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## **Design-Based Research in Music Education: Theoretical Foundations, Methodological Perspectives, and Practice Implications**

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**Abstract:** This article examines the integration of Design-Based Research (DBR) into music education, concentrating on its philosophical underpinnings, methodological features, and its potential to yield transformative educational practices. The study analyzes DBR as a cyclical and iterative process that interweaves design, implementation, and reflection within authentic learning environments through a theory-driven synthesis and methodological literature review. Its originality lies in bridging the rich international discourse on DBR with the underrepresented field of music pedagogy, offering a comprehensive framework that integrates theories such as constructivism, conceptual change, activity theory, and cognitive apprenticeship. The article examines how DBR can inform the design of music learning environments responsive to students' needs, culturally situated, and pedagogically adaptive. It highlights key challenges—such as the demands of long-term field engagement, the complexity of data management, and questions of generalizability—while emphasizing DBR's capacity to produce grounded, flexible, and theory-informed solutions. Practical examples from recent studies illustrate its application across diverse musical contexts, including digital composition tools, informal music-making, community-based practices, and teacher education. By framing teaching as a design act and theory as emergent from practice, DBR is presented as a methodology and a dynamic stance toward innovation. It empowers music

educators to act as reflective practitioners and co-researchers, supporting sustainable educational change. The article concludes by proposing directions for future research that expand the role of DBR in advancing inclusive, creative, and context-sensitive approaches to music learning.

**Keywords:** design-based research, research methodology, instructional design, music education, educational research.

## **Introduction**

Educational research has consistently sought to deepen the understanding of teaching and learning processes to improve educational practice. However, innovative ideas substantiated through research often fail to effectively transfer to the classroom (Brown, 1992; Collins, 1992), primarily when methodological approaches focus on evaluating interventions in contexts detached from authentic educational settings (Cobb et al., 2003).

In this framework, Design-Based Research (DBR) emerges as a methodological approach that requires the active involvement of researchers in designing, implementing, and iteratively refining one or more interventions, bridging theoretical justification with educational practice (Anderson & Shattuck, 2012; Design-Based Research Collective, 2003). A central assumption of DBR is that meaningful enhancement of teaching and learning can be achieved through authentic interventions, acknowledging the complexity of educational environments (Collins, 1992). The interplay between teachers, students, available resources, and sociocultural conditions is approached holistically, aiming to understand how and why an innovation does—or does not—work (Barab & Squire, 2016). Meanwhile, the practical improvement of each intervention is accompanied by the development or refinement of local theories, which evolve into broader design principles through iterative processes and implementation across diverse settings (Anderson & Shattuck, 2012; Cobb et al., 2003). Therefore, DBR is not merely another educational research methodology, but a distinctive perspective on the research-practice relationship, emphasizing a continuous cycle of design, enactment, and revision to achieve meaningful educational change within specific contexts (Anderson & Shattuck, 2012; Reeves, 2006).

This article examines DBR's methodological approach within the field of music education, focusing on its philosophical and theoretical foundations, research characteristics, and potential to generate and refine learning theories grounded in educational practice. Through a comparative presentation with other research methods and the analysis of examples from music pedagogy, the role of DBR is highlighted as a fertile framework for designing, evaluating, and theoretically grounding innovative interventions in music teaching and learning.

## **Research Problem**

Although DBR has become a well-established methodological approach in the learning sciences and STEM education, its application in music education remains relatively limited. This absence is particularly striking, given the highly dynamic, multimodal, and creative nature of music learning environments, which aligns well with DBR's iterative and context-sensitive logic. Moreover, while many music education studies focus on implementing innovative tools or pedagogical practices, few are grounded in design-based frameworks that can explain and improve the learning process. In an era where educational innovation is increasingly valued, and music educators face new challenges related to inclusion, technology, and cultural relevance, integrating DBR into music pedagogy becomes necessary. This integration can benefit the music classroom and the broader scientific community by generating transferable design principles, contextually valid theories, and practice models. It also offers a robust

methodological alternative for those seeking to bridge the gap between empirical inquiry and the realities of artistic-pedagogical practice.

### **Research Focus**

This study focuses on DBR's potential as a transformative framework for music education. It critically examines how the fundamental principles and structures of DBR—cyclicity, design orientation, theoretical generation, and collaboration—can be adapted to address the specific needs of music teaching and learning. The emphasis lies in exploring the intersection of DBR with the pedagogical, cognitive, and aesthetic dimensions of music education.

### **Research Aim and Research Questions**

This study aims to explore how DBR can be effectively positioned and adapted within the field of music education. Drawing from a comprehensive synthesis of theoretical foundations, methodological models, and selected case studies, the article seeks to illuminate the specific features, possibilities, and challenges of applying DBR in music teaching and learning contexts. Research questions are as follows:

1. What theoretical and pedagogical foundations support the implementation of DBR in music education?
2. How has DBR been adapted across different music education settings, and what are its core characteristics in these applications?
3. What design principles, challenges, and transformative potentials emerge from the uses of DBR in music education?

### **Literature Review**

This section provides a structured overview of the conceptual and methodological foundations of DBR, aiming to establish its relevance to the field of music education. It begins by tracing the historical development of DBR, highlighting how it emerged in response to the limitations of traditional research approaches in capturing the complexity of learning environments. It then explores core features of DBR—such as iterative design, theoretical grounding, and methodological flexibility—alongside its underlying learning theories, including constructivism, activity theory, and cognitive apprenticeship. Finally, the cyclical nature of DBR is illustrated through selected process models, which offer a framework for understanding how interventions evolve through successive cycles of design, implementation, and refinement. This review lays the groundwork for examining how DBR can be meaningfully adapted to address the unique characteristics and needs of music education.

### **Historical Context of Design-Based Research**

The origins of DBR can be traced back to the 1960s when designers, researchers, and academics sought to establish design as an independent scientific perspective. Simultaneously, by the mid-20th century, it became evident that traditional, experimental, and quantitative methods in educational research had limitations in capturing and interpreting the complexity of classroom environments (Brown, 1992; Cobb et al., 2003).

An early example of incorporating design into educational research can be found in Germany with the *Realistic Mathematics Education* approach, an innovative practice at the time that focused on teaching mathematics through authentic learning experiences. This approach emphasized the construction of meaning through guided reinvention, encouraging students to develop strategies and solutions (Freudenthal, 1973), principles that later became foundational for DBR. The design process is not

considered a linear application of theory, but rather an evolving dialogue between design conjectures, empirical findings, and instructional adaptations (Gravemeijer & Cobb, 2006).

Around the same period in France, the *Ingénierie didactique* approach emerged, emphasizing the importance of designing instructional materials and activities through cyclical processes (Artigue, 1988). This model introduced a structured methodology consisting of stages such as a priori analysis, classroom experimentation, and a posteriori evaluation, highlighting the need to adapt theoretical constructs in response to empirical classroom data. It emphasized the iterative negotiation between didactical intentions and actual student responses, thereby prefiguring key principles of DBR, such as adaptive design, empirical grounding, and close collaboration between researchers and practitioners.

During the 1980s, the “*teaching experiments*” trend in the United States gained momentum. These were small-scale, systematic teaching interventions in which the researcher collected qualitative data as a teacher-collaborator in the classroom (Van den Akker et al., 2006). The interventions were repeated after data analysis, and the teaching strategies were redesigned for application to various student groups (Brown, 1992). In the 1990s, “*design experiments*” emerged as an alternative to experimental methodologies. These researchers employed a design and empirical testing approach as a holistic scientific method, aiming to enhance the educational environment—teaching tools, interactions, and classroom organization—through a dynamic, iterative process of revision and modification (Brown, 1992; Collins, 1992).

In the following years, studies reflecting this methodological perspective began to be implemented in educational research, with a common thread being the iterative process of design, implementation, evaluation, and redesign (Cobb et al., 2003). However, the diversity in design and methodological execution led to the emergence of various terms such as “*formative research*,” “*development research*,” or “*developmental research*” (Van den Akker, 1999), while the term “*design research*” gradually became more established (Anderson & Shattuck, 2012; Collins et al., 2016). The term “design-based research” was introduced in the landmark article by the Design-Based Research Collective (2003), where a group of researchers clarified the core components of the approach: the complexity of authentic educational settings, the cyclical and iterative process of design-implementation-feedback, the production of both practical solutions and theoretical principles, and the close collaboration among all stakeholders (Barab & Squire, 2016; Reeves, 2006). This evolution of DBR reflects a broader epistemological shift in educational research—from positivist traditions that emphasized objectivity and standardization toward interpretivist and sociocultural paradigms that value complexity, contextualization, and learner agency. As the limitations of experimental methods became increasingly apparent, DBR emerged as a response to the need for research that could not only observe practice but also transform it from within (Barab & Squire, 2016; Design-Based Research Collective, 2003).

DBR has gained increasing popularity in recent years, particularly in educational research that focuses on introducing innovations utilizing technological tools (Sommerhoff et al., 2018). Notable examples include the design of digital learning platforms, where continuous optimization is pursued through successive redesign cycles via user testing and the collection of learning analytics in a mode of “perpetual beta testing” (McKenney & Reeves, 2018). Finally, in contrast to conventional DBR studies, which focus on a limited number of classrooms, the term “*design-based implementation research*” has emerged to describe large-scale projects in diverse learning environments (Penuel, 2019; Fishman et al., 2013).

### ***Towards a Definition of Design-Based Research***

DBR constitutes a gradual and continuously iterative process of designing, implementing, evaluating, and redesigning an educational intervention within authentic learning environments. It aims

to propose practical solutions while simultaneously generating theoretical knowledge emerging from practice (Anderson & Shattuck, 2012; Hall, 2020; Mavrommati, 2019; McKenney & Reeves, 2018). Through this cyclical process, a theoretical framework emerges, shaped by multiple previously fragmented elements (Confrey & Lachance, 2016). As a methodology, DBR combines elements from various scientific fields, including education, psychology, and human-computer interaction, drawing inspiration from the real needs of the educational community and guided by educators themselves (McKenney & Reeves, 2013). This interdisciplinary perspective emphasizes the significance of collaboration among researchers, designers, and educators, aiming to bridge the gap between research and practice (Lewis et al., 2020). Since each participant may have different priorities and goals (Easterday et al., 2022), a collaborative approach enhances alignment with actual needs and increases the likelihood of successfully implementing the proposed practices (Anderson & Shattuck, 2012).

The iterative nature of design enables interventions to adapt to students' needs and contexts, thereby deepening their understanding of the topic, identifying patterns or trends, and refining methods (Barab & Squire, 2016). DBR researchers believe that the methodology aligns with the philosophy of education, wherein teachers design and revise their practices based on students' needs (McKenney & Reeves, 2018). This process of redesigning instructional strategies allows teachers to remain flexible and effectively respond to the demands of their specific educational contexts (Charalambidou, 2024). An essential feature of DBR is the dialectical relationship between theoretical grounding and practical implementation. The theoretical frameworks analyzed below are used not only to justify the initial design of an intervention but are also tested, refined, or even reconfigured based on empirical classroom interactions. This interplay ensures that theoretical assumptions are constantly scrutinized in real time, as researchers and educators collaboratively respond to learners' needs, contextual variables, and unanticipated outcomes. In this sense, design mediates abstract theory and lived educational experience, offering a structured yet flexible means of theory-informed experimentation (Barab & Squire, 2016; Cobb et al., 2003; Edelson, 2002).

It is important to note that DBR is characterized by “methodological pluralism” (Rodríguez, 2017), with no universally accepted definition. The complexity of the approach is accompanied by ambiguities in terminology and the development of models, steps, or procedures (Christensen & West, 2018). Nevertheless, research activity in the field converges around a set of structural and functional features of DBR. Specifically, it (a) is driven by design as the core of the research process, involving both the development of instructional materials and the organization of interventions; (b) takes place in authentic contexts and is directly applicable; (c) includes multiple cycles of design, testing, feedback, and revision, allowing the intervention to be dynamically modified based on collected data; (d) promotes interdisciplinary collaboration among researchers, designers, and educators; (e) aims to develop theories that help understand the processes of teaching and learning; (f) focuses on innovations related to content, methods, teaching tools, or the role of the teacher and student; (g) seeks to produce applicable materials, scenarios, models, or learning environments; (h) formulates research questions explored through empirical practices combining qualitative and quantitative methods; and (i) employs scientific approaches that lead to theories and findings characterized by transferability (see Anderson & Shattuck, 2012; Barab & Squire, 2016; Charalambidou, 2024; Christensen & West, 2018; Cobb et al., 2003; Design-Based Research Collective, 2003; Edelson, 2002; Euler, 2014; Hall, 2020; Oppl et al., 2022; Mavrommati, 2019).

In conclusion, DBR does not aim to be a distinct research methodology; rather, it is an approach that integrates a variety of tools to generate generalizable theoretical principles, design frameworks, and models, ensuring practical applicability of the designed interventions across broader contexts (McKenney & Reeves, 2013; Reeves & Lin, 2020). Researchers are expected to apply practices that create the

conditions for observation, measurement, analysis, evaluation, and ultimately, improvement of the learning process (Anderson & Shattuck, 2012).

### ***Theoretical Framework of Design-Based Research***

DBR does not require a strictly predetermined methodological framework (Anderson & Shattuck, 2012; Bell, 2004). As a research approach, it is grounded in specific epistemological assumptions (Sandoval, 2014), which can be grouped into four core dimensions:

- Ontologically, DBR is founded on the coexistence of multiple learning theories, aiming not only to investigate the effectiveness of a tool or process but also to understand why it works or does not work, with an emphasis on transferring and generalizing findings to other learning environments (Barab & Squire, 2016; Cobb et al., 2003).
- It seeks to generate measurable improvements in learning processes (Anderson & Shattuck, 2012; McKenney & Reeves, 2013), ensuring that the emerging theoretical knowledge is applicable and educationally beneficial in real classroom settings (Hoadley, 2004).
- DBR emphasizes the development of design principles that guide future creation and implementation of educational tools and procedures, ensuring that research outcomes add learning value across diverse educational contexts (Edelson, 2002).
- It involves the implementation of extended and iterative instructional interventions in authentic learning environments such as school classrooms. Long-term observation of the learning process enables a deeper understanding of the holistic impact of interventions, contrasting with the limitations of short-term experimental designs (Barab & Squire, 2016).

At its core, DBR is rooted in *Constructivism*, as developed during the second half of the 20th century. It views learners as active agents in the learning process and aims to create environments that facilitate the construction of knowledge. The focus is on how tools, tasks, and classroom conditions are designed and shaped in response to students' needs. Within the framework of *Sociocultural Constructivist* learning theories, design emphasizes communication norms and the cultural context that influences learning (Charalambidou, 2024). The classroom is an ecosystem of diverse and unique individuals interacting (Barab & Squire, 2016). Moreover, since teaching and learning are multidimensional and involve multiple interactions (Cobb et al., 2003), *Activity Theory* provides a perspective that emphasizes the relationships among actions, tools, and systems, thereby reshaping classroom structures (Engeström, 1987). Grounded in social constructivism, the concept of *Cognitive Apprenticeship* also plays a crucial role. According to this view, learning occurs when students actively engage in expert-like practices through guided participation and gradual independence (Collins et al., 1989). This approach is embedded in DBR's learning environments, where students are expected to solve authentic problems, and the teacher takes on the role of mentor or partner.

Since DBR is based on design and practical implementation, it reflects a *Constructionist* mindset, where knowledge is considered a product of negotiation, and teaching is viewed as a creative design practice that transforms the environment (Resnick, 2017). Just as learners actively construct knowledge through engagement in authentic projects (Papert, 1980), the iterative nature of DBR mirrors this approach, providing opportunities for active participation in the design process (Charalambidou, 2024).

The influence of learning theories that view knowledge as dynamic, context-dependent, and continuously reorganized is also significant. One of the key theoretical references is the concept of *Conceptual Change* (Vosniadou, 1994), which describes the process by which learners transform their initial conceptions into new, more scientifically grounded representations (Ohlsson, 2016). This change is not merely the addition of new information; it involves a restructuring of cognitive frameworks. This restructuring is achieved through active engagement with authentic problems and experiences that

trigger cognitive conflict and promote the renegotiation of mental models. Building on this foundation, the *Knowledge-in-Pieces* approach (diSessa, 2018) proposes that knowledge consists of small, autonomous, and active cognitive units that are selectively activated depending on the features of each learning experience. Rather than treating learners' prior conceptions as coherent but incorrect models (Vosniadou, 2013), this perspective considers prior knowledge rich, generative, and capable of reorganization through experience and targeted support (diSessa, 2018). Within this framework, DBR focuses on designing educational environments that support the gradual transformation of knowledge. Through iterative design, testing, revision, and reflection cycles, students' existing cognitive structures are integrated into the learning process, creating deep, transformative learning (Barab, 2022; Sandoval, 2014).

Furthermore, DBR draws from the principles of Dewey's *Pragmatism* (1916), which maintains that theory should be judged not by its correctness but by its ability to function in real-world contexts. In DBR, theory and practice are inextricably intertwined: design does not precede experience; instead, it emerges from it, creating tools, practices, and theories (Anderson & Shattuck, 2012; Euler, 2014). Design processes evolve based on the specific conditions of the educational context (Edelson, 2002) and are not treated as static frameworks detached from pedagogical practice (Charalambidou, 2024). Within this pragmatic framework, DBR does not seek universal truths, but rather transformative outcomes grounded in everyday educational experiences.

DBR is closely linked to *Design Thinking*, as the teacher-researcher is not a neutral observer but an active designer of solutions. This role resembles an engineer who employs engineering thinking to design, test, fail, reflect, and redesign in a continuous improvement cycle. As in engineering, design is not separate from practice; instead, theory guides design, design tests the validity of theory, and ultimately, practice informs and transforms both, reshaping the original framework (Anderson & Shattuck, 2012; Tiberghien et al., 2009).

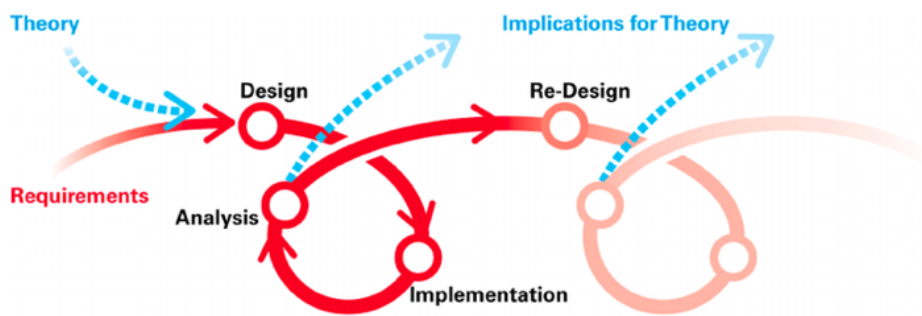
These theoretical foundations provide a philosophical backdrop and directly inform design decisions within DBR. For example, cognitive apprenticeship influences the structure of scaffolding and expert modeling in instructional sequences; conceptual change informs the incorporation of tasks that challenge learners' existing understandings; and activity theory affects the analysis of tools, roles, and rules within classroom systems. Consequently, applying these theories in iterative design cycles leads to their refinement, adaptation, or even reconceptualization. Thus, DBR establishes a recursive relationship between theory and practice, where design is both a product of theory and a means of exploring and reinterpreting that theory. In this framework, DBR employs a diverse range of learning theories to examine teaching and learning processes in complex educational settings, utilizing a relational approach that integrates theory and practice at every stage.

### ***The Cyclical Nature of Design-Based Research***

As previously noted, DBR is a continuous and cyclical process of ongoing interaction between theory and practice (Edelson, 2002). Each stage influences and is influenced by the others, leading to a constant redefinition of the design and the development of interventions that evolve dynamically (McKenney & Reeves, 2018). The process begins with the identification of an educational problem, followed by the initial design of the intervention in authentic contexts. It progresses through iterative feedback and evaluation within a framework of complementary processes (Cobb et al., 2003; Euler, 2014; Reeves, 2006). In this way, DBR aims for a gradual convergence toward an increasingly refined interventional model, even though the inherent complexity of educational settings never allows for complete control (Cobb et al., 2003).

**Figure 1**

*Design-Based Research*

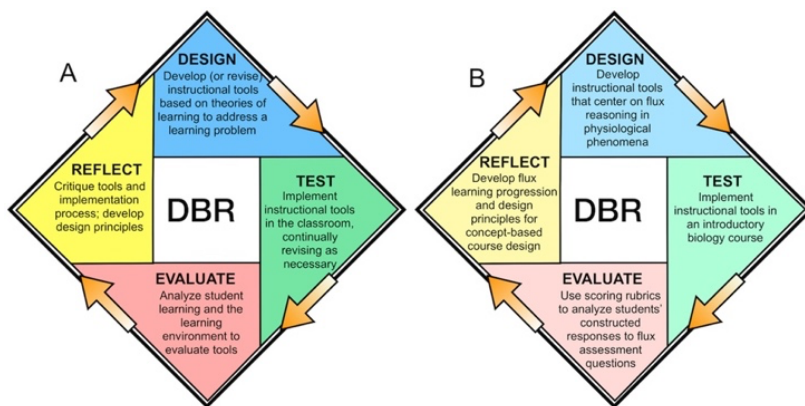


Source: Fraefel, 2014

Various models have been proposed over time to describe the iterative nature of DBR. Each model presents emphases and highlights different dimensions of the process, reflecting its complexity. According to Edelson (2002) and Fraefel (2014), DBR unfolds in three core stages. The first stage concerns the initial design, which includes a needs analysis, a literature review, formulating research questions, and clarifying the theoretical framework (Anderson & Shattuck, 2012). The second stage involves implementing the intervention and collecting data. The third stage focuses on systematically analyzing the data and redesigning, identifying factors that influence learning and weaknesses in the original design. This phase strengthens the transformative potential of the methodology (Cobb et al., 2003). When the intervention is tailored to the specific characteristics of the learning context, a local theory may emerge, aiming to articulate the underlying design mechanisms (Penuel et al., 2011; Reeves, 2006).

