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Exploring the Interdisciplinary Relationship between Music and Language for Enhanced Bilingual Curriculum

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ABSTRACT
Developing an interdisciplinary approach is a paramount concern for educators and researchers in the field of education, given its proven effectiveness in enhancing cognitive comprehension and practical knowledge application. This study examines the pivotal role of music as a potential medium that possesses traits akin to language, serving as a conduit for expressing thoughts and emotions. Emphasizing the significance of music education, this study delves into its profound impact on fostering linguistic abilities. Through a comprehensive review of 32 studies, this study explores the dynamic interplay between music and language. It examines the development of musical properties and inherent characteristics of music competency, catering to diverse intelligences within the framework of linguistic growth. The findings obtained from the specified studies illustrate the manifold benefits of music in enhancing specific aspects of linguistic abilities, underscoring its positive impact on language education. This study provides valuable recommendations for music/language educators and bilingual instructors. It also identifies potential areas of focus, thereby establishing the foundation for future inquiries within this interdisciplinary field.

KEYWORDS
Interdisciplinary approach; music competency; linguistic ability; bilingual instruction; cross-domain curricular design.

INTRODUCTION

Developing interdisciplinary integration skills is a concern for teachers and educational researchers in the artificial intelligence (AI) era. Rapid changes in information may compress traditional school curricula, providing students with more time for autonomous learning. The emphasis on knowledge that can be practically applied in life and future work necessitates strong language skills, especially in light of the current fervent promotion of bilingual education in Taiwan. This initiative aims to cultivate individuals capable of effective global communication and possessing international literacy. Music, as a powerful medium, encompasses a multitude of attributes that are crucial in fostering the advancement of language skills. The integration of musical elements across curricula assumes a vital role as a synergistic amalgamation of diverse influences, skillfully harmonizing interrelated and overlapping components, including time, pitch, timbre, and process (Pallonetto et al., 2022).

One vital capacity emphasized by Taiwan's 12-Year Basic Education system's general curricular guidelines is the integration of competencies into real-life scenarios. However, interdisciplinary teaching approaches pose a challenge for school instructors accustomed to teaching one discipline at a time. They argue that it is not feasible for students to master different subjects simultaneously ("Competence-based," 2019). Even though more educators and practitioners are increasingly aware of the importance of the connection between disciplines, there is a clear disparity between theoretical knowledge and the formulation of an effective teaching strategy. It appears that the interdisciplinary instruction of music and language is not entirely novel, and there is sufficient evidence to support the notion that music holds great potential in advancing linguistic capacities. Yet, there is limited literature providing a practical bridge for music or language instructors to implement in an actual course. What are the advantages stemming from the correlation between language and music? How does musicianship contribute to facilitating the implementation of a bilingual classroom mode?

Existing literature reviews on the role of music in language learning have primarily focused on neuroscientific perspectives (Neves et al., 2022) and physiological connections between these two domains (Temperley, 2022). Temperley (2022) and Neves et al. (2022) have made significant contributions to the field by examining the impact of music training on language-related skills and brain function and structure, respectively. However, there has been a limited investigation into the correlation between music as a medium and a platform for crafting bilingual curricula. As such, the main aim of this study is to thoroughly synthesize the intricate relationship between musical elements and language development, encompassing all aspects of language acquisition, including listening, speaking, and reading skills. This will be achieved by examining pertinent literature from the past two decades. The overarching goal is to address the pressing needs of teaching and learning in bilingual education contexts, with a specific focus on exploring the potential of music as a medium.

METHODS

The review process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009) for conducting systematic reviews. The studies, sourced from reputable scientific journals, were selected using electronic databases from Scopus, Web of Science, and EBSCOhost. Given the diverse literature on music and English language learning, the primary focus was to examine the interrelationship between these two domains through a literature search on the impact of music on English language learning. This approach aimed to ensure a more comprehensive inclusion of potential articles that directly or indirectly addressed this subject.

The descriptors used included combinations of music and English, musical proficiency, and language skills. Initially, the filtering criteria were language-specific, focusing exclusively on English, with no restrictions on the search timeframe. However, it became evident that a substantial number of publications primarily concentrated on English language research, with limited relevance to the field of music. Consequently, the focus shifted to encompass language acquisition across all languages, beyond the confines of English, while considering research conducted after 2000, when interdisciplinary learning began to gain increasing attention (Ivanitskaya et al., 2002; Kaittani et al., 2017).

