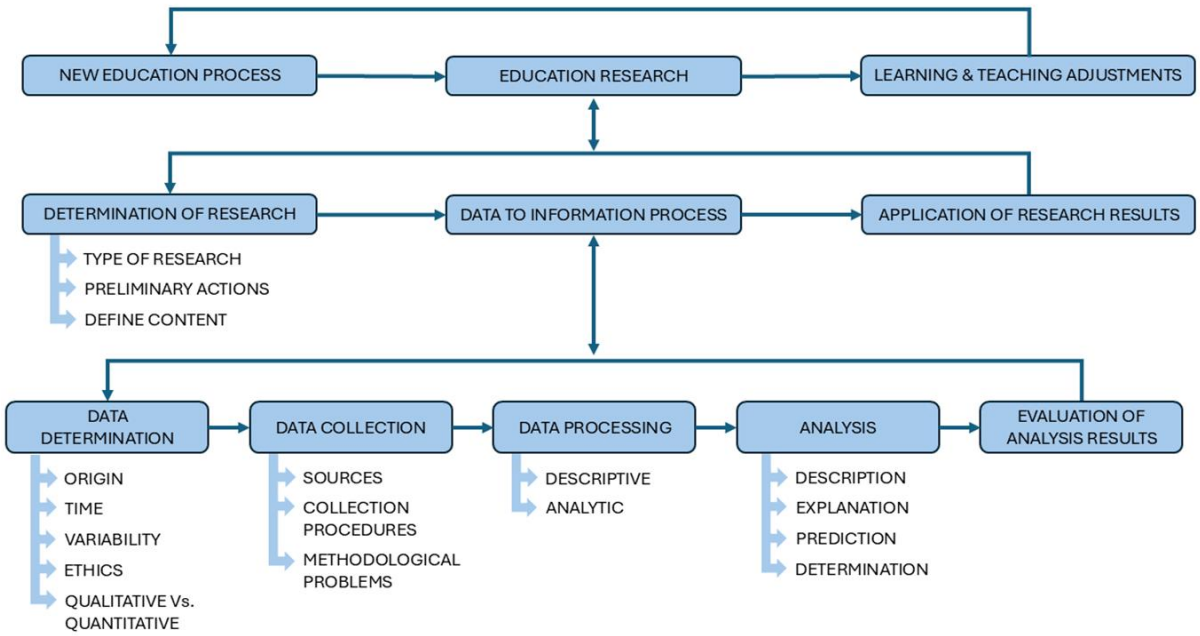

Figure 1. Proposed toolkit.

3.1. Determination of Research

The first stage refers to the identification of the problem or the purpose to which the research study aims, it outlines the scientific steps it has to follow, the principals it is required to clarify, and mainly to describe the purpose of the study. The precise identification of the problem of the educational research is its main axis or its orientation, because the purpose to which the study aims and delimits the problem to be solved. It outlines the scientific steps it has to follow, the principals it is required to clarify, and mainly to describe the research area of interest, which contains the purpose of the study and delimits the problem to be solved. It is basically the first step that the research requires, but at the same time it is the most decisive. Of course, determining the

nature of the problem, related both to its components and in its interrelationships, naturally varies from one research to another, but there are some fundamental processes that need to be carried out at this stage of an educational research. For example, there is an urgent need to simplify the complex educational reality, which lead to hypotheses formulation that represent a very common research strategy, particularly when the research has theory-making claims (Amedeo & Golledge, 1975). However, when hypotheses are made, they must be formulated correctly, and clearly so that in the course of the research effort can be modified or discarded.

It should be noted that the purpose of this paper is not a complete list of all research requirements (After all, this is scientifically impossible), but to understand the need for defining and selecting the basic categories, which in turn combined with the content, will determine the exact research aim. There are three major issues in this step.

3.1.1. Types of Research

For the documentation needs of research projects and the explanation of the innovation sought, any of the following types can be utilized based on their specific characteristics.

