

Music and Games in Education: Technological Experiences and Human Development

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The European Conference on Education 2023
Official Conference Proceedings

Abstract

Music and Games share a wide range of specific characteristics mediated by the technological component which, in a way, impose an incessant dialogue between the demands of education, music education and human development itself. The consonance and versatility of this approach interact directly with the teaching and learning processes, constituting itself as a potential integrator with respect to the organisation and contexts of the game, the technological resources, the experiences and the potential contribution to the integral development of the individual. Among the areas and topics linked by this context, it is possible to mention gamification, game-based learning, music education, psychology, studies on human cognition, educational technologies, the inclusive perspective in education and science attached to imputations (benefits or disadvantages of the game) in human development. This research integrates a series of works carried out regularly and continuously, in order to strengthen the state of the art and respective literature review, along with the contribution to reflection, discussion and analysis on the relationship and structural characteristics between music and games, regarding its presence and influence in the educational universe and human development in general.

Keywords: Education, Music, Learning Technology, Games, Inclusion, Learning, Human Development

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Introduction

To start, for the development of this work, the context of games is considered, formed by the structural characteristics of games, as a potential organizer of educational demands, with an emphasis on music education (Silva, 2022). To name a few of such characteristics, it would be possible to mention rules, playfulness, clarity, engagement, belonging (significance, meaning), immersion, motivation (intrinsic, extrinsic), voluntariness, feedback, objectives, requirements, resources, fairness (according to the rules), autonomy, protagonism, controlled environment, narrative, chance and possible outcomes, difficulty, level, stages, rewards, challenge, player profiles, customization, as well as the following, which should be given due prominence: temporality, sociability, progression, fantasy, and integration. It is believed that by unifying these characteristics through the context of games, the understanding of these aspects will also be intensified, and since they are directly related to the demands of education, the teaching and learning process will be enhanced.

Music notably contributes to education by adding a sense of belonging, playfulness, and sociability, in addition to the frequently referenced affective, motor, and cognitive benefits. However, it is possible to incorporate various characteristics that music shares in common with the context of games and thus expand the possibilities of its contributions. This approach avoids approaches regarding the presence of music in education that are limited solely to recreational or exclusively playful aspects. These approaches treat these aspects as remedies that negate the need for a deeper understanding of the experiences of musical practice. The accounts of Miranda (2013) exemplify this matter when describing the execution of their work involving a workshop of games, musical activities, legends, and rhymes offered to a sixth-grade class in a public state school in São Paulo, Brazil. During the initially turbulent process, the researcher's expectations were continually thwarted by their proposals, despite their playful nature, as they encountered several issues. Among these, the relationship between the difficulty of the activity and the students' skill level, the lack of significance of the themes for the class, difficulty in understanding the activity (lack of clarity or excessive complexity progression), among others, led to a lack of engagement, focus, interest, and eventually, the loss of the playful aspect of the activity.

Objections against this type of fragmented thinking are found in Fonterrada (2008), while discussing networked learning, and also in a practical example directed towards the use of decontextualized tools. The author relates that it's possible to identify the presence of the game in the methodology of the renowned music educator Shinichi Suzuki as a mere “currency for the child to do what the adults want them to do.” Leme and Bellochio (2007), Bordini and Oliveira (2017), when discussing the use of digital games and technology in the classroom, also point out the importance of not considering the use itself of technologies or digital games as a guarantee of results. They emphasize the necessity for educators to have more awareness and preparation in utilizing such resources. The cross-cutting nature of this thinking can also be observed in the fields of special education and human development. In special education, beyond the continuous search for a wide array of assistive technologies, the emphasis on the student's protagonism during assessment and specialized educational support exemplifies the demand for inventiveness and versatility of resources and approaches. This ensures that the information provided by medical diagnoses, studies, and procedures related to specific disabilities is used in a contextualized manner for the life of the target student in special education. This approach considers their multiple interactions with the environments they participate in. In the realm of human development science, the emergence of paradigms that prioritize inventive, contextual, multifaceted, pluralistic,

integrative, and interdisciplinary approaches is reported. In alignment with these paradigms, education values approaches based on rich experiential interactions, especially when it comes to early childhood education and the initial years of elementary education.