Selection of Studies

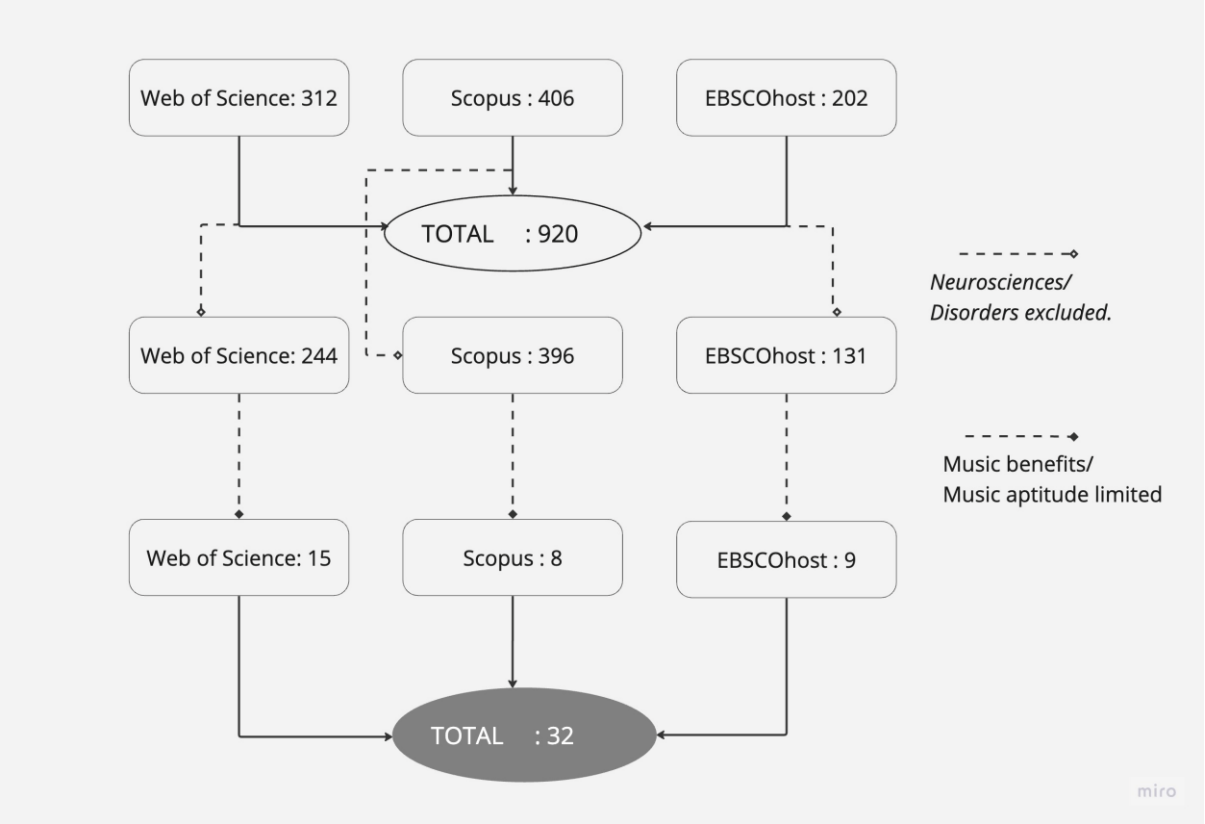
Three primary criteria were established to facilitate the selection of relevant literature. First, the articles examined the overall correlation between music learning and language performance. Second, study samples were excluded if they solely focused on neuroscience or addressed issues related to disorders without considering the interplay between music and language. Third, particular emphasis was given to exploring the language development benefits derived from music.

In the initial phase of the literature search concerning the impact of music on language acquisition, the dataset encompassed 920 papers. These studies subsequently underwent a meticulous evaluation and elimination process, as depicted in Figure 1. Out of the initial 920 studies, only 32 were ultimately selected for in-depth analysis, as shown in Table 1. To achieve a comprehensive examination of the role of music in language learning, with a particular emphasis on its deliberate use as a pedagogical instrument and the exploration of the underlying associations and mechanisms between music and language, we initially classified the research articles into two distinct sections: (a) intervention studies and (b) investigative studies. The latter category was subsequently subdivided into studies that explored topics related to music education and its role in enhancing language acquisition, as well as those that examined (c) its influence on various facets of language proficiency. Furthermore, research dealing directly with (d) instrumental training, singing, or music learning embedded in digital devices/applications for language ability development was taken into consideration. Additionally, (e) the perspectives of neuroscience on music and their influence on language abilities were examined, as well as how these developments impact individuals with (f) auditory-

involved disorders or learning disabilities. Lastly, engagement in music activities (g) within specific sociocultural contexts has the potential to facilitate language acquisition.