- Research based on Scientific Literacy and Educational Content. Research in this area investigates how curriculum design, inquiry-based learning, and interdisciplinary approaches enhance students' engagement and conceptual understanding. Indeed, scientific literacy has emerged as a central construct in contemporary educational research, reflecting the need for learners to understand scientific concepts, processes, and their applications in everyday life. Such research approach emphasizes that scientific literacy extends beyond factual knowledge to include the ability to evaluate evidence, apply scientific reasoning, and make informed decisions about socio-scientific issues such as climate change, health, and technology use (Bybee, 2018; OECD, 2023). Moreover, in this approach the implementation of formative assessment strategies, coupled with technology-enhanced inquiry tools (e.g., simulations, virtual labs), has been shown to strengthen students' ability to think scientifically and transfer knowledge to new contexts (Lederman et al., 2023). In sum, research on scientific literacy calls for a balance between conceptual content knowledge and epistemic understanding of science, ensuring that learners not only know scientific facts but also understand how scientific knowledge is constructed, validated, and communicated in an educational environment.
- Research based on Educational and Pedagogical Methodologies. This type of research focuses on the processes, strategies, and frameworks through which effective teaching and learning occur. That is, the evolution from traditional, teacher-centered models to learner-centered and constructivist pedagogies is well-documented (Bruner, 2021; Hattie, 2023) and thus universally accepted. As a result, current research explores hybrid and blended learning models, inquiry-based learning, project-based learning, and collaborative learning as methodologies that align with 21st-century skill development (Darling-Hammond, Flook, Schachner, & Wojcikiewicz, 2022). This research approach puts emphasis on: evidence-based pedagogy, which integrate the findings from cognitive science, learning analytics, and classroom research to guide instructional design; the teacher professional development, which considers it as a crucial factor in sustaining pedagogical innovation and ensuring fidelity of implementation (Amemasor, Oppong, Ghansah, Benuwa, & Essel, 2025) and finally examines the inclusive pedagogical frameworks that support diverse learners by addressing linguistic, cultural, and ability differences (Woodcock, Hitches, & Manning, 2023). In sum this research approach; first, utilizes methodologies that underscore the importance of adaptability, reflective practice, and co-design between teachers and learners; and second, is more data-informed and interdisciplinary, and mainly attempts to refine our understanding of how teaching practices influence cognitive, emotional, and social dimensions of learning.
- Research based on Technological Development and Practices. This research approach focuses on the potential and the limitations of the technology-enhanced learning environments, by examining: first, how digital technologies mediate learning processes, including motivation, self-regulation, and collaboration (Bond-Lamberty et al., 2024; Selwyn, 2022) which is the result of the rise of digital learning ecosystems, learning analytics, and artificial intelligence in education (Garzón, Muñoz-Maya, & Díaz-Villamizar, 2025; Holmes et al., 2023) accompanied by the condition that technological innovation must be guided by pedagogical principles, ensuring that technology supports human-centered learning rather than replacing critical teacher–student interactions (Williamson & Eynon, 2023) second by the digital divide or the disparities in access, skills, and participation that shape educational outcomes (Akiba, Shing, Tang, Sun, & Ha, 2025; Van De Werfhorst, Kessenich, & Geven, 2022) which links technological literacy with equity, emphasizing the need for policies and practices that ensure inclusive participation in digital education; and third, by exploring how sustained exposure to technology-rich environments affects students' cognitive development, creativity, and ethical awareness. In sum, research on technological development and practices is moving toward integrated,

ethical, and sustainable frameworks, where technology acts as a catalyst for innovation rather than an end in itself.

3.1.2. Preliminary Action

The determination of the nature of the research problem, both in its parts and in the interrelations, naturally varies from study to study. Nevertheless, there are the following three basic processes that need to be carried out at this initial stage of the educational research. In particular, within the definition of the determination of research there should be a clear delimitation of the definition of the overall goal and objectives of the research effort; the delimitation of the necessary functional definitions; and the declaration of needed assumptions.

- Goal and objectives: Regarding the definition of the objectives of the research the main themes are encompassed in the successful expression of the three P's: Problem, Products, and Provisions and more specifically in the following questions: What is the problem that needs to be solved? What are the final products of the research effort? and the result is a benefit to whom and to how many users? The answers to the above questions clearly affect both the aim and purpose of the study, as well as their implementation.
- Functional definitions: The role of functional definitions is to introduce the purpose for which a term or idea will be used to clearly identify its role and importance as a component of the problem. These arbitrary definitions are not, of course, the ultimate truth, but a tool that paves the way for the study of a problem and therefore cannot be judged as right or wrong, as true or not (Mitchell, 1980).
- Assumptions: Assumptions are necessary at this stage of the research, because there is an immediate need to simplify the complex reality. Essentially, hypotheses represent a very common educational research strategy, particularly when the study has claims to create theory (Amedeo & Golledge, 1975) and refers to the admission, without proof, of certain rules, situations or procedures, which make the problem of the research study simple to deal with.
- Defining the content: There are several major issues with broad themes currently facing educational research, which in practice they overlap, intersect, and manifest differently depending on context (K–12 vs. higher education; global vs local, developed countries vs developing; different disciplines, etc.). The bibliography (Alfredo et al., 2024; Amemasor et al., 2025; J. Garzón, Patiño, & Marulanda, 2025; Lee & Kwon, 2024; Lythreatis, Singh, & El-Kassar, 2022) and experience shows that the following are considered as the major contents to satisfy nowadays issues: equity, access and contextual variation (e.g., persistent inequities such as rural vs urban; low-income vs higher-income; majority vs minority populations; able vs disabled learners); research design, methodology and validity (e.g., methods that don't sufficiently deal with the complexity of many interacting variables, contexts, teacher effects, students background); technology, AI and digital tools in education (e.g., what are the actual effects of digital/AI tools in everyday classrooms); policy, practice and research gaps (there is a gap between what research recommends and what is implemented in practice); funding, resources and research capacity (e.g., cost-effective research methods can be developed, but can they maintain rigor?); changing demands for skills and curriculum relevance (e.g., "education for the future" is accepted that is shifting); ethical, privacy and data governance issues (e.g., ethical lapses or mis-use of data undermines trust in educational research); longitudinal, sustainability and scaling issues (e.g., lasting impact of research cannot succeed without longitudinal and scaling evidence); bridging the gap between theory and practice (e.g., teacher-researcher link or the "research into practice" pipeline is weak.)

In sum, researcher should take into consideration that educational research today must live up to the challenge of complexity, variability, equity, digital transformation and real-world impact. He (she) must ask not only "what works?" but "for whom, in what context, and how sustainable is it?"