The variety of connections between the realm of game context, gamification, game-based learning, game design, musical education (including its experience and practice), special education, education as a whole, and human development is emphasized. This current work aims to delve into this extensive panorama, believing that the exposition of the various parallels found among music, games, and the different aforementioned areas – all of which are considered of utmost interest for musical education – can broaden and enhance the methodological and pedagogical range for educators, especially music teachers. It's believed that, despite its breadth, the theme will remain cohesive when directed and organized within the context of games.

Technology, Experiences and Human Development

Amidst the rapid pace of information exchange, technological updates, and innovations, coupled with the gradual increase in the accessibility of technologies to a wide audience, games and gamer culture captivate an ever-growing portion of society. This phenomenon also extends their presence to other media forms such as series, books, events, and movies. Access to music, re-recordings, discographies, performances, and full concerts is also experiencing substantial advancements through streaming platforms and tools on social networks that enable listeners to share playlists and compilations expressing their preferences. All of this is also a part and a reflection of a context of continuous changes in technological and communicational advances, which have gone through five generations in the last two centuries (Santaella, 2010).

When discussing technology in the realms of teaching and learning, it's crucial to consider this presented context as the backdrop in which a significant portion of students is immersed in their daily lives. At times, they might be more informed and up-to-date than the education professionals themselves (Leme & Bellochio, 2007; Bordini & Oliveira, 2017). Technological enhancement is undeniably an educational demand highlighted by a wide range of studies. Many of these studies seek to investigate whether the implementation of technological resources in the classroom would bring positive or negative effects to the learning process. The findings are inconclusive, pointing towards negative, neutral, and positive aspects (Leme & Bellochio, 2007; Fadel et al., 2014; Bordini & Oliveira, 2017; Passarelli et al., 2018; Curioni et al., 2019; Passarelli et al., 2019). Much should be questioned and kept in mind concerning the results of these research endeavors, given that the implementation of technologies in the classroom can vary from replacing a paper form with a digital one to carrying out game-based learning that involves a triple-A game produced by major game industries, boasting high quality and substantial budget. Such games come with engaging storytelling and immersive gameplay experiences. Even when considering the last example of using a high-quality game, the results are still tied to how its application takes place in the classroom. What cannot be denied is that by seeking to understand games and their applications in education, doors open to numerous new tools and areas of knowledge that can be utilized – or not – in the processes of teaching and learning. This also creates pathways for the implementation of other Information and Communication Technologies (ICTs). Studies like those on Gamification, Game Theory, Game-Based Learning, and Game Design can be considered as part of this discussion.

Deepening the understanding of the game context involves challenging “the generic assumption that games support learning because they are motivating and engaging. The aim is to enrich the body of knowledge concerning learning with games with a better understanding of the conditions for games to be motivating both to play and to learn from” (Passarelli et al., 2019, p. 331). Similarly to the theme of this present work, this challenge to generic assumptions extends cross-cuttingly into the realm of musical education. In this area, it's also important to avoid solely recreational approaches based purely on the playfulness of musical practice, at the expense of understanding the network of interactions experienced in the musical journey.

Playfulness, engagement, and motivational elements are crucial characteristics, but not the only ones. Continuing with the example of a triple-A game, the "quality" of the game doesn't guarantee that it will be more enjoyable or meaningful for the player, nor that the curriculum content to be developed and worked on will be experienced by the student. However, high-quality audiovisuals, problem-free mechanics and controls, and smooth gameplay flow all contribute to the enhancement of certain characteristics, organized within the game context. These include immersion, narrative, temporality, engagement, personalization, progression, difficulty, and clarity. In turn, these attributes create an environment conducive to learning (Fadel et al., 2014; Busarello, 2016; Silva, 2022). A good game design, much like a well-crafted lesson plan by a teacher, takes these considerations into account. Games inherently present systems that need to be learned in order to be mastered. They rely on solid learning principles to prevent players from failing excessively and becoming overly frustrated in their experience, which could lead to losing interest in the game (Bordini & Oliveira, 2017). A well-designed serious game, a game with an educational purpose beyond entertainment, must strike a balance between learning aspects and the enjoyable elements. It should harmonize objectives, feedback mechanisms, progression, accuracy of the educational content covered, reward systems, with emotional connection, pleasure, sense of control, immersion, and significance (Lima et al., 2021).