**Figure 2**

*Design-Based Research (Scott et al., 2020)*

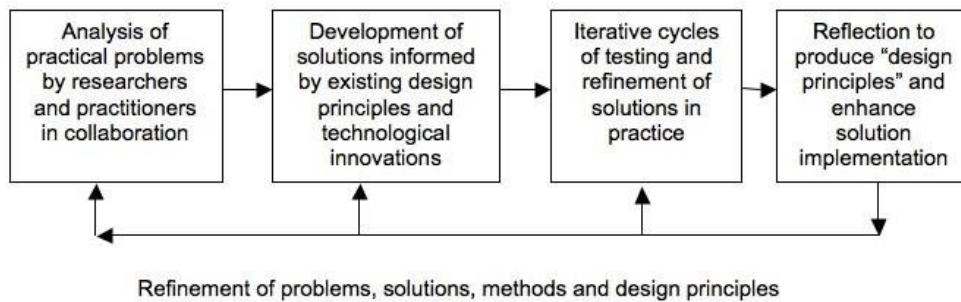


Source: Scott et al., 2020

From a complementary perspective, DBR, inspired by the field of engineering, proposes that researchers identify an existing learning problem and design a potential intervention in the form of instructional tools based on theoretical and empirical foundations (Scott et al., 2020; Sandoval, 2014). The intervention is tested in real-world conditions, while the tools are evaluated and adjusted in real-time (Collins, 1992). Researchers engage in reflective analysis of the outcomes, identifying effective elements and revising findings that may contribute to theoretical advancement. This process leads to new cycles of design, testing, evaluation, and reflection, where the individual stages are not always clearly distinct, as they often overlap and mutually inform one another (Scott et al., 2020).

**Figure 3**

*Design-Based Research*



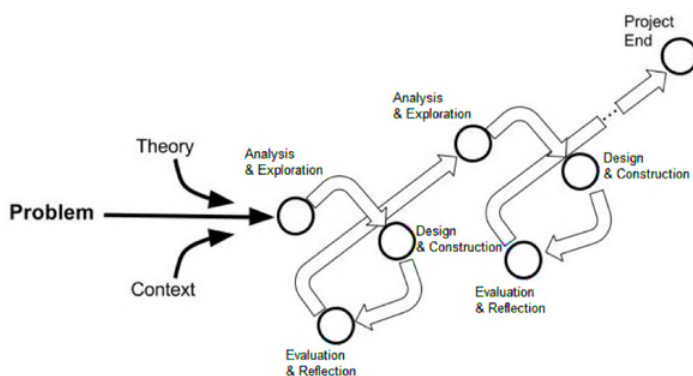
Source: Reeves, 2006

According to Reeves (2006), researchers and practitioners first collaborate to identify and analyze a practical problem, thus shaping the research framework. Solutions are developed based on existing design principles and by leveraging technological innovations. This is followed by the iterative testing and refinement phase, in which the solutions are implemented, tested, and modified through successive cycles of feedback. During this process, reflection occurs, and new design principles are generated to enhance the implementation of interventions. The process is repeated with the redefinition of problems, solutions, methods, and design principles, ensuring continued development and adaptation to evolving needs.

McKenney and Reeves' (2012) approach, which refines the previous model, begins with the analysis phase, where a gap or educational issue is identified. This phase includes reviewing the relevant literature, analyzing curricula, clarifying learning expectations, and often conducting small-scale field studies. This is followed by the design phase, which involves developing an initial prototype, such as creating educational activities, writing lesson plans, software development, or creating digital learning environments. Learning objectives, interaction modes, tools, and the teacher's role are articulated at this stage. The next stage is evaluation, during which data is collected, and feedback is provided, and all involved parties critically reflect on the process.

**Figure 4**

*Design-Based Research*



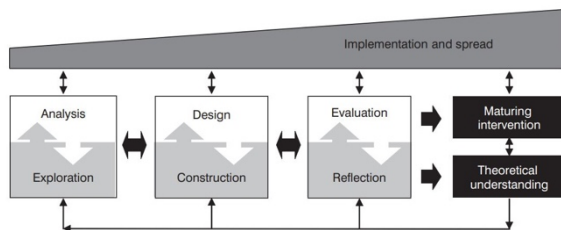
Source: McKenney & Reeves, 2006

The redesign of the above approach emphasizes several redesign cycles, leading the intervention into a more stable phase of maturity, integrating it into a broader academic context, and fostering the

development of a deeper theoretical understanding, which results in the formulation of generalizable principles (McKenney & Reeves, 2018). The ultimate goal is the implementation and dissemination of design principles and findings, with an emphasis on scalability and generalizability of the research (Penuel et al., 2011). The process is not a strict sequence of stages but rather a dynamic, circular, and constantly evolving path in which each phase interacts with previous and subsequent ones, contributing to the continuous improvement of the design (McKenney & Reeves, 2018).

**Figure 5**

*Design-Based Research (McKenney & Reeves, 2018)*

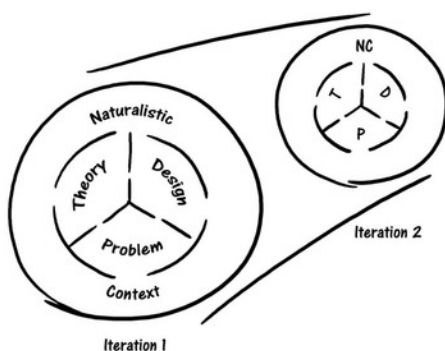


Source: McKenney & Reeves, 2018

Finally, Barab (2022) proposes a representative model of the iterative and evolutionary nature of DBR, highlighting the interconnection among theory, design, and problem within a continuous process of reframing. Design is approached from a naturalistic perspective, where theory, problem, and design coexist constantly with the broader context. As the research progresses and enters subsequent iterations, the emphasis shifts toward the emerging normalization of the intervention through ongoing redefinition, systematic implementation, and empirical validation.

**Figure 6**

*Design-Based Research*



Source: Barab, 2022

In summary, the cyclical nature of Design-Based Research reflects a dynamic interplay between design, theory, and practice. Through iterative loops of analysis, design, implementation, and reflection, DBR ensures that educational interventions are continually refined in response to authentic needs and contextual realities. Rather than following a linear path, DBR unfolds through overlapping and mutually informative stages, supporting both practical improvements and theoretical development. Across the reviewed models—from Edelson’s structured phases to Barab’s naturalistic reframing—there is a shared emphasis on responsiveness, collaboration, and adaptability. This iterative notion enhances the ecological

validity of education research and fosters sustainable innovation grounded in the complexities of real-world classrooms.

## **Results**

Although this study does not rely on collecting primary empirical data, it offers a theoretically grounded synthesis that addresses the research questions through interpretive analysis, comparative model examination, and the integration of relevant literature in music pedagogy and learning sciences. The following section presents key insights that emerge from this process, highlighting how DBR aligns with the specific characteristics of music education, what principles can guide its application, and the implications that arise for future design and research.

### ***Methodological Design of Design-Based Research***

DBR does not constitute a strictly defined methodological approach in the traditional sense of educational research; instead, it offers a broader perspective that integrates various tools (McKenney & Reeves, 2013). As such, DBR does not impose specific requirements regarding the form of educational tools or the methods by which they are evaluated (Anderson & Shattuck, 2012; Bell, 2004). It adopts a flexible, multimodal, and adaptive framework for data collection and analysis, prioritizing a combination of qualitative and quantitative approaches. However, this combination does not align with the classical framework of mixed methods. Instead, it is viewed as a shift in perspective between the “microscopic”—in-depth qualitative investigation—and the “macroscopic”—quantitative data—aiming to understand how and why an intervention did or did not work (Van den Akker et al., 2006). Quantitative analysis is considered valuable only to the extent that it is embedded within an interpretive framework aligned with the pedagogical goals of the intervention. For this reason, quantitative measurements are interpreted qualitatively rather than being seen as mere records of measurable outcomes (Anderson & Shattuck, 2012). In this way, DBR seeks to integrate “internal understanding”—attitudes, experiences, knowledge, and perceptions—with “external validation”—the measurement or assessment of progress (Design-Based Research Collective, 2003). Compared to experimental research, DBR does not aim to isolate variables or control all contextual factors. Rather than seeking causal generalizations, it prioritizes contextually grounded explanations and theory-building through iterative cycles of analysis. While experimental designs offer high internal validity, they often lack ecological validity when removed from authentic learning environments (Barab & Squire, 2016). In contrast, DBR excels in producing practical, adaptable solutions and design principles with strong local relevance. However, its context-specific nature can challenge generalization, replicability, and standardization. Nevertheless, by explicitly integrating design, implementation, and theory development, DBR provides a powerful alternative for researchers seeking to bridge the gap between innovation and real-world educational practice (Design-Based Research Collective, 2003; McKenney & Reeves, 2013).

### ***Methods of Data Collection and Analysis***

Data collection in DBR employs both qualitative and quantitative tools. Qualitative approaches include, among others, participant observation, note-taking, or field diaries, and video recordings of teaching sessions (Creswell & Creswell, 2018). Semi-structured and open-ended interviews, along with informal conversations with stakeholders—teachers, students, and parents—involved in the classroom play a significant role in capturing their interpretations and expectations (Cohen et al., 2002). The presence of an external observer can also enhance the validity and reliability of the process. Quantitatively, pre- and post-intervention questionnaires are used, employing Likert-type scales or open-ended questions (Anderson & Shattuck, 2012). In technology-supported environments, special emphasis is placed on interaction logs and learning analytics, which provide valuable insights into students’ use of digital tools and engagement with learning materials (Baker, 2010). Additionally, various forms of

student work can be used to assess learning outcomes, including portfolios, written assignments, and formative assessments such as exit tickets, 3-2-1 reflections, or one-minute books (see Mygdanis, 2023).

The multi-level nature of data collection necessitates the systematic use of various methods and tools within a triangulation framework, aiming to strengthen the validity and reliability of the conclusions (Cobb et al., 2003). When different methodological perspectives converge on similar findings, it increases confidence that the results are not products of methodological bias or interpretive arbitrariness but genuinely reflect the dynamics of the educational intervention (Barab & Squire, 2016). It is essential to emphasize that, during field data collection, DBR places particular importance on opportunistic recordings as valuable sources of theoretical and design-oriented reflection. These refer to unexpected events, such as spontaneous teaching practices or students' unforeseen reactions, which are actively incorporated into the research process (Dede, 2016). Investigating these events reveals hidden dimensions of educational reality, enriching data polyphony and deepening theoretical understanding in subsequent design iterations.

Data analysis constitutes a continuous and conceptually focused process that is not temporally confined to the end of the research; instead, it unfolds in parallel with data collection (Barab & Squire, 2016). Like data collection, it is grounded in a triangulation perspective, aiming to yield a multidimensional and reliable understanding of the phenomenon. A common approach to data analysis in DBR is the code-to-theory model, where the data are initially organized into thematic or conceptual categories, such as patterns of interaction, teaching strategies, or students' emotional responses. These categories are then transformed into codes and hierarchically reconstructed, gradually progressing from the specific and tangible to the abstract and theoretical (Saldaña, 2013). For the analysis of these codes, thematic content analysis can be employed—a method that identifies, describes, and thematizes meaningful patterns that recur and emerge from the data themselves, rather than from the researcher's preconceived assumptions (Braun & Clarke, 2006). This method adheres to the principles of meaning condensation (Finfgeld-Connett, 2014), facilitating the identification, coding, frequency counting (e.g., of words and/or phrases), and re-examination of the data (Brinkmann & Kvale, 2015).

In the context of music education, integrating diverse data collection methods—such as classroom observations, interviews, video analysis, and learning analytics—not only enhances the ecological validity of DBR studies but also captures the multimodal and affective dimensions of musical learning. Utilizing opportunistic recordings and iterative coding strategies enables researchers to trace how students engage with sound, movement, and collaborative creativity in authentic environments. These procedures provide a robust foundation for interpreting how musical knowledge is constructed and transformed, setting the stage for deeper pedagogical insights discussed in the next section.

### ***Interpretive Lenses in Design-Based Research***

Interpretive lenses refer to the multiple perspectives through which a phenomenon is viewed and interpreted. Each researcher constructs a distinct framework for understanding data, shaped by their perspective (Mygdanis, 2023). DBR employs a range of interpretive lenses, adopting an interdisciplinary and mixed-methods approach that seeks external validation of an intervention's effectiveness and internal understanding of how learners construct knowledge (Design-Based Research Collective, 2003). These varied perspectives complement each other, enhancing the triangulation of findings and enabling analysis at both micro and macro levels (Van den Akker et al., 2006).

Indicative analytical lenses include the monological, subjective, and dialogical perspectives (see Carspecken & Apple, 1992; Mygdanis, 2023), ensuring that the data reflect both the voices of participants and the researcher's interpretations. The monological lens corresponds to external and detached observation, utilizing tools such as structured observations, questionnaires, document analysis, log files,

or learning analytics, with a primary focus on what is happening. The subjective lens bridges the external and internal perspectives by incorporating participants' lived experiences. It includes interviews, informal conversations, and formative assessments, emphasizing how participants make sense of educational practice and the meanings they ascribe to it. Finally, the dialogical lens represents the most participatory and collaborative perspective, necessitating meaning-making to emerge through the dialogic relationship between researcher and participants. Narratives unfold through interviews, recorded meetings, and conversations—not as static accounts, but as co-constructed realities in which all voices contribute to shaping the interpretation of events.

In music education, such lenses are particularly valuable for interpreting embodied, affective, and creative aspects of learning. They allow researchers to capture the interplay between sound, movement, expression, and reflection in authentic musical contexts. This multi-voiced analysis enriches our understanding of how musical meaning is negotiated, shared, and transformed in pedagogical practice.

### ***The Multiple Roles of the Researcher in Design-Based Research***

One of the core characteristics of DBR is the complexity of the researcher's roles, constituting a deliberate strategic choice. The researcher actively participates in the intervention's design, implementation, and evaluation, continuously shifting between roles such as project coordinator, designer, theorist, educator, and analyst (Christensen & West, 2018). While this fluid and overlapping role-taking allows for in-depth engagement at both micro and macro levels, full involvement in all aspects of the process may hinder the generalizability of findings, as transferability remains a central challenge (Barab & Squire, 2016). For this reason, it is recommended that these roles be distributed among different individuals within a collaborative framework in which all members are considered co-creators of the research (Design-Based Research Collective, 2003).

Regardless of the number of participants involved, the roles of the researcher in DBR are clearly defined. In the primary role, as in other methodological approaches, the researcher is responsible for ensuring ethical integrity, methodological validity, and minimizing bias (Hoadley, 2004). As a project coordinator, the researcher fosters team cohesion, facilitates role integration, and promotes interdisciplinary collaboration (Collins et al., 2016). Each design decision impacts the research process, and conversely, each research decision imposes constraints on the design possibilities (Van den Akker, 1999). As a designer, the researcher is expected to manage these interactions, balancing contextual demands with the needs of both design and research (Christensen & West, 2018). In the role of theorist, the researcher reflects on the foundational assumptions of the intervention and seeks to articulate theoretical conclusions that emerge from practice (Design-Based Research Collective, 2003). Finally, as an educator, the researcher assumes responsibility for delivering the intervention, setting objectives, selecting strategies, and adapting their role according to the needs of the classroom (Christensen & West, 2018).

In the context of music education, these multifaceted roles become even more pronounced, as the researcher often navigates artistic, pedagogical, and technological domains simultaneously. The interplay between designing musical experiences and evaluating their pedagogical impact requires both subject-specific sensitivity and adaptive research practices. This dynamic positioning enables deeper insights into how learners engage with music in a meaningful and creative way.

### ***Differences between Design-Based Research and Other Methodologies***

DBR shares commonalities with other qualitative methodologies, particularly in its application within authentic environments, its emphasis on feedback, and its dynamic adaptation to practice (McKenney & Reeves, 2018). However, a fundamental distinction lies in how design and research are

conceptualized. In conventional methodologies, these are treated as separate and sequential processes—an intervention is first designed based on a theory and then evaluated through research. In contrast, DBR positions design at the core of the research process itself (Anderson & Shattuck, 2012; Edelson, 2002).

*Action Research* exhibits several similarities with DBR. Both are described as dynamic research approaches that emphasize iterative feedback and are conducted in real-world settings to address practical issues and enhance learning outcomes (Charalambidou, 2024; Efron & Ravid, 2019). In some interpretations, DBR is viewed as a variant or extension of Action Research (Cernusca & Ionas, 2014). Nonetheless, the two approaches differ significantly in their theoretical orientation (McKenney & Reeves, 2018). While both aim to improve educational practice, Action Research tends to focus more on local context without necessarily seeking transferability of results, whereas DBR aspires to generate generalizable design principles (Kemmis & McTaggart, 2005; Design-Based Research Collective, 2003). Thus, DBR addresses educational problems and promotes learning improvement while simultaneously producing theoretical knowledge, whereas Action Research primarily tackles immediate and specific challenges without aiming for generalization (Efron & Ravid, 2019; Van den Akker et al., 2006). Furthermore, DBR often involves expert teams and requires a high level of documentation (Cobb et al., 2003; Edelson, 2002; McKenney & Reeves, 2018), whereas in Action Research, even when collaboration exists, the teacher's role tends to dominate the process (Efron & Ravid, 2019).

A further point of comparison can be made with ethnographic approaches and *Case Studies*, which focus on in-depth observation, documentation of the sociocultural context, and understanding of the “what” and “why” within a classroom or group (Stake, 1995). In contrast, DBR is an interventionist and transformative approach that aims to enact active change in the educational context and generate theoretical insights. Nonetheless, ethnographic techniques can be valuable in the early stages of a DBR study—for instance, in understanding the context or school culture—or in documenting the change process (Barab & Squire, 2016; McKenney & Reeves, 2012).

In summary, DBR presents a multi-layered and hybrid character, selectively drawing from a variety of methodological traditions while maintaining its core focus on iterative design of educational solutions with theoretical relevance. Rather than adhering to a rigid research model, it adopts a blended approach, integrating elements from other methodologies to generate design principles that bridge theory and practice (Anderson & Shattuck, 2012; Cobb et al., 2003; Collins, 1992). This eclectic nature positions DBR as a “meta-methodological” approach—one capable of incorporating diverse techniques, provided they serve the overarching logic of design (Barab & Squire, 2016). In music education, this meta-methodological flexibility allows DBR to effectively incorporate creative, performative, and culturally situated dimensions of musical learning. By drawing from and adapting multiple methodological traditions, DBR enables music educators to design and study interventions that reflect the embodied, collaborative, and expressive nature of music learning, offering a robust framework for theory-informed innovation in practice.

### ***Challenges, Limitations, and Criticism about Design-Based Research***

Despite the significant advantages associated with using DBR as a methodological approach in educational research, the literature highlights a range of serious challenges and limitations in its application (Barab & Squire, 2016; Cobb et al., 2003; McKenney & Reeves, 2012). Nevertheless, this critique does not diminish the potential of DBR; rather, it serves as a prompt for reflection and discussion regarding the conditions necessary for rigorous methodological and ethical considerations.

First, DBR is time-consuming due to its multiple iterative cycles. A complete DBR study can extend far beyond the duration of a typical instructional intervention with a predefined timeline, while unpredictable factors may disrupt the design flow (Reeves, 2006). This challenge is compounded by the

need for systematic documentation, which requires meticulous archiving of every minor modification to the design, along with significant time and resource investment for analyzing often large volumes of data (Van den Akker et al., 2006). Furthermore, collaboration among researchers, educators, and other stakeholders, as well as the deployment of human and material resources, presents a challenge that can complicate the integration of diverse theoretical perspectives (Angel-Alvarado et al., 2017). Special care must be taken to ensure that such collaboration does not lead to an imposition of design decisions by researchers, marginalizing the voices of participants (McKenney & Reeves, 2018). This scenario reflects an educational philosophy that genuine improvements arise from long-term, iterative efforts rather than fragmented interventions (Collins, 1992).

Regarding the legitimacy of the research (see Symeou, 2006), the issue of generalizability is a key concern. Although DBR aims to produce design principles that can be transferred to other educational contexts, its emphasis on authenticity and complexity often yields highly localized findings (Cobb et al., 2003). While this local focus can be viewed as a strength, enabling deeper adaptation to the unique features of each case, it also raises questions about whether the outcomes can be applied to other educational or cultural settings (McKenney & Reeves, 2018). To address this, the concept of theoretical and design transferability is proposed, emphasizing principles that can be meaningfully integrated elsewhere (Van den Akker et al., 2006), even while acknowledging that the theories generated are not universal (Warr et al., 2020).

In terms of validity and reliability, DBR departs from conventional research paradigms. Rather than aiming for causal proof, it emphasizes thorough and transparent documentation of design decisions, using multiple sources and methods (Cobb et al., 2003). It seeks to bridge the gap between methodological consistency and the inherent complexity of educational reality through a robust, multifaceted approach (Design-Based Research Collective, 2003). Methodological plurality and triangulation act as safeguards for reliability, although the interpretation of findings remains inherently complex.

Finally, the existing literature outlines various process models that lead to different outcomes regarding generalizability (Easterday et al., 2022; McKenney & Reeves, 2014; Wozniak, 2015). The dual objective of DBR—to generate both practical solutions and scientific knowledge—raises challenges related to the factors that influence the transferability of findings (Oppl et al., 2022). The intense focus on design may also prompt questions about the legitimacy of the research process itself (Edelson, 2002), while the absence of shared standards and models may contribute to DBR not yet being fully established as a standard practice in educational research (Oppl et al., 2022). These challenges resonate particularly in the context of music education, as the field is characterized by diverse pedagogical settings, embodied learning experiences, and strong cultural dimensions. The complexity and subjectivity inherent in musical learning environments intensify the need for thoughtful negotiation of validity, transferability, and collaborative roles in DBR. Nevertheless, when appropriately contextualized, DBR offers a powerful lens through which to understand and improve music teaching and learning in authentic, creative, and responsive ways.

### ***Applying Design-Based Research in Music Education***

DBR emerges as a fertile approach in music education, aligning with the nature of music teaching and learning while offering a dynamic tool for educational inquiry (Angel-Alvarado et al., 2017). Its flexibility allows for implementation in both formal environments, such as schools or conservatories, and informal ones, including community music, lifelong learning, educational programs, and teacher training. This opens new perspectives for a holistic and interdisciplinary approach to music learning that bridges theory and practice. In conjunction with the relevant DBR literature, specific key dimensions emerge in applying this framework to music education, which researchers are advised to consider. Specifically DBR:

- formulates research questions grounded in music practice, beginning with real issues arising from educational experience and focusing on dimensions of music education that are often overlooked or marginalized,
- is guided by music-pedagogical design, placing design at the core of the research and continuously redefined through field-based feedback. In this context, conjecture maps are used to link theoretical assumptions, design decisions, and expected learning outcomes (Sandoval, 2014).
- provides a clear line of reasoning so that findings are reasonable and verifiable, ensuring validity and reliability, particularly in the presence of intense subjectivity and empirical complexity,
- develops within authentic music-pedagogical environments, where music learning is approached as a living, social, and cultural process,
- explores issues and challenges related to educational innovation, investigating the effectiveness of practices such as the use of digital technologies, the maker movement, improvised tools, and informal approaches to composition or improvisation,
- incorporates multiple cycles of design, testing, and revision, enriching, modifying, or redesigning the initial music interventions by students' experiences and attitudes as well as teachers' observations,
- recognizes collaboration among researchers, designers, and educators as critical, considering all stakeholders as co-researchers and co-creators,
- aims to develop a theory to understand the processes underlying music learning, identifying recurring patterns, connections, and relationships,
- generates materials, theories, scenarios, and other outputs to be utilized by the educational community, thus enhancing knowledge dissemination,
- prioritizes the combination of qualitative and quantitative methodological approaches, acknowledging that music learning involves both internal experiences and external data,
- creates conditions conducive to learning by designing environments that foster creativity, collaboration, and student autonomy in musical practice,
- Develops tested solutions with realistic added value, grounded in real needs, applied, evaluated, and redesigned in authentic contexts, aiming at the long-term improvement of music education.

In conclusion, the use of DBR in music education is not merely an alternative methodological option, but rather a dynamic, creative, and reflective research stance. Connecting theory with practice, it provides opportunities for meaningful engagement with complex challenges in music education, seeking to shape innovative practices that respond to the actual needs of learners and educators. Through this process, learning, creativity, and research coexist and mutually inform one another, blurring the boundaries between them.

### ***Examples of Design-Based Research in Music Education***

As previously mentioned, the use of DBR as a research methodology in music education remains limited. This may be because DBR originates primarily from the pedagogy of the natural sciences, where methodological approaches follow different aims. However, in recent years, emerging applications suggest that DBR is gaining momentum in various music learning contexts, from digital technology integration to community-based music initiatives.

In the field of music technology, DBR has been employed to develop effective forms of on-demand learning. The doctoral study by Voss (2018) focused on developing design principles for educational resources that support novice students in popular music production—a field often characterized by

informal, self-directed learning through online tutorials. Involving 125 students and eight instructors, the study highlighted the challenges of navigating complex software and equipment. Through iterative testing cycles, a set of design principles emerged that guided the development of flexible, accessible, and immediately applicable instructional resource materials.

Regarding the application of DBR to the development of online music learning environments, a notable example is the study by Supriatna et al. (2024), which focused on creating an online platform for learning the Indonesian gamelan ensemble. Through continuous cycles of collaboration with students and instructors, the research team developed a remote-use simulation of the gamelan, culminating in a conceptual design that functions as both an educational tool and a theoretical framework model.

In the Greek context, the study by Koutelidaki and Mouzakis (2022) focused on the design, development, and evaluation of instructional materials for distance music education in primary schools. The intervention was implemented within the Chamilo platform and was designed by the principles of distance learning, specifically tailored to the subject of music. The research process was structured into three phases: needs analysis, digital course development, and evaluation, which utilized a combination of qualitative and quantitative methods.

Another characteristic example of DBR implementation is the educational tool Groove Pizza, designed by the Music Experience Design Lab at NYU. This tool teaches rhythm using geometric patterns. The designers based their development on iterative cycles of design, implementation, and feedback, collaborating with teachers and students in classroom settings to generate theoretical insights into the connections between music, technology, and learning (Hein & Srinivasan, 2019).

Two pivotal applications of DBR by Angel-Alvarado and colleagues (2017, 2018) focus on developing theoretical models of teaching and learning that incorporate design-based reasoning (DBR). The first study analyzes the application of didactical engineering to music education, proposing a model for examining the instructional triangle—comprising teacher, student, and content—through continuous feedback loops (Angel-Alvarado et al., 2017). In the second study, the researchers propose a holistic architecture for music education, structured into four phases—preliminary study, prospective analysis, field implementation, and retrospective analysis—to systematically explore the relationship between theory and practice (Angel-Alvarado et al, 2018).

An essential application of DBR in music education arises from the field of maker education. As proposed by Treß (2024), the concept of maker music education utilizes DBR to reconceptualize music learning as a post-digital, participatory, and experiential process, positioning the music classroom as a space of freedom, experimentation, and sustainable innovation. Through iterative research and design cycles, the author developed seven key design principles for maker music education: project-based learning, interdisciplinarity, ecological awareness, learner-centeredness, creativity, collaboration, and accessibility.

Another compelling DBR example stems from the realm of community music. Cooper (2017) used DBR to investigate and support choral conducting in Australia, based on the premise that choral conducting skills are primarily acquired through experiential learning and informal practice. Throughout a three-year study, she consciously adopted a dual role as both researcher and trainee conductor, developing a learning model grounded in community music practices (Cooper, 2017).

Finally, Charalambidou's (2024) study applied DBR methodology with pre-service early childhood educators who lacked musical confidence. Through the Strategic Informal Approach, which combined experiential activities, collaborative learning, and reflection, the study demonstrated the gradual empowerment of participants and the transformation of their beliefs about music teaching and learning.

The findings highlighted how a flexible, experience-based music education model can cultivate musical and pedagogical skills in future educators in environments of acceptance and creativity.

These diverse examples demonstrate that DBR holds significant potential for advancing music pedagogy across formal and informal settings. By grounding research in authentic classroom experiences and iteratively refining interventions, DBR fosters the development of context-sensitive, theory-informed practices that respond dynamically to the unique challenges of music education.

## **Discussion**

The findings of this literature study support the growing literature that positions DBR as a robust methodological approach for addressing the complexity of real-world educational contexts. In music education—an area characterized by embodied learning, expressive meaning-making, and collaborative creativity—DBR offers a valuable lens for enacting and analyzing pedagogical innovation (Barab & Squire, 2016; McKenney & Reeves, 2018). This study reaffirms that DBR is grounded in constructivist and sociocultural perspectives, placing the learner at the center of iterative, authentic experiences (Cobb et al., 2003). The emphasis on continuous design cycles—through planning, enactment, feedback, and redesign—supports the development of educational interventions that are both context-sensitive and theoretically informed. Moreover, the theoretical foundations of DBR resonate strongly with the principles of practical music teaching and learning.

The examples discussed in this study demonstrate how DBR fosters innovation and theory-building in music education. From Groove Pizza (Hein & Srinivasan, 2019), which visualizes rhythm through interactive design, to Charalambidou's (2024) application of DBR in preservice teacher education, the methodology has supported the creation of tools and environments that respond to specific pedagogical challenges. These cases align with Barab's (2022) view that DBR facilitates the negotiation between local constraints and broader theoretical aims, enabling researchers to reframe design problems in response to real-time feedback. Additionally, the study identifies recurring design principles—authenticity, flexibility, learner agency, and interdisciplinary collaboration—that are especially salient in music educational contexts. Such principles emerge through iterative processes rather than prescriptive models, allowing teachers and researchers to act as co-designers of meaningful learning environments (Anderson & Shattuck, 2012; Edelson, 2002). Integrating these principles into teaching practice reflects the value of DBR as a method for simultaneously addressing instructional design, educational theory, and reflective practice inquiry.

An essential contribution of this study is the clarification of DBR's potential to support the development of methodological tools tailored to music education. Unlike more rigid experimental designs, DBR accommodates the embodied, affective, and performative aspects of music learning, allowing researchers to explore how musical understanding develops through tools, tasks, and social interaction (Papert, 1980; Resnick, 2017). This reflects a broader epistemological shift from standardized knowledge production toward context-rich, negotiated knowledge construction (Confrey & Lachance, 2016; Sandoval, 2014).

When comparing DBR to other qualitative methods, such as action research and ethnography, the hybrid nature of the approach becomes clear. While action research emphasizes practitioner-led inquiry, DBR builds on this by incorporating explicit design logic and theory-generation (Cernusca & Ionas, 2014; McKenney & Reeves, 2013). Its focus on scalability and theoretical transferability sets it apart, enabling applications beyond isolated case studies and supporting generalizable design principles (Cobb et al., 2003; Reeves, 2006).

Despite its promise, the current analysis also reveals the limited uptake of DBR within music education. Most applications remain isolated or pilot-scale, suggesting a need for larger, multi-phase studies that explore how DBR can inform systemic change in curriculum design, assessment, and professional development. The field would also benefit from further exploration of DBR's role in interdisciplinary initiatives such as STEAM education, the maker movement, and inclusive pedagogies (Angel-Alvarado et al., 2018; Treß, 2024). Another essential insight concerns DBR's transformative potential to reposition educators as design researchers. Music teachers, often operating within rigid curricular frameworks, are empowered to challenge these constraints through DBR's iterative experimentation. This aligns with Dewey's (1916) vision of education as inquiry and Resnick's (2017) call for more creative, learner-centered educational ecosystems. Through the lens of DBR, music classrooms become sites of both learning and research, where innovation is not externally imposed but collaboratively constructed.

In summary, this discussion highlights how DBR supports both the improvement of music education practice and the advancement of music-pedagogical research. By embedding theoretical inquiry within real-world experimentation, DBR empowers educators and researchers to co-construct knowledge, adapt to emerging needs, and develop practices that are both pedagogically sound and deeply responsive to learners. Its application in music education represents not just a methodological choice but a shift toward inquiry-based, design-driven approaches that honor the complexity and transformative potential of music learning.

## **Conclusion**

In conclusion, DBR is not merely another methodological proposal; rather, it is a meta-methodological, eclectic research approach grounded in design, practice, and continuous feedback (Barab, 2022). It does not aim to produce abstract generalizations but emphasizes the development of theories and applications that are tested and refined within authentic environments. The outcomes resemble puzzle pieces that, through cycles of observation, redesign, and reflection, gradually form a dynamic and multifaceted body of knowledge (Confrey & Lachance, 2016).

This study offers a focused contribution to the methodological discourse in music pedagogy by positioning DBR not merely as a general educational approach but as a framework particularly well-suited to the complex, performative, and context-sensitive nature of music learning. Mapping theoretical constructs onto specific pedagogical realities in music education suggests how DBR can inform the creation of research-informed practices that honor the fluid interplay between design, action, and reflection. In doing so, it enhances the visibility of DBR within music-pedagogical inquiry and provides a structured yet flexible model for its integration into formal and informal educational contexts. The goal of DBR is not to generate theoretical "proposals on paper" but to develop tested solutions that emerge through the continuous engagement of educators and learners. It creates conditions under which learning can occur in observable, analyzable ways, and is subject to improvement. These solutions offer genuine added value, as they reflect the authentic needs of educational practice and often contribute to the enrichment of pedagogical theory, highlighting the productive interplay between theory and experience (Anderson & Shattuck, 2012). The emerging theories are not static but are subject to ongoing negotiation and adjustment, responding to the complexity and variability of educational contexts. Thus, DBR is not simply an alternative methodological option but a systematic and organic approach to studying education, where theory, design, and practice are viewed as interconnected and mutually reinforcing domains (Cobb et al, 2003).

Although the application of DBR in music education remains limited, recent years have seen the emergence of a stable and evolving research trend. The nature of music provides fertile ground for

implementing DBR processes and environments in the development of innovative music pedagogical practices. Through a meaningful connection between theory and practice, music educators can act as researchers, project managers, designers, theorists, and teachers, responding to the demands of the dynamic, creative, and often unpredictable music classroom environment. In a field like music education, where cultural, aesthetic, and emotional dimensions are constantly intertwined, DBR opens new possibilities for targeted, sustainable, and transformative educational innovation. We hope that this article contributes to the systematic clarification of the roles and functions of DBR within the field of music education, serving as a starting point for new pathways in music pedagogy research.

### ***Suggestions for Future Research***

Future research in music education could expand upon the present study by exploring how DBR can systematically support the design, implementation, and refinement of pedagogical models rooted in authentic musical practices. A key area for further investigation involves using DBR to develop learning environments that promote students' creative agency through composition, improvisation, and collaborative performance. Often marginalized in traditional curricula, these domains could be reframed through iterative cycles that respond to learners' musical identities, experiences, and cultural background contexts.

Additionally, DBR can offer a robust framework for examining how multimodal, embodied, and technology-enhanced strategies impact the teaching of rhythm, melody, harmony, and musical form. Research could concentrate on how learning environments are co-constructed by students, teachers, tools, and repertoires, revealing the dynamic nature of classroom ecologies. The integration of emerging technologies (e.g., digital instruments, notation software, augmented reality) could be examined in the development of students' cognitive and expressive capabilities.

Teacher education is another promising field for future DBR studies. Investigating how pre-service and in-service music educators engage with iterative design processes may illuminate effective strategies for fostering reflective practice, sustained innovation, and adaptive teaching across educational levels. Finally, cross-contextual comparative research—including studies in formal schooling, community-based initiatives, and informal learning environments—could contribute to articulating transferable design principles for inclusive, culturally responsive, and student-centered music pedagogy.

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