3.2. Data-to-Information Process

At the onset the terms data and information need to be clarified and their role and their differences fully understood, namely that the differentiation between data and information refers to a specific activity of analysis, The second stage explains this widely misunderstood process, which is the epicenter of any educational research effort. As a process, it follows the finalization of the major issues characterizing the type research and its goals and objectives and forms the basis for the evaluation of the analysis and the formulation of the results that conclude the stage from data to information in a way that these steps/processes are linked by feedback relations. For example, the evaluation of the analysis can lead to a redefinition of the research problem, or its goal which in turn sets in motion a new process of collecting, processing and analyzing data, which also form the basis of new evaluation and conclusions. This form of process, as old as science itself, leads to a constant quest that has greatly benefited the scientific approach to teaching and learning. Indeed, with its feedback nature (a problem is defined, data are collected, processed, and analyzed and based on these new definitions are created, followed by a new problem definition, new data processes and new results, etc.), in this stage research methods are significantly improved, new perceptions are created and new laws are established. The data-to-information process involves four key steps that are detailed below.

3.2.1. Data Determination

The first step in this process is to determine the data needed to accomplish the research. It should be noted, however that the purpose of this paper is not a complete list of data requirements (after all, this is scientifically impossible), but to understand the need for definition and selection of their basic categories, which then, combined with the content, will form the actual basis of any research effort. That is, data determination is a foundational stage in educational research, shaping the validity, reliability, and interpretability of the study's findings. It refers to the systematic process of identifying what data are necessary to address the research questions or hypotheses, and how those data will be later collected, measured, and analyzed. This process requires deliberate consideration of the research paradigm, methodological design, and contextual factors influencing the educational setting. In sum, effective data determination is an iterative and reflective process. It requires continuous alignment between the research questions, theoretical framework, and methodological tools. By carefully determining the nature, scope, and sources of data, educational researchers enhance the coherence and integrity of their studies, contributing to the broader goal of generating credible and meaningful knowledge about teaching, learning, and educational systems. This step requires the determination of a set of the following data activities.

- Origin: Based on their origin, the data are differentiated into primary and secondary. Primary data are those derived from direct observations, while secondary data are those derived from a combination or processing of primary ones. Both these categories have advantages and liabilities that should be weighed against the nature of the research. However, checking these types of data for reliability, rationality and documentation is a prerequisite for their use.
- Content: Data determination in present day educational research reflects the increasing complexity, diversity, and technological integration of contemporary learning environments. As a result, data content has expanded beyond traditional concerns of pedagogy and curriculum design to incorporate interdisciplinary perspectives from psychology, sociology, neuroscience, data science, and artificial intelligence. This shift signifies a broader understanding of education as a dynamic system influenced by cultural, economic, and technological transformations. The most prominent areas are the study of: digital and technology-enhanced learning, which examines the pedagogical implications of AI, virtual reality, and adaptive learning systems in both formal and informal educational settings; equity, inclusion, and social justice in education, which explores how systemic inequalities affect educational outcomes, particularly in terms of socioeconomic status, gender, race, and disability (Banks et al., 2020) learning analytics and evidence-based practice, which focuses in understanding learner behavior and improving instructional design; and finally, the globalization of education, which is aiming at introducing new lines of inquiry related to internationalization, comparative education, and policy transfer.
- Time: Research data are distinguished into two major categories of data, related to time: The historical or data of yesterday and the present or data of today. Because today is a consequence of yesterday, which means that we understand the present situation better, the more we know about the past and help with projections for the future. The avoidance of the use of historical data, when needed, is not only unscientific but constrain the success of a research.
- Variability: This differentiation distinguishes data into variables and constants. Constants are data with a known value, unchanged in space (not in time). Speaking in the language of mathematics, it can be coefficients or indices. Variables, on the other hand, are divided into two categories: discrete, based on easily divisible events, (obviously all qualitative variables are distinct) and continuous variables (e.g., distance), which can theoretically be divided infinitely into fractional quantities. This subdivision of variables mainly serves different forms of data processing that influences the success of a research.
- Ethics: Moreover, ethical considerations play a crucial role in determining data in educational research. Researchers must ensure informed consent, confidentiality, and data security, especially when dealing with vulnerable populations such as students or minors. Decisions about what data to collect and how to store and report them are guided not only by methodological rigor but also by ethical responsibility.
- Qualitative vs Quantitative Data: Another distinction that is completely technical and tragically problematic for the development of education is the reference to qualitative and quantitative data. Quantitative data are those that can be measured, get a value, are characterized by the order of magnitude (e.g., number of students, teaching hours, the volume of subjects in the curriculum, etc.). Quality data do not have size, but express a property (e.g., the quality of teaching and learning, the utility of the curriculum in helping students, etc.). Unfortunately, in recent decades at the level of methodology, great emphasis has been placed on these two concepts in education and the controversy between supporters of qualitativization and quantification has been increasing. It is believed that such a differentiation of educational data based on the nature of the data is essentially non-existent, scientifically unrealistic and leads to insurmountable problems. Fortunately, this separation is not catalytic, (e.g., qualitative data can be converted into quantitative data and this further facilitates analysis, comparisons of phenomena, etc.)

In sum, the utility of the data depends on the objective of the research study and therefore by their nature and form should provide a description of the research issue as well as their documentation, implementation and monitoring. That is, regardless of the categorization of the data, what counts are not the choices made regarding their type, but their importance to research.

3.2.2. Data Collection

A fundamental activity of a researcher in education is the collection of data, because human curiosity can be satisfied with knowledge as a prerequisite for educational institutions to control and manage issues of interest. Therefore, data collection is a foundational element of educational research, serving as the primary means through which researchers obtain the empirical evidence necessary to understand, evaluate, and improve educational phenomena. It involves the systematic gathering of information from various sources to address research questions, test hypotheses, and generate new knowledge. The integrity and relevance of educational research depend largely on the rigor and appropriateness of its data collection processes. In an era increasingly shaped by digital technologies and learning analytics, data collection has expanded to include digital traces of learner activity, online assessments, and institutional databases. This evolution offers new opportunities for large-scale and longitudinal studies, while also raising critical ethical considerations regarding privacy, consent, and data governance where the main activity is, and should be, the multifaceted analysis of issues or phenomena in education and their full understanding. Ultimately, effective data collection is not merely a technical procedure but an epistemological cornerstone of educational research. It determines the quality of evidence on which educational knowledge is built and the credibility of the conclusions that shape educational practice and policy. However, data collection is a very complex task and therefore its completion requires a series of procedures and especially a series of options, the main ones of which are presented below.

- Sources. Three basic processes can be considered as sources of educational data: field work, which includes observations of all educational processes and activities or a sample, censuses, and various measurements; theoretical research, which include considerations of models, laws and theories; and archival recordings, which include ready-made, codified, processed, and sorted in various analogue or digital formats from secondary sources. The complexity of field work varies, depending each time on the nature of the problem. What is constant is that field work is long and involving many researchers, and a research design that requires a high degree of collaboration, and many observations and field measurements, which have the disadvantage of significant cost as well as longtime of obtaining the desired data. At the same time, however provides a relatively large volume of data, with a tested degree of reliability. The theoretical form of data collection can be an important source of educational data, providing a large amount of data that can be evaluated in terms of its quality, accuracy and importance. Theoretical research acts in two ways in providing data. In the first case it becomes the main data source. That is, a model can project the conclusions of a study over time, giving estimates, for example of the state of teaching and learning, if the same educational approach continues. The second offer of theoretical research may have the character of a guide, a means or a tool that leads us to sources of educational data. Finally, the data from archival recordings can be of various kinds and formats, the result of the field or theoretical work of others. That is, the choice of the data source depends on the objective of the research study, the resources available, and the inclusion of data from all types of sources is desirable.
- Collection Procedure: This procedure refers to the way of collecting the data specified at the previous stage. Therefore, the role of data procedure extends across all collection activities of the research process. At the exploratory stage or pre-experimental, data collection allows researchers to identify trends, patterns, and gaps in existing educational practices or outcomes processes that out of necessity are limited to collecting data for a specific issue, a certain group of phenomena or for a specified time. During experimental or evaluative research studies, data collection enables the measurement of variables and the assessment of causal relationships between instructional methods, learning environments, and student performance. Whether quantitative, qualitative, or mixed-method, data collection strategies must align with the study's theoretical framework and objectives to ensure validity, reliability, and ethical soundness. Moreover, robust data collection procedures promote transparency and accountability in education research. They enable replication of studies, facilitate peer review, and contribute to the accumulation of reliable knowledge that informs educational theory, policy, and practice. In applied contexts, data collected through research guide curriculum development, teaching innovations, and policy reforms aimed at enhancing learning outcomes and equity
- Collection Methods: Once the sources and procedure of data collection are determined, the difficult task of collecting them begins. Scientists have at their disposal a large number of methods and techniques to collect the data they are interested in. McGrath (1972) proposed the following four areas of data collection methods: Methods of Area I are used by the physical sciences; the methods of Area II focus on experimental sciences (e.g., physics, chemistry, etc.); the methods of Area III are used primarily by the social sciences; and finally, all sciences make use of the methods of Area IV a detailed explanation can be

found in McGrath (1972). In education, Area III method is the most common used and consists of inventorying the data, using different sampling techniques. It is preferable from recording the entire population of the phenomenon under consideration, given that the population is very large and requires time and costs. That is, most educational researchers resort to probabilistic theory, utilizing scientifically accepted samples.

- Data Collection Methodological Problems Data collection, a critical process in educational research, presents serious methodological problems. The most important of these problems are: first, identifying collection-recording techniques, which has been and will be a critical point in any process of approaching the classroom and the stakeholder that in turn affects the overall accuracy of the data, their extent, their form and has a direct impact on the cost of the study and its processing time; second achieving the observation of the research issue, because education data can only be acquired from the experience of observation. As Harvey, Bushnell, and Beckwith (1969) wrote: "Reality presents the observer with a wealth of data and it is within the function of observational techniques to select and classify the elements in such a way that they become usable and understandable. This process is a kind of research path. It's clear that the way we investigate reality and process the data we choose have a huge impact on the kinds of questions we investigate and the kinds of answers we are able to give."; third the measurement of the collected data, which is directly related to observation and has been defined in different ways, but it is obvious that measurement is a specific process that must follow specific and clear rules. Since measurement, on the one hand has a significant impact on the reliability and validity of a study, and on the other hand the application of measurement rules is something difficult, requiring knowledge and long-term experience, many methodological problems have appeared, which unfortunately have not yet been solved. Regardless of these problems, however, measurement as a process is not desirable or undesirable. It is simply necessary; and fourth, data recording, which is directly related to observation and measurements and has been defined in different ways. For example, Nunnally, Knott, Duchnowski, and Parker (1967) refers to data recording as "Rules for assigning numbers to objects to represent quantities and properties...". It is obvious therefore that educational data recording is a specific process that must follow specific and clear rules. Data recording, has a significant impact on the reliability and validity of a research study and the application of its rules requires knowledge and long-term experience.

3.2.3. Data Processing

Data processing is a crucial step in this stage of educational research, bridging the gap between data collection and analysis. It involves the systematic organization and transformation of collected data to feed analysis that extracts valid and reliable information in order to support evidence-based conclusions. The role of data processing encompasses activities such as: data cleaning, coding, classification, and tabulation. These processes ensure that the data are accurate, complete, and suitable for analysis, thereby maintaining the integrity and credibility of research outcomes. In essence, data processing enables researchers to convert unstructured or fragmented data into coherent findings that contribute to knowledge advancement and educational improvement. In other words, data processing in educational research by driving educational innovation and reform underpins the needed scientific rigor of the research process, enabling education stakeholders, and institutions to make informed decisions that improve teaching, learning, and educational equity. In essence, data processing transforms education from an intuition-driven field to one guided by empirical evidence. When applied ethically and responsibly, it enhances teaching effectiveness, supports learner success, and drives continuous improvement across all levels of the educational ecosystem. The processing of educational data is a complex and multilevel process. Complex because it includes descriptive as well as analytical (mainly statistical) procedures, and multilevel because it is applied to various steps of a research. In other words, the activity of data processing includes issues of election, judgment, accuracy, reliability, completeness and of course cost. In the processing of educational data, we distinguish two main processes: descriptive, and analytical processing.

- Descriptive Processing: This processing involves many activities, such as classification and coding, that are mainly used to describe and summarize the existing data. The results of a descriptive treatment are usually: tables, histograms, frequency polygons, cumulative frequency diagrams, averages, deviation calculations and descriptions of educational schemes, etc. The descriptive treatment, however, also includes statistical descriptions, such as: correlations of two variables with scatter charts or Lorentz percentage distributions, three variables with triangular representations or many variables with Lebret silhouettes. And the list can be extremely long, because the topics of description are practically endless.
- Analytical Processing: Analytical processing takes advantage of today's technological developments in mathematics and probabilistic theory to help in automation issues, storage methods, etc. It basically uses the language of mathematics and probabilistic theory and statistically analyzes the data. It also uses them to create others and tests approximations (fit) to distributions with the well-known criteria x^2, t, F. It primarily uses the computer, creating files or condensing the data into functional formats for use in models, etc. Thanks to analytical processing we are able to store and process large volumes of

data in a minimum of time and often directly from the source of the data, utilizing technological tools such as Artificial Intelligence, without human intervention. The result is modern data bases, networks of variables in the educational environment, new forms of statistical methods, etc.

3.2.4. Analysis

Analysis occupies a central position in educational research, serving as the step through which collected and processed data are systematically examined, interpreted, and transformed into information leading to meaningful conclusions. It bridges the gap between empirical evidence and theoretical understanding, enabling researchers to make sense of complex educational phenomena. Through analysis, raw data are organized, compared, and evaluated to uncover patterns, relationships, and underlying principles or transformed into information that assist both theory and practice in education.

The primary role of analysis in educational research is to convert descriptive data into explanatory and interpretive insights. In quantitative data analysis, which involves data that can be measured, take a value, and analyzed by their order of magnitude. As a result, the analysis involves statistical methods that test hypotheses, determine correlations or causal relationships, and quantify the magnitude of educational effects. Such data analyses allow researchers to generalize findings across populations and make data-driven recommendations for policy or instructional improvement. In qualitative data analysis, which focuses on the depth and richness of data rather than numerical representation. That is, data do not have measurable value, but express a property, or can best capture educational participants' experiences and perspectives. As a result, data analysis entails the coding, categorization, and thematic interpretation of textual or visual data. This process helps to reveal participants' perspectives, contextual influences, and meanings embedded in educational experiences. When combined in mixed-methods data analysis, a procedure is formulated that integrates numerical trends with narrative depth, offering a holistic understanding of educational issues. Moreover, in contemporary research, the role of data analysis has expanded with the rise of digital data and learning analytics. Computational and statistical tools now allow for large-scale, real-time analysis of educational data, offering deeper insights into learning behaviors, instructional effectiveness, and systemic challenges. However, these advancements also require critical reflection on ethical considerations, including data privacy and responsible interpretation. That is, researchers must balance breadth and depth, ensuring that each data form contributes meaningfully to the synthesis of results.

In sum, data analysis is the intellectual core of educational research. It transforms data into knowledge or information, connects empirical findings to educational theory, and provides the evidence base necessary for innovation, reflection, and continuous improvement within educational systems by bridging theory and practice. Moreover, it cultivates a culture of reflection, accountability, and innovation, empowering all educational stakeholders to make informed, ethical, and strategic decisions that enhance learning outcomes and educational equity. In attaining these objectives, there is a mechanism comprised of three distinct but complementary stages: description, explanation, and prediction. The explanation occupies the central place and forms the basis of every scientific effort. But it necessarily follows the description and logically leads to predictions.

- Description: A number of procedures are included under the general heading of description, but they all have to do with arranging the data so that they can be used efficiently in a research study. Basically, it is an organization and classification of data in a system that follows some logic, so that everyone knows exactly what each event represents. Description occupies an important place in education, because its main purposes are to systematize teaching and learning experiences, summarize such data and suggest hypotheses that may explain the distribution of specific educational categories of phenomena. In conclusion, the description focuses exclusively on the questions of what? which? and when?
- Explanation: The most important activity in an educational research study is the explanation. The search for explanation leads to the search for theory. Thus, theories are at the heart of explanation in science in general and education in particular. Explanation can be considered any satisfactory answer to the questions of how and why. Most of the answers of these questions in educational research studies do not have a one-size-fits-all answer. Usually there are a number of alternative explanations and therefore theories for the same series of teaching and learning activities, and each of them is possible to satisfy different researchers. The key point, however, is that explanations must be logically consistent. Different explanations for the same events are possible, because the explanation can be done in different ways. In the idiographic way that characterizes earlier research efforts, the emphasis was on genetic explanation. This type of explanation consists of a series of statements about past events, taken together describing how the existing educational environment originated. The genetic explanation, which still exists in many educational research studies, but its importance is limited because it considers teaching and learning to be unique. The main types of explanation in education today are based on sequential and logical arguments, expressed in either deterministic or probabilistic terms. The deterministic explanation is based on the classical idea of the direct cause and effect relationship between educational activities and the determination of the necessary and sufficient educational conditions for their occurrence. Once the specific causal factors have been selected, a single explanation is by definition

possible. But many events, particularly those associated with behavior in the classroom, are much less predictable. For such events the explanation should be less specific and expressed in terms of probability. In this case it is accepted that a series of outcomes is possible, each of which can be linked to a given level of probability. Another form of explanation, found almost only in modern research, is the functional explanation. In this form, teaching and learning activities are explained by the functions that are fulfilled in an educational system. Although the functional explanation is linked to a number of conceptual problems, it becomes important as long as educational research studies are done in a systemic context.

- Prediction: In social science, including education, prediction is usually formulated in terms of hypothetical statements such as: if X happens then Y will occur, (e.g., the appearance of X could result in or be associated with the appearance of Y). Prediction is of great importance for education, since making either individual or complete interventions in teaching and learning has multiple effects on them. Such interventions should not be done randomly, but based on some theory that their effects on education have been studied. That is, educational prediction is possible only if there is some adequate theory for a given teaching and learning problem. Therefore, prediction follows the explanation and is logically the final activity of analysis.
- Determination: Another concept that is closely related to analysis, but not part of it, is the determination. This normative concept refers to a process aimed at what should exist and not what or will exist. That is, determination represents a crucial methodological construct within educational research, functioning as both an attribute of research and a focal point of inquiry. Ultimately, determination in educational research is not merely an object of measurement, but a guiding principle for scholarly inquiry itself. It underpins the pursuit of innovation, the critical examination of pedagogical practices, and the sustained effort necessary to produce transformative insights in education.

3.2.5. Evaluation of Analysis Results

The final step of the data to information process is a set of techniques (not a methodology) for the evaluation and the drawing of well substantiated conclusions. In order to achieve a continuous updating and monitoring of the conditions that prevail inside and outside the classroom that change over time, subjects the whole effort of educational research to a process of continuous feedback, in order for its conclusions to reflect as much as possible the current reality. It is obvious that continuous creation of information from data promotes more correct and updated conclusions. Improving data collection and processing methods and evaluation techniques, for example, is an important factor in enhancing their reliability and validity. Moreover, monitoring the teaching and learning activities and conditions that operate on, paint a picture of the current situation, because they change over time.

3.3. Results of Research

The last stage in educational research is a methodology whose aim is to link the research study with the process of intervention in education. That is, it is not enough to simply quote the results from a data analysis technique. There is a need for a methodology leading towards an intervention in the education process in order to improve it. That is, the intervention in education is a dynamic process, substantiating why the conclusions of an educational research study must, on one hand create the necessary information with which this intervention should be fed with and, on the other hand, find the most appropriate way to implement the results of the research in learning and teaching. That is, the research leads into an adjustment of the teaching and learning practices, which in turn requires a new education process (see Figure 1). The continuous updating and monitoring of the conditions that prevail inside and outside the classroom that change over time, subjects the whole effort of educational research to a process of continuous feedback, in order for its conclusions to reflect as much as possible the current reality.

Moreover, the conclusions of the research reflect the implementation of the goal and objectives of the research and the alternative views to address the educational issue under consideration. The proposed solutions and their feasibility are presented as answers to questions such as: what is, and what is feasible. It should be noted, however, that at this stage of the research the primary concern is to draw conclusions based on all the processes of the data to information steps, (e.g., the results must be fully substantiated from the collection, processing, and analysis of the chosen data). That is, the conclusions must be either carefully substantiated on the basis of appropriate evidence, which is preferable, or if based on the opinion or judgment of the researcher, the reasons for this opinion must be clearly explained. The confusion between the reality that exists (Results of the analysis of the evidence) and the reality that the researcher would like to exist (Opinions and judgments) always leads to problems.