Additionally, in game-based learning, the crucial decision of which game to use and for what purpose brings the discussion to another point raised by Passarelli et al. (2018) about "market games" and "serious games," considering research and technological advancements. Beyond these points, the issue of available resources within the game industry is addressed, highlighting the stark difference between this industry and the somewhat lagging academic sphere, especially in specific aspects. The author underscores the importance of reinforcing mutual contributions between the industry and research fields. This is because psychological studies and education-focused research from academia could theoretically complement the technological and artistic quality of games produced for the market very well.

This difference becomes even more pronounced from the player's perspective. In their daily life, they encounter higher-quality products, while in the educational environment, they interact with products that fall short in comparison to the former. This concern can also be translated to the use of technologies in the classroom, especially in situations where there is insufficient preparation on the part of the teacher to handle such resources, which may already be part of the student's daily life and even mastered by them. It's necessary to establish a stronger dialogue between academia and development, the educational realm and technological innovation. Additionally, efforts should be made to ensure that teachers are updated and equipped with the necessary technical and theoretical knowledge about the technologies they will use, along with the broader characteristics and aspects that surround

them, such as the game context (Leme & Bellochio, 2007; Bordini & Oliveira, 2017; Silva, 2022).

For use in musical education, several digital games and applications can be mentioned, including Rocksmith, Descobrimos Sons, Flute Master, Piano Game, Flappy Crabb, Simply Piano, VR4EDU, Deu a louca no maestro, MusicandoRA, GenVirtual, Melodia, Dó Ré Música, Musikinésia, Tuho Musical, Musique, Mini Maestro, and Musical Instructor. Additionally, it's worth mentioning apps for composition, score editing, musical instrument simulation, acoustic experimentation, and musical analysis, such as Encore, GuitarPro, MuseScore, kbPiano, Virtual Piano, Sonic Visualizer, Ableton Live, Melodic, and Chrome Music Lab (Lima et al., 2021).

However, it's important to highlight that while digital games provide and require the use of modern technologies, offering clarity, immersion, and significance (among other cited characteristics) through well-presented stories, well-executed mechanics, seamless gameplay experiences, high-quality audio, and graphics, the use of analog games and toys can also be considered a use of technology, even though they fall under the category of low-tech. Integrating this perspective into the previous considerations allows for a reevaluation of analog games and playthings, which are currently more accessible and prevalent in educational settings compared to digital games.

Games and play are inherently connected to musical education, especially but not exclusively in early childhood education and the initial years of elementary education. This brings together the studies, advancements, methodologies, resources, demands, and concerns from the various mentioned areas into this context. Musical instruments and resources, both digital and analog, can also be included as versatile tools for engaging in activities with gamification elements.

Using the activities listed in Fernandes (2011), Guia and França (2015) as a reference, the proposed musical activities indeed affirm a wide diversity of approaches, resources, and stimuli (visual, motor, auditory, emotional, tactile, cognitive) provided and required. This variety offers numerous pathways to create an environment conducive to learning. Among the resources used, each with its usage to be reinvented depending on the activity, include: Dice, Cards, Posters, Game Boards and Tracks, Tokens, Dominoes, Plush Toys, Mats and Hula Hoops, Bowling Pins, Puzzles. These can be customized during their creation or adapted, for example: plush toys and bowling pins that function as rattles and shakers for timbral recognition; personalizing the faces of a dice with figures of musical instruments, rhythms, notes, elements of musical notation, objects from soundscapes; Mats, Hula Hoops, Posters, and similar items that redefine the physical classroom space; Dominos that, with the help of rules, match not only identical pairs but also equivalent pairs, or that forgo the formation of pairs to emulate progressