

Evidence-based Teaching: Essential Implications, Realistic Dilemmas and Possible Paths

Xiaopei Gu*

School of Educational Sciences, Lingnan Normal University, Zhanjiang, Guangdong, China

**Corresponding Author*

Abstract: As a new paradigm of effective teaching, evidence-based teaching has significant advantages in enhancing the scientific rigor of instruction. However, there remain disagreements within the academic community regarding its essential implications, and its practical pathways within the Chinese educational context are yet to be clarified. This study systematically reviews the theoretical development of evidence-based teaching through a literature analysis method, elucidating its essential connotations and value orientations. It also analyzes the practical dilemmas facing evidence-based teaching by situating them within China's basic education practice ecosystem. The findings reveal that evidence-based teaching is characterized by three features—cyclicity, collaborativity, and diversity—which enable it to achieve the integration of scientism and humanism, enhance educational equity, and create conditions for teaching reform. At the practical level, however, it faces structural obstacles including the absence of an evidence-based culture, the lack of a supporting system, and insufficient evidence-based competencies among teaching practitioners. Based on these findings, the study constructs a four-stage cyclical implementation pathway for evidence-based teaching— "Preparation—Design—Intervention—Dissemination"—providing an actionable reference framework for translating evidence-based teaching from conception to practice.

Keywords: Evidence-Based Teaching; Effective Teaching; Evidence-Based Literacy; Evidence; Instructional Design

1. Introduction

Characteristics of the natural sciences and humanities were incorporated into the medical

practice in the 1980s and 1990s and evidence-based medicine came into being [1]. Over time, the concept of evidence-based practice infiltrated other related fields, and turned into a new "paradigm" [2] in the world of practice and a broad "movement" [3]. With the full development of the evidence-based practice movement in the social sciences, evidence-based education came into being. The idea that teachers should use research evidence to guide their teaching practice was first introduced by David Hargreaves in 1996, and teachers were likened to doctors. Subsequent researchers have often referred to this point of view and it has become an important theoretical foundation for the evidence-based education movement, which may be summed up by some researchers as using "research evidence" as the basis for teaching practice [4]. In 1999, Philip Davies officially put forth the idea of evidence-based education which is about bringing together teachers' personal teaching expertise with the best evidence from external systematic research [5]. Ever since then, evidence-based education has become a hot topic in academia and has had a significant impact on contemporary education. Evidence-based teaching is one of the branches of evidence-based education. In 2001, Robert J. Marzano detailed the effective evidence for evidence-based teaching [6]. Later, systematic research on the connotation and principles of evidence-based teaching by Geoff Petty [7] ushered in the research on evidence-based teaching.

In the era of big data, the classroom teaching model is changing from traditional to evidence-based. Evidence-based teaching, with its beneficial characteristics, including improving the scientific rigor of teaching and its high operability, has become a new trend in the teaching theory research and practice. There is a close connection between evidence-based teaching and educational equity and educational policy-making. However, in the current

academic world there are still disagreements regarding the connotation of evidence-based teaching. The subject structure and steps of implementation of evidence-based teaching are hard to apply directly to teaching practice, as they are mainly derived from evidence-based medicine. This either/or misconception is also found with regard to evidence-based teaching among teaching practitioners. It is significant to understand the essential features of evidence-based teaching as this will enable teachers to make a change in their teaching behavior and successfully implement evidence-based teaching practices. This paper further clarifies the essential connotation of evidence-based teaching and examines dilemmas of evidence-based teaching in the practice ecosystem of basic education in China and builds practical pathways for evidence-based teaching, which can be used as a reference for effective implementation.

2. Essential Connotation of Evidence-based Teaching

Evidence-based teaching is oriented towards achieving optimal development, with teachers and students forming a community that seeks the best learning evidence from massive data [8]. Evidence-based teaching is teaching that follows evidence; it is the process of making teaching decisions and conducting teaching activities through the organic combination of the best research evidence, professional wisdom and student characteristics [9]. It cannot be separated from the teachers' personal experience and professional wisdom. Professional wisdom is one's ability to take proper action and make proper responses in teaching based on the situation [10]. The best evidence will not simply become instructional design; it will need to be used in conjunction with professional wisdom on the part of the teacher. Professional wisdom can ensure the artistry and dynamic generativity of teaching, while the best evidence can enhance the scientific rigor and effectiveness of teaching. Evidence-based teaching brings this together in an organic way, combining artistry and science in teaching. As evidence-based teaching involves research on best evidence, it must also recognize the importance of personal experience and professional wisdom in teaching [11]. Evidence-based teaching takes solving teaching problems as its starting point and

ultimate goal. In the process of evidence-based teaching, teachers pay full attention to students' individual needs and learning aspirations, take students' evidence-informed views into consideration in teaching decisions, combine collective teaching with individualized teaching, emphasize the all-round development of all students in the same class and provide students with more room to develop their individuality. Thus, evidence-based teaching is a practical activity in which teachers take solving teaching problems as the starting point, organically combine their personal experience and professional wisdom with the best evidence provided by researchers, and promote the development of students' individuality.