Figure 1.

Flowchart for the Study Selection Process



RESULTS

The findings of the analysis of the selected studies are presented based on their respective field of study and the research methodology employed (Table 1).

Table 1.

Taxonomy of Selected Studies for Comprehensive Exploration of Music's Role in Language Development (see Appendix)

Effects of Singing or Playing Instruments on Language Abilities

The 10 selected articles explored the power of singing and playing an instrument on language acquisition. Two studies (MacDonald, 2022; Reynolds & Burton, 2017) suggested that singing during infancy positively impacts language development. The potential benefits of musical interactions, in the form of early-years singing, can stimulate cognitive and non-cognitive processes related to language learning. The non-cognitive benefits include manipulating objects, improvising, creating, or writing various forms of notation to preserve musical ideas (Reynolds & Burton, 2017). Shared singing activities have significant potential to facilitate the development of linguistic skills among young children, both in their first language and when

acquiring additional languages (MacDonald, 2022).

In addition to using singing as a pedagogical tool for acquiring new vocabulary (Toscano-Fuentes & Fonseca Mora, 2012), research in the field of language acquisition investigates the correlation between singing proficiency and language competence by utilizing phonetic aptitude assessments to measure the ability to articulate unfamiliar foreign languages or replicate foreign accents. Coumel et al. (2023) suggested that high musical abilities contribute to higher proficiency in L2 pronunciation, while Christiner et al. (2022) reported a correlation between singing ability and the ability to link Mandarin syllable tones. Singing ability is particularly associated with the ability to mimic foreign accents and pronounce foreign words and longer sequences of phrases. It is suggested that singing can be a useful tool to improve the ability to learn new words. Furthermore, for individuals diagnosed with dyslexia, an auditory and sensory processing deficit, singing training tends to help address reading obstacles, and the rhythm, melody, and intonation involved in singing contribute to improved reading fluency (Christiner et al., 2022). Similarly, the integration of digitized music as an instructional tool has been shown to be beneficial in enhancing language acquisition and proficiency.

Sundberg and Cardoso (2019) confirmed the functionalities of the Bande à Part app, which allows users to access a curated selection of songs and engage in an interactive video experience. The app incorporates specific enhancements that emphasize French language characteristics, including gender and phonological phenomena, to promote language awareness and enhance comprehension of the lyrics. Furthermore, the app explores the impact of music on the process of second language (L2) acquisition and serves as a practical example of the successful integration of theoretical principles into instructional technologies. However, Sarı et al. (2019) reported that the inclusion of music and sound effects in digital books did not significantly affect story comprehension among kindergarteners aged 4 to 6. They observed that the presence of such audio elements had a negative effect on young children's receptive vocabulary skills.

Moreover, instrumental learning enhances the control of voice imitation and intonation. According to Forgeard et al. (2008), children who underwent a minimum of three years of instrumental training displayed superior performance compared to their control counterparts in both music-related domains and other areas, such as vocabulary and nonverbal reasoning skills. Turker et al.'s (2021) claimed that proficiency in playing musical instruments or singing, which involves mastering the expression and control of sound, contributes to language learners' ability to imitate and acquire new phonetic and intonation patterns. Maria Toscano-Fuente and Fonseca Mora (2012) provided a comprehensive overview of the potential benefits of learning an instrument for language development. They highlighted fine motor skills, emotional expression, motivation, engagement, cognitive benefits, phonological awareness, and listening skills as specific areas that can be positively affected by instrumental learning.

The Relationship between Music and Language from the Neuroscientific Perspective

From the perspective of neuroscience, six selected papers employed a quantitative

methodology to support the correlation between musical aptitude and language development. The neurological associations can be delineated into four dimensions. First, music training confers advantages across multiple facets of speech and language comprehension, encompassing sound recognition, syllabic analysis, lexical segmentation, and prosodic boundary recognition. Music training can improve implicit learning of both musical and linguistic structures, enhance phoneme processing abilities, and facilitate language segmentation (Forgeard et al., 2008; Schön & Tillmann, 2015). Second, reading disabilities are associated with deficits in auditory and sensory processing, which simultaneously affect the development of music and language abilities (Christiner et al., 2022; Vaquero et al., 2020). Additionally, Forgeard et al. (2008) and Picciotti et al. (2018) noted that musical and linguistic abilities involve similar cognitive and neural processes. Individuals with musical training or singing ability perform better in aspects such as language pronunciation, imitation of foreign accents, and learning new words. In a sense, the effects of music and language alter brain structures associated with the auditory-motor pathway, particularly regions involved in auditory recognition and motor control (Forgeard et al., 2008; Vaquero et al., 2020). Last, Hannon and Trainor (2007) also suggested that formal musical training has an impact on the significance of musical input and the cortical regions involved in processing music, which, in turn, creates an environment that fosters attention and executive functioning, thereby promoting language learning. Overall, the acquisition of musical skills and language proficiency involves similar neural processes and brain structures, shedding light on their shared cognitive mechanisms and impact on learning.

Music's Benefits for Disabilities of Language Development

The three selected studies within this category investigated the rehabilitative relationship between music and language, aiming to explore the potential benefits of music interventions for individuals with language disabilities or impairments. These three studies suggested that musical input practice has a positive impact on various aspects of language rehabilitation, language acquisition, and language perception. Schön and Tillmann (2015) argued that external rhythmic auditory stimulation, such as musical rhythm, can affect temporal attention and subsequently benefit language processing. Basic timekeeping skills can be developed through musical training, especially during critical literacy development years (Aral et al., 2022; Slater et al., 2014; van Vuuren, 2022).

Interventions involving rhythm or musical activities have the potential to enhance temporal attention, rhythmic aptitude, and foundational timekeeping capabilities, leading to improvements in language processing, reading proficiency, and the fundamental skills that support learning and literacy. Moreover, in the study by Looi et al. (2018), cognitive and neural mechanisms play a role in the observed enhancements of language perception and auditory skills in children with cochlear implants. Schön and Tillmann (2015) also argued that processes such as spectrotemporal analysis, phonological awareness, implicit learning, syllabic processing, and speech segmentation affect these mechanisms and enhance language rehabilitation. All three studies confirmed that engagement with music, even in individuals with cochlear

implants, can enhance language skills, including word-finding, rhyming, perception of speech in background noise, and performance in language tasks.

Music's Benefits to Language Development from the Sociocultural Angle

The six selected research studies concurred in considering the sociocultural component of music engagement as integral to language capacity. Reynolds and Burton (2017) claimd that early music training positively impacts language development by providing opportunities for children to engage in music-based interactions that stimulate cognitive and noncognitive processes related to language learning. Although Schön and Tillmann (2015) did not explicitly discuss the sociocultural angle, they presented evidence that more realistic music-based activities, which involve emotional and social aspects in addition to basic musical features, have the potential to benefit phonological and reading abilities through music training. Similarly, Maria Toscano-Fuentes and Fonseca Mora (2012) stated that the use of music in language learning can enhance cultural awareness and literacy, fostering a deeper understanding of the target language and its associated cultural context.

Hannon and Trainor (2007) proposed that the characteristic rhythms and pitch structures of spoken languages can be observed in the musical rhythms and pitch structures of the corresponding culture. Infants, for instance, are sensitive to basic universal features of music, such as consonance and metrical interpretation based on movement, which provide the scaffolding for building complex, culturally unique musical systems. De Quadros and Vu (2017) conducted a comprehensive analysis of the inclusion of refugees in Swedish choirs and musical groups, highlighting the positive impact of music in fostering intercultural understanding and welcoming new arrivals. Their study emphasized the significance of these choral initiatives as acts of goodwill, showcasing the power of music in bridging cultural gaps. In contrast, Wojtkowska & Łopatka-Koneczny (2019) examined the integration of art and popular culture in Polish language education. While they didn't specifically address the benefits of music in language development, they emphasized the importance of incorporating artistic expression and cultural contexts into language learning. Collectively, these studies highlighted the various ways in which music and cultural engagement contribute to inclusive practices and enrich language education.

Correlation between Musicianship and Language Competencies

The study findings emphasize the significant influence of musicianship on both language learning and bilingual education. The evidence suggests that active involvement in music can enhance various aspects of language acquisition, including listening, oral proficiency, and reading skills. However, it also highlights potential challenges and areas that need attention when effectively incorporating musicianship into language learning strategies.