4. Conclusions

This paper presents a fully documented research toolkit not only in the way educational research can assist in teaching and learning, but most importantly offers a list of research approaches for consideration. As

a result, its major conclusions are.

- Research has been utilized in education not only as another tool for innovation, but mainly as a reliable and responsive instrument for all education stakeholders, who have the responsibility to carefully select new classroom practices to help teaching and learning.
- There is a need for a toolkit with specific characteristic in order to help educational stakeholders to enhance learning and teaching based on a toolkit for integrating innovations into classroom approaches.
- The proposed toolkit is fundamentally altering the way we teach and learn by providing a three-stage process accompanied with a set of concepts to help all educational stakeholders to enhance learning and teaching.
- The proposed toolkit with specific guidelines provides a framework for integrating needed educational activities, due to social, technological etc., into classroom practices.
- The proposed educational toolkit is not focused only on identifying educational knowledge, but in enhancing educational stakeholders' confidence, self-reflective mindsets and wiliness to apply new classroom activities.
- The proposed educational toolkit has three stages, each one of which includes several steps, executing different activities
- The first stage- Determination of research refers to the identification of the problem, the purpose to which the research study aims, it outlines the scientific steps it has to follow, the principals it is required to clarify, and mainly to describe the purpose of the study.
- The second stage-from data to information explains this widely misunderstood process, which is the epicenter of any educational research effort, characterized by feedback relations. As a process, it follows the finalization of the goals and objectives of the research and forms the basis of their evaluation.
- The third stage-application of research results presents the implementation of the second stage results in addressing the educational issue under consideration. The application of the research results answers to questions such as: what is, what can be and what is feasible.
- There are some important concepts, which although are fundamental in education (Definition of educational research, educational paradigm changes, the differentiation of methodology vs technics and data vs information) unfortunately most stakeholder ignore, insisting on misleading consideration of them.
- To make the best use of educational research in classroom there is a need to shift our concern from simply gaining knowledge to integrating the research results into the teaching process.
- There is a fundamental difference between research implementation and random research use. That is, the former is well structured, purposely intentional, and mainly educational-driven, while the latter is unstructured, haphazard and very seldom has any educational value.
- Educational research is what education needs and aims for. That is, education has to sift from using research as a new teaching and learning tool to experiment with, to an instrument which has to be purposeful, meaningful, and a powerful contributor in enhancing learning and teaching.
- There are educators that feel uncertain about innovation brought about by research, in terms of their role, and practice. The reality and the simple truth are that educational research is beneficial to education.

References

Akiba, T., Shing, M., Tang, Y., Sun, Q., & Ha, D. (2025). Evolutionary optimization of model merging recipes. *Nature Machine Intelligence, 7*(2), 195-204.

Alfredo, R., Echeverria, V., Jin, Y., Swiecki, Z., Gašević, D., & Martinez-Maldonado, R. (2024). *SLADE: A method for designing human-centred learning analytics systems.* Paper presented at the Proceedings of the 14th Learning Analytics and Knowledge Conference.

Amedeo, D., & Golledge, R. G. (1975). Introduction to scientific reasoning in geography. In (pp. 431). New York: John Wiley and Sons

Amemasor, S. K., Oppong, S. O., Ghansah, B., Benuwa, B.-B., & Essel, D. D. (2025). A systematic review on the impact of teacher professional development on digital instructional integration and teaching practices. *Frontiers in Educatio, 10*, 1-14. https://doi.org/10.3389/feduc.2025.1541031

Banks, S., Cai, T., De Jonge, E., Shears, J., Shum, M., Sobočan, A. M., . . . Weinberg, M. (2020). Practising ethically during COVID-19: Social work challenges and responses. *International Social Work, 63*(5), 569-583.

Bond-Lamberty, B., Ballantyne, A., Berryman, E., Fluet-Chouinard, E., Jian, J., Morris, K. A., . . . Vargas, R. (2024). Twenty years of progress, challenges, and opportunities in measuring and understanding soil respiration. *Journal of Geophysical Research: Biogeosciences, 129*(2), e2023JG007637.

Bruner, J. (2021). *Mental reality and possible worlds: The acts of imagination that give meaning to experience.* Barcelona, Spain: Gedisa Editorial.

Bybee, R. W. (2018). *STEM education now more than ever.* Arlington, VA: NSTA Press.