2.1 Features of Evidence-based Teaching

To gain a deeper understanding of evidence-based teaching, teaching practitioners need to first understand its features as follows.

2.1.1 Cyclicality

The two-way flow of theory and practice can be realized in evidence-based teaching, as the teaching is cyclical. There is a two-way relationship between theoretical research and practice [12]. With evidence-based teaching, theoretical research can be applied in practice and vice versa. When evidence is absent or uncertain, teachers need to establish reasonable evidence [13] and practice must be used to support theory. This requires researchers to collaborate with teachers in doing scientific research so that the evidence obtained can be used to enrich the theory and not only experience. Evidence-based teaching is an iterative process that involves multiple attempts to solve teaching problems, ongoing empirical data collection, ongoing primary research and the creation of scientific theoretical evidence, which in turn creates new applied theories to guide teaching. This is at the heart of evidence-based teaching. Teachers need to first look for the relevant educational and teaching theories when facing practical teaching problems. Here, theory becomes the main evidence for evidence-based teaching. Evidence-based teaching does not choose abstract theory, but research findings that can offer solutions to problems. Evidence-based teaching is the teaching practice based on applied theory, aiming to improve the scientificity and standardization of teaching practice and effectively solve teaching problems. Evidence-

based teaching effectively connects theory and practice, bridges the gap between theory and practice and makes bi-directional movement of theory and practice in terms of method possible.

2.1.2 Collaborativity

Collaborativity implies that evidence-based teaching may be multi-dimensional, in the sense that it is the interaction among the multiple subjects that are involved in the teaching. Based on the actual conditions of teaching, the subjects of evidence-based teaching should include three parties. Researchers collect, critique, evaluate and integrate evidence; they share the best evidence with teachers; and they explain and translate the evidence generated in practice. The teachers take students' culture, preferences, values, learning aspirations and other factors into account fully and use the best evidence, personal experience and professional wisdom in teaching. Students are involved in making decisions about the teaching using evidence. Students' insights and unique feelings are interwoven with teachers' experience. Researchers and teachers work side by side to convert the empirical evidence to scientific evidence. In equal dialogue, teachers and students achieve teaching goals, and the data generated from the interaction become new empirical evidence. Collaborative involvement and consultation among the three parties in the evidence chain are the essence of evidence-based teaching.

2.1.3 Diversity

Diversity means that through evidence-based teaching, integration and coexistence of different research methods can be achieved. The intervention programs for solving problems in the field of evidence-based teaching are in general based on the positivist approach, but with regard to the research methods they are not restricted to one dimension of either quantitative or qualitative research. Because of the complexity of the contexts in which specific teaching problems are situated, various research methods should be selected so that intervention programs can effectively solve practical problems. The researchers should focus on teachers' real needs in their teaching practice. Qualitative research method should be used if the teachers are concerned with the causes of teaching problems, while quantitative research methods are indispensable if the teachers are concerned with the effectiveness of teaching methods. Evidence-based teaching emphasizes

the objectivity of evidence and highlights the inherent tension of theory. Theoretical speculation is an integral part of any research design, as well as of the stage of research conclusions' refinement. Empirical means are needed in the collection of evidence in evidence-based teaching as well. So evidence-based teaching is not exclusive to any one research method; each type of research method has its own importance in solving problems of teaching. Evidence-based teaching should give full play to the synergistic advantages of multiple methods, encourage the diversification of research methods, and in parallel, pay attention to the overall use and integration of multiple research methods.

2.2 The Value of Evidence-based Teaching

Evidence-based teaching is an endeavor to bridge the theory and practice divide of education, an endeavor to make education more scientific and it will necessarily affect traditional teaching. The significance of evidence-based teaching is not only to solve some problems that are hard to solve in teaching practice through the research process, but also to improve the level of classroom teaching, rationalize and standardize the teaching process, supplement and improve the traditional teaching pattern, and provide preconditions for the education and teaching reform.

2.2.1 Evidence-based Teaching can Realize the Perfect Combination of "Scientism" and "Humanism"

Throughout the 40-year course of curriculum and teaching reform in China, the debate between "scientism" and "humanism" has always been an important topic affecting China's curriculum and teaching reform. The opposition between the two implies the contradiction between science and humanity. Evidence-based teaching follows a more pragmatic methodology; with the guidance of this pragmatism, scientificity and humanism are integrated [14]. "Scientism" is committed to optimizing teaching activities and improving teaching effectiveness. Evidence-based teaching has strict research design, the support of the best evidence and "operable" implementation steps; it implements scientific and standardized teaching, obtains the greatest benefit at the lowest cost, improves the scientificity and efficiency of teaching decisions, and is

consistent with the tendency of "scientism". Meanwhile in evidence-based teaching, teachers pay attention to students' learning aspirations and individual needs in the process of learning and carry out differentiated teaching based on the evidence of learning. In evidence-based teaching, teachers and students engage in individualized interaction and equal dialogue. Teachers respect students' rights and meet students' learning aspirations, which reflects the tendency of "humanism".

2.2.2 Evidence-Based Teaching can Expand the Scope of Educational Equity

Traditional experience-based teaching is largely influenced by teachers' personal experience and teaching ability, and the teaching effectiveness is largely related to the teaching level of the teachers that students encounter. While the high-quality, balanced development of compulsory education is the goal of basic education, it will still take a long time to achieve this. Currently, there is still an imbalance in teachers' competence between the eastern and western areas, urban and rural areas, as well as between schools. In the areas/schools where education and teaching are not very developed, it is hard to offer students high quality education and teaching services based on teachers' experience only. By carrying out evidence-based teaching, teachers can make teaching decisions based on research evidence from around the world, which largely overcomes the shortcomings of teaching based only on personal experience, broadens teachers' horizons and thinking, and compensates for teaching problems caused by teachers' insufficient personal competence. Evidence-based teaching helps to overcome the constraints of time, space and experience for teachers in relatively underdeveloped areas and enables them to use the latest research evidence to inform their teaching. By effectively implementing evidence-based teaching, the educational and teaching level of the relatively underdeveloped regions can be improved and educational equity can be promoted in schools, regions, or even broader ranges.

2.2.3 Evidence-Based Teaching can Provide Preconditions for Teaching Reform

Changing mental models is the key to changing behavior – the key to education reform. Evidence-based teaching practice can help teachers shift their teaching decisions from relying on personal experience to relying on

research evidence, break through the limitations of traditional experience-based and subjective teaching, and form the habit of critical thinking and consciously applying evidence. This behavioral shift from individuals to the group is likely to provide a bottom-up impetus for change to China's basic education. Evidence-based teaching will also create more high-quality evidence for evidence-based teaching, enrich the evidence database of evidence-based teaching, feed back into subsequent teaching practice, and provide sustained evidence support for teaching reform. It should be emphasized, however, that evidence-based teaching is not a panacea or a guide for teaching reform, but rather a whole set of practical action frameworks that serve as the foundation for adjusting teaching methods.

3. Realistic Dilemmas of Evidence-based Teaching

The challenges teachers encounter when implementing evidence-based practice are many, such as difficulties in accessing and using evidence and the lack of effective feedback and evaluation mechanisms [15]. In evidence-based teaching practice, some issues may arise, such as increased workloads and conflicts with existing work. Even when teaching practitioners are aware of the value of implementing evidence-based teaching, there may be concerns about how it will be implemented when an evidence-based teaching culture is lacking. Academic research on evidence-based teaching began somewhat late in China, and awareness of it is still low. Due to its positivist tendency, evidence-based teaching has been questioned for following the technical practice model and has been widely criticized as a "blunt instrument" [16]. Another issue is the lack of a government-supported evidence database for evidence-based teaching. These all constrain the research and implementation of evidence-based teaching.

3.1 The Lack of an Evidence-based Teaching Culture

The evidence-based teaching paradigm is quite new and teachers' awareness of the role of evidence is still low. Under the influence of the traditional subjective teaching, teachers tend to teach according to their own comprehension of teaching and their preferred teaching methods. Evidence-based teaching emphasizes students'

participation in teaching decisions based on evidence. Students are now used to the dominant role of the teacher in classroom instruction and are relatively accustomed to obeying the teacher's instructions. In teaching, opportunities are lacking for students to fully express their learning aspirations and individual needs. It will still take a period for teachers to accept students' opinions in teaching decisions. In this kind of tradition, without questioning and reflection, teachers lack an internal basis for consciously reflecting on evidence-based teaching issues; the experience-based way of operation limits teachers' subjectivity and creativity. For evidence-based teaching, a democratic, cooperative, and scientific field culture is required. But, in the interaction between researchers and teachers, there is a tendency toward academic authority, and researchers often dominate the discourse. Similarly, constrained by the teacher role, there is also a tendency for teachers to dominate in the interactive internal psychological relationship between teachers and students. All these will directly impact the smooth implementation of evidence-based teaching.