Language Listening

Music aids in the development of language comprehension. When listening to rhythmic patterns in speech or music, individuals may better understand and process the linguistic content, leading to improved comprehension of spoken language. Additionally, rhythm aids in

the encoding and memory of language structure, especially for complex sequences.

The rhythmic patterns in music can assist in encoding the structure of spoken language, particularly complex sequences and grammatical arrangements. Moreover, melody helps with language comprehension. It enables a better understanding of the nuances, emotions, emphasis, and intentions conveyed by varying melodic patterns and intonation, ultimately leading to an improved understanding of the communicated message. Hence, engaging with music stimulates memory processes related to recognizing and recalling melodies and rhythmic patterns. This heightened melodic and rhythmic memory can have a positive impact on the ability to remember and understand spoken language, especially in melodic languages where pitch and rhythm play significant roles in conveying meaning. Moreover, instrument training sharpens auditory perception and attention to sound details. This increased sensitivity to sounds can transfer to language listening, allowing learners to better perceive and understand speech sounds, intonation, and rhythm in the target language. Likewise, singing enhances phoneme discrimination abilities, which aid in perceiving and distinguishing speech sounds in the target language. Individuals are required to produce different phonemes accurately through singing, enabling them to better recognize and differentiate speech sounds in spoken language. Also, the presence of music and sound effects in electronic storybooks may potentially disrupt children's vocabulary learning process (Chung, 2020; Kim & Jia, 2020; Pontier et al., 2020). These auditory distractions may divert attention away from the target vocabulary, hindering effective vocabulary acquisition.

Language Speaking

Rhythm training affects language processing and phonemic awareness. Engaging in rhythm-based activities or training can enhance a person's ability to distinguish individual phonemes, which is crucial for language production and phonological awareness. The rhythmic patterns in music may enhance speech rhythm and pacing, leading to more fluent and natural verbal communication. Furthermore, by practicing accurate vowel pronunciation and neutralizing accents while singing, language learners can enhance their overall speaking proficiency and achieve clearer and more intelligible communication in the target language. Mastering vowel pronunciation and reducing local accents are critical aspects of language speaking proficiency. Additionally, music performance skills enhance oral expression fluency, particularly when learning musical instruments during childhood. This may foster improved oral expression and nonverbal reasoning abilities, which can have a positive impact on overall language development. Thus, engaging in music performance can enhance oral expression fluency, as musicians develop a sense of rhythm and timing that transfers to their spoken language abilities.

Language Reading

Rhythmic ability correlates with reading proficiency. Individuals with a heightened sense of rhythm may demonstrate improved reading skills due to the rhythmic patterns and cadences often found in written language. Similarly, melodic memory or cues assist in establishing connections between ideas, identifying key points, and following the flow of the narrative or

information. The process of learning musical notation can contribute to improved memory for vocabulary, phrases, and sentence structures. This memory enhancement extends to language reading, enabling learners to retain and recall information from written texts more effectively. Additionally, when language learners acquire prosodic features of the target language, transferring this awareness to reading enhances their ability to comprehend written texts more naturally and fluidly. Learning to play musical instruments correlates with enhanced oral expression and nonverbal reasoning skills, particularly during childhood. Similarly, adult musical abilities impact reading proficiency. Proficiency in music is associated with enhanced reading skills, suggesting that individuals with advanced musical abilities may also excel in language reading comprehension and fluency.

CONCLUSION AND DISCUSSION

The interdisciplinary exploration of the music-language relationship reveals the profound impact of musicianship on language learning and bilingual education. Music serves as a potent conduit, sharing characteristics with language, and fosters linguistic abilities across listening, speaking, and reading. This comprehensive review of 32 studies highlights the manifold advantages of engaging with music in enhancing specific aspects of language acquisition.

Language listening reaps benefits from music's rhythmic and melodic elements, facilitating the encoding of spoken language structures and bolstering comprehension. Instrument training refines auditory perception, sound detail attentiveness, and phoneme discrimination, thereby enriching language listening experiences. However, potential challenges arise with the use of music and sound effects in electronic storybooks, necessitating meticulous selection and control. In language speaking, rhythm training enhances phonemic awareness, speech rhythm, and pacing, resulting in more fluent verbal communication. Furthermore, singing exercises improve vowel pronunciation, reduce accents, and enhance oral expression fluency. Additionally, music performance skills positively impact oral expression and nonverbal reasoning, fostering comprehensive language development. Concerning language reading, a heightened sense of rhythm correlates with improved reading proficiency, and melodic memory assists in establishing connections between ideas while also facilitating vocabulary and sentence structure recall. Integrating musical notation exercises enhances learners' reading comprehension and written information retention.

Suggestions for Bilingual Instruction

Based on four main categories from the bilingual course assessment (Kao & Tsou, 2017), the following recommendations leverage the interplay between music and language to guide future educators in enhancing bilingual instruction across various subjects.

Class Design

a. Interdisciplinary Projects: Develop cross-curricular projects that integrate music and bilingual elements. For example, in social science classes, students can create bilingual presentations on historical events, incorporating music and cultural elements to enhance understanding.

b. Music-Infused Lessons for Target Language Proficiency: In the curriculum design for bilingual instruction across various subjects, music can be effectively employed as a tool to practice key concept-specific vocabulary and sentence patterns in the target language.

Lecture Delivery

a. Rhythm and Timing in Math: In math classes, incorporate rhythmic elements and musical cues to reinforce mathematical concepts. Use music to help students understand mathematical patterns and sequences.

b. Multimodal Learning in Varied Subjects: Use a multimodal approach, combining visuals, interactive elements, and music to reinforce scientific concepts. Music can serve as an auditory aid, enhancing students' engagement and comprehension. Creating supplementary music materials in the target language facilitates the proficient attainment of the curriculum's learning concepts.

Class Interaction

a. Music-Based Role Play: Employ music as a backdrop for role-play activities and dramatic performances in different subjects. For example, in history classes, students can reenact historical events with music as background accompaniment.

b. Collaborative Music Projects: Promote collaborative music initiatives in multidisciplinary group activities. In this approach, educators can assign specific themes or topics that encourage students to collaboratively employ their musical skills to create bilingual songs or presentations related to the academic subject matter.

Multimodality and Translanguaging

a. Sensory Experiences via Music: Through the integration of music as sensory stimuli, students acquire the capacity to access subject-specific content in a bilingual curriculum. For instance, the study conducted by An and Tillman (2013), which explored an interdisciplinary curriculum integrating music and mathematics, illustrates that addressing mathematical story questions or investigating mathematical properties can effectively engage learners through immersive musical instrument activities.

b. Music-Infused Translanguaging: By employing musical elements as a medium for translanguaging, educators can create a dynamic and immersive setting within a bilingual curriculum. As an illustration, consider Team Hyena Puppet, which aspires to make science learning enjoyable, stimulating, and distinctive through the advocacy of Wiline Pangle, a biologist. They collaborated with musicians and dancers to depict the ecological evolution of Michigan's sand dunes (Trommer-Beardslee et al., 2019). This instructional approach facilitates students in fluidly transitioning between languages while actively participating in the subject matter through the medium of music. Furthermore, it nurtures an immersive learning environment that amplifies students' focus and comprehension of new information.

Intelligibility and Comprehensibility

a. Integrating Rhythmic Patterns: The integration of rhythmic patterns into language instruction enhances learners' capacity to internalize the structure of spoken language. This

method aids in enhancing comprehension and memory retention of complex linguistic sequences and grammatical arrangements.

b. Emphasizing Melodic Nuances: Prioritizing the study of melodic elements assists students in capturing the subtle nuances, emotions, and intentions expressed in spoken language. This increased melodic awareness has a positive effect on their ability to recall and comprehend spoken language, particularly in melodic languages.

c. Cross-Cultural Exploration: To enhance cross-cultural comprehension, encourage students to delve into the cultures of countries where the target language is spoken using music as a medium. Encourage discussions and the expression of their findings in both the target language and their native language(s), thereby fostering a deeper understanding of cross-cultural perspectives.

By adhering to these guidelines, educators can unleash the full potential of integrating musicianship into bilingual instruction, resulting in the establishment of a captivating, immersive, and exceptionally effective learning environment. Music, as a versatile resource, enriches the quality of teaching and learning experiences, concurrently enhancing various language skills within the framework of bilingual education.

Discussion

This study stands out from recent investigations into the interaction between music and language in several notable ways. First, it embraces a comprehensive approach, thoroughly exploring the interdisciplinary connection between music and language. While Temperley (2022) uncovered insights into the impact of musical training on language-related skills and the rhythm variations among different languages, this study provides an extensive examination of the distinct benefits of music in enhancing various facets of language acquisition, including listening, speaking, and reading proficiencies.