Cohen, L., Manion, L., & Morrison, K. (2018). *Research methods in education* (8th ed.). Abingdon, Oxfordshire, UK & New York, NY, USA: Routledge.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Thousand Oaks, CA: SAGE Publications.
Darling-Hammond, L., Flook, L., Schachner, A., & Wojcikiewicz, S. (2022). *Educator learning to enact the science of learning and development.* Palo Alto, CA: Learning Policy Institute.
Denzin, N. K., & Lincoln, Y. S. (2017). *The SAGE handbook of qualitative research* (5th ed.). Thousand Oaks, CA: SAGE Publications.
Elliott, J. (1991). *Action research for educational change developing teachers & teaching series.* Milton Keynes, England & Philadelphia, PA, USA: Open University Press.
Garzón, J., Patiño, E., & Marulanda, C. (2025). Systematic review of artificial intelligence in education: Trends, benefits, and challenges. *Multimodal Technologies and Interaction, 9*(8), 84. https://doi.org/10.3390/mti9080084
Garzón, M. T. R., Muñoz-Maya, C. M., & Díaz-Villamizar, O. L. (2025). *Sustainability and strategic organizational management of SMEs in Bogotá in uncertain environments. In R. Pérez-Uribe, D. Ocampo-Guzmán, & L. J. Lozano-Correa (Eds.), Models, strategies, and tools for competitive SMEs.* Hershey, PA & New York, NY, USA: IGI Global.
Hammersley, M. (2007). *Educational research and evidence-based practice published in association with the open university.* London & Thousand Oaks, CA: SAGE Publications.
Harvey, W. D., Bushnell, D. M., & Beckwith, I. E. (1969). *Fluctuating properties of turbulent boundary layers for mach numbers up to 9 (NASA TN D-5496).* Washington, DC: National Aeronautics and Space Administration.
Hattie, J. (2023). *Visible learning: The sequel – A synthesis of over 2,100 Meta-analyses relating to achievement.* Abingdon, Oxon & New York: Routledge.
Holmes, J., Liu, Z., Zhang, L., Ding, Y., Sio, T. T., McGee, L. A., . . . Shen, J. (2023). Evaluating large language models on a highly-specialized topic, radiation oncology physics. *Frontiers in Oncology, 13*, 1219326.
Koutsopoulos, K. (1979). GEOGRAPHY: Methodology and technics in spatial analysis. In (pp. 459). Athens, Greece: Seloundos Publishing
Koutsopoulos, K. C., & Kotsanis, Y. C. (2014). School on cloud: Towards a paradigm shift. *Themes in Science and Technology Education, 7*(1), 47-62.
Lederman, S., Ottery, F. D., Cano, A., Santoro, N., Shapiro, M., Stute, P., . . . Lee, M. (2023). Fezolinetant for treatment of moderate-to-severe vasomotor symptoms associated with menopause (SKYLIGHT 1): A phase 3 randomised controlled study. *The Lancet, 401*(10382), 1091-1102.
Lee, S. J., & Kwon, K. (2024). A systematic review of AI education in K-12 classrooms from 2018 to 2023: Topics, strategies, and learning outcomes. *Computers and Education: Artificial Intelligence, 6*, 100211. https://doi.org/10.1016/j.caeai.2024.100211
Lythreatis, S., Singh, S. K., & El-Kassar, A.-N. (2022). The digital divide: A review and future research agenda. *Technological Forecasting and Social Change, 175*, 121359. https://doi.org/10.1016/j.techfore.2021.121359
McGrath, P. (1972). Giant-cell tumour of bone: an analysis of fifty-two cases. *The Journal of Bone & Joint Surgery British Volume, 54*(2), 216-229.
McMillan, J. H., & Schumacher, S. (2021). *Research in education: Evidence-based inquiry* (8th ed.). Boston, MA: Pearson.
Mitchell, B. J. (1980). Frequency dependence of shear wave internal friction in the continental crust of eastern North America. *Journal of Geophysical Research: Solid Earth, 85*(B10), 5212-5218.
National Research Council. (2002). *Scientific research in education committee on scientific principles for education research. Shavelson, R.J., and Towne, L., Editors center for education division of behavioral and social sciences and education.* Washington, DC: National Academy Press.
Nunnally, J. C., Knott, P. D., Duchnowski, A., & Parker, R. (1967). Pupillary response as a general measure of activation. *Perception & Psychophysics, 2*(4), 149-155.
OECD. (2023). *Education at a glance 2023: OECD indicators.* Paris: OECD Publishing.
Ponce, O. A., & Pagán-Maldonado, N. (2015). Mixed methods research in education: Capturing the complexity of the profession. *International Journal of Educational Excellence, 1*(1), 111-135.
Ponce, O. A., Pagán-Maldonado, N., & Gómez Galán, J. (2017). *Philosophy of educational research in a global era: Challenges and opportunities for scientific effectiveness.* San Juan Puerto Rico: Puerto Rican Publications.
Pring, R. (2000). *Philosophy of educational research.* London & New York: Continuum International Publishing Group.
Selwyn, N. (2022). The future of AI and education: Some cautionary notes. *European Journal of Education, 57*(4), 620-631.
Siemens, G., & Long, P. (2011). Penetrating the fog: Analytics in learning and education. *TD Tecnologie Didattiche, 22*, 132–137.
Van De Werfhorst, H. G., Kessenich, E., & Geven, S. (2022). The digital divide in online education: Inequality in digital readiness of students and schools. *Computers and education open, 3*, 100100. https://doi.org/10.1016/j.caeo.2022.100100
Walters, P. B. (2009). *The politics of knowledge. (Chapter 1). In Walter, P. B., Lareau, A., and Ranis, S. H. (2009). Education research on trial: Policy reform and the call for scientific rigor.* New York and London: Routledge, Taylor & Francis Group.
Williamson, B., & Eynon, R. (2023). *When public policy 'fails' and venture capital 'saves' education: Edtech investors as economic and political actors globalisation, societies and education.* Abingdon, Oxon & New York, NY, USA: Routledge.
Woodcock, S., Hitches, E., & Manning, A. (2023). 'The hardest part is…': Teacher self-efficacy and inclusive practice. *International Journal of Educational Research Open, 5*, 100289. https://doi.org/10.1016/j.ijedro.2023.100289
Zeichner, K. (1999). The new scholarship in teacher education. *Educational Researcher, 28*(9), 4-15.