3.2 Absence of a Support System for Evidence-Based Teaching

Evidence-based teaching strengthens teachers' roles as researchers, which inevitably increases their workload and may conflict with existing responsibilities. In light of the current situation in China, teachers already shoulder heavy workloads, making it difficult for them to allocate time for theoretical study and pedagogical research. Schools implement comprehensive normative management of teaching throughout the entire process—lesson preparation, classroom instruction, and teaching evaluation are all subject to strict regulations—leaving teachers with little room for “choice” in evidence-based teaching. Effective implementation of evidence-based teaching lacks systematic institutional safeguards. At present, schools have not provided teachers with a flexible teaching environment or additional time guarantees for conducting evidence-based teaching, nor have they introduced concrete measures to coordinate it with existing duties. Teacher evaluation systems primarily emphasize knowledge transmission, with insufficient incentives for pedagogical research. Moreover, evidence-

based teaching requires researchers' continuous involvement throughout the teaching process; yet researchers are already fully occupied with their own teaching and research responsibilities, leaving them little time for sustained participation. Research institutions likewise have not incorporated participation in evidence-based teaching in basic education into their performance evaluation criteria. Evidence-based teaching in China remains at a nascent stage. A localized evidence base for evidence-based teaching has yet to be systematically constructed; available research evidence is insufficient and of uneven quality, with relatively few intervention studies that are genuinely applicable to instructional decision-making. A large body of educational theoretical research lacks rigorous experimental validation and quality assessment of effectiveness. Consequently, teaching practitioners find it difficult to obtain high-quality evidence, which increases the difficulty of evidence-based instructional decision-making and hinders the effective implementation of evidence-based teaching.

3.3 Insufficient Evidence-Based Teaching Competence of Teaching Subjects

Evidence-based teaching is closely linked to the literacy and competence of teaching subjects themselves. At present, however, teachers lack experience in connecting the concept of evidence-based teaching with instructional practice. Evidence-based teaching requires teachers to possess habits of critical thinking, an awareness of evidence, and a scientific spirit. Yet contemporary teachers are accustomed to relying on experiential decision-making in teaching and lack the capacity to apply evidence in instruction. On the one hand, teacher education curricula rarely include courses on “research methods for evidence-based teaching.” Pre-service teachers therefore receive no relevant training and have little opportunity for evidence-based teaching practice. In response to the insufficient evidence-based teaching competence of pre-service teachers, existing studies have begun to explore cultivation pathways supported by digital and intelligent technologies, [17] though these remain to be widely promoted. On the other hand, in-service teacher training programs likewise seldom incorporate courses devoted to developing evidence-based teaching

competence. In short, both pre-service education and in-service training curricula lack systematic provision for the cultivation of evidence-based teaching capacity.

Evidence-based teaching requires researchers to conduct educational research in authentic practice settings and to possess instructional practice competence. Researchers must critically appraise, evaluate, and integrate evidence in order to supply teachers with the best available evidence for instructional decision-making, and subsequently interpret and transform the empirical evidence generated during instructional interventions. Yet in China, scholars' practical research on evidence-based teaching remains limited, and their theoretical foundations and practical experience are still insufficiently developed. As a result, researchers find it difficult to fully assume their bridging role. At the present stage, evidence-informed participation in instructional decision-making is still novel for students, who have not yet fully developed the autonomous learning literacy and evidence awareness required. The cultivation of students' evidence-based competence is a gradual process and thus introduces certain difficulties into the implementation of evidence-based teaching.

4. Possible Pathways for Evidence-Based Teaching

Evidence-based teaching constitutes both a value orientation and a comprehensive framework for practical action; its theoretical and applied value ultimately must be realized in instructional practice. The implementation pathway of evidence-based teaching is a cyclical process of "preparation—design—intervention—dissemination." Through successive cycles, instructional models are validated and refined. In the preparation stage, teachers identify an appropriate theoretical framework and obtain evidence for addressing instructional problems. In the design stage, researchers critically appraise, evaluate, and integrate evidence, while teachers employ the best available evidence to design instruction. In the intervention stage, teachers implement the intervention plan and researchers follow up by collecting data. In the dissemination stage, if the evaluation results are recognized by both the practice community and the academic community, the new model is made public and effective evidence is transformed into scientific

evidence. Otherwise, the process enters a cycle of adjustment of the intervention model until it reaches the standard required for public dissemination.