Second, it further incorporates insights from the field of neuroscience to unveil the neurological mechanisms that underpin the connection between music and language. In contrast to the recent neuroscientific study by Neves et al. (2022), which offered a narrative synthesis of neuroscientific studies highlighting the effects of music training on brain function and structure. Although the authors may possess limited expertise in neuroscience, they acknowledge potential limitations in making well-informed recommendations for future research or practical applications based on the neuroscientific findings. However, this review does provide a synthesis of prior relevant neuroscientific studies that concentrate on the neural connections between specific elements of music and language, such as sound recognition, syllabic analysis, lexical segmentation, and prosodic boundary recognition.

Third, this study places a notable emphasis on the significance of musicianship in the context of language learning and bilingual education, emphasizing the profound influence of music on linguistic abilities. Degrave (2019) discussed various methods, including the use of music without lyrics, songs, and rhythmical activities. The potential advantages of incorporating music into language acquisition are also scrutinized in this study, encompassing enhanced

motivation, attention, and linguistic skills. Nevertheless, the findings did not establish a causal relationship between the use of music and improvements in language skills. In contrast, Temperley (2022) delved into the resemblances and interplay between music and language, examining aspects like the correlation between musical rhythm and linguistic stress, as well as the utilization of repetition in both music and language. In contrast to the recent studies mentioned earlier, this study places additional emphasis on how active engagement with music can enhance different dimensions of language acquisition, encompassing listening, speaking, and reading proficiencies. Furthermore, it delves into the potential challenges and areas that demand attention when integrating musicianship effectively into language learning strategies.

Nonetheless, it's worth noting that this study primarily draws from existing research and does not include original empirical investigations, which might limit the scope of the analysis and introduce potential biases. As such, the conceptual recommendations put forth would benefit from empirical validation, especially considering the scarcity of empirical data across various subject domains in bilingual education. Therefore, it is recommended that future research should undertake empirical validation of these conceptual insights to support innovative curriculum development across diverse disciplines and the implementation of effective teaching and learning strategies. Such empirical validation is expected to enhance the practical applicability of these insights for educators working within the realms of music, language, and bilingual curricular scenarios.

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APPENDIX

Taxonomy of Selected Studies for Comprehensive Exploration of Music's Role in Language Development

		(a) Intervention	(b) Investigative research	(c) Impact on language skills	(d) Instrumental or vocal training/digital devices	(e) Neuroscientific aspect	(f) Auditory or learning disabilities	(g) Social or cultural impact
1	Talamini et al. (2018)		V	V				
2	Bhatara et al. (2015)		V	V				
3	Reynolds & Burton (2017)		V	V	V			V
4	Schön & Tillmann (2015)	V		V		V	V	V
5	Coumel et al. (2023)		V	V	V			
6	Christiner & Reiterer (2018)		V	V				
7	Fonseca-Mora (2021)		V	V				
8	Sarı et al. (2019)	V		V	V			
9	Sun et al. (2021)		V	V				
10	Jekiel & Malarski (2021)		V	V				
11	Turker & Reiterer (2021)		V	V	V			
12	Legaz Torregrosa (2018)		V	V				
13	Christiner et al. (2022)		V	V	V	V		
14	Picciotti (2018)		V	V		V		
15	Malzer (2018)		V	V				
16	Forgeard et al. (2008)		V	V	V	V		
17	Fonseca-Mora et al. (2015)	V	V	V				
18	Slater et al. (2014)		V	V			V	
19	Maria Toscano-Fuentes & Fonseca Mora (2012)		V	V	V			V
20	Grant et al. (2008)	V	V	V				
21	Hannon & Trainor (2007)		V	V		V		V
22	Gruhn (2002)	V		V				
23	Saffran et al. (2001)		V	V				
24	Looi et al. (2018)	V		V	V		V	
25	Vaquero et al. (2020)		V	V		V		
26	Besedova (2018)		V	V				
27	MacDonald (2022)		V	V	V			
28	Degrave (2022)		V	V	V			
29	Sundberg & Cardoso (2019)	V		V	V			
30	Rajan (2016)		V	V				
31	de Quadros & Vu (2017)	V		V	V			V
32	Łopatka-Koneczny & Wojtkowska (2019)	V		V				V