4.1 Preparation Stage: Anchoring Theory, Systematically Understanding Instructional Problems, and Obtaining Evidence

Evidence-based teaching is a form of practical research conducted through collaboration between teachers and researchers. Problem formulation constitutes both the starting point and the ultimate destination of evidence-based teaching. Teachers must possess critical awareness and the capacity to identify problems. Guided by the degree of attainment of instructional objectives, they should locate classroom "bottlenecks," analyze their causes through methods such as literature review and case slicing, and distill genuine research problems. The value of a research problem depends on its relevance to existing research and theory as well as its responsiveness to policy and practice. Determining the research problem requires anchoring an appropriate theoretical framework: the selected theory must both fit the practical project and possess adequate explanatory power for classroom problems. Evidence is the result of systematic research that expands the total body of knowledge. [18] The key characteristics of evidence are its accessibility and validity.[19] In evidence-based teaching, evidence comprises all research information obtainable by researchers that addresses the instructional problem. Its collection should be guided by practical utility and emphasize collaboration between researchers and teachers. When collecting evidence, the instructional problem should be formalized, core concepts decomposed, and key terms extracted; relevant research literature can then be systematically obtained through database searches and citation tracing.

4.2 Design Stage: Critically Appraising, Evaluating, and Integrating Evidence, and Employing the Best Evidence for Instructional Design

Existing research evidence commonly suffers from weak research methods and biased modes of expression, [20] making it difficult for most users to identify high-quality evidence. [21] Researchers must critically evaluate levels of

evidence and seek the “best available evidence.” The U.S. Department of Education’s hierarchy of evidence is based primarily on the scientific rigor of the research methods employed, with randomized trials ranked highest and case studies generally excluded from the hierarchy. This classification has two shortcomings. First, it neglects practical guiding utility and falls into methodological centrism. [22] Best evidence should be understood as relative and must comprehensively consider both methodological rigor and practical guidance value. Second, it directly excludes excellent teaching cases from the evidence hierarchy, whereas cases that have been tested by theory and practice and are adapted to specific contexts should be assigned a relatively high evidence level. After evaluating the evidence, researchers must further integrate it jointly with teachers. “Best-evidence integration” refers to the comprehensive, systematic, and reflective synthesis of all available evidence. [23] Best evidence does not automatically guide teaching; teachers must actively combine it with their personal experience, transform it into instructional design, and put it into practice. By continually revising the instructional process with the aid of best evidence, they achieve efficient translation of evidence into practice.

4.3 Intervention Stage: Implementing the Intervention Plan and Accumulating Empirical Data for Verification

Teachers implement the intervention plan in order to identify causal relationships with instructional outcomes. The core idea of evidence-based teaching is to conduct instruction in accordance with the intervention plan. Teachers must apply the intervention plan flexibly, seeking a dynamic balance among research evidence, pedagogical wisdom, and students’ individual needs, thereby organically integrating the intervention plan with the classroom context and enhancing the scientificity and effectiveness of teaching. Evidence-based teaching emphasizes practice grounded in research evidence while simultaneously advocating the generation of new evidence through practice. During the instructional process, teacher–student interactions generate new empirical evidence. Such evidence must be collected by researchers using scientific methods and subjected to

validity testing. Because evidence-based teaching aims to solve actual instructional problems and improve teaching effectiveness, two criteria are used to test the practical effectiveness of the empirical evidence generated: the effectiveness of the evidence in solving the instructional problem, and the extent to which it meets students’ learning needs. Teachers alone find it difficult to complete this task; researchers therefore play a crucial role.

4.4 Dissemination Stage: Evaluating Intervention Outcomes and Transforming Empirical Evidence into Scientific Evidence

Upon completion of evidence-based teaching, researchers must employ scientific methods to evaluate the effectiveness of the intervention plan and promote the transformation of empirical evidence into scientific evidence. This requires researchers to possess relatively solid theoretical foundations and research competence. Evaluation of evidence necessitates the formulation of indicators, the establishment of evaluation standards, and the assignment of indicator weights. Evaluation instruments should also possess high reliability and validity in order to achieve the conversion of empirical evidence into scientific evidence. Scientific evidence will then serve as a further source of guidance for evidence-based teaching and supplement the evidence base. If the evaluation results demonstrate that the instructional problem has been solved, that the teaching outcomes are accepted by the practice community, and that academic recognition has been obtained, the process enters the dissemination stage. If the results are not fully recognized or accepted, the process enters a cycle of adjustment of the intervention model, generating different versions of the intervention plan and continuing to the next round of evidence-based teaching practice until the standard required for public dissemination is reached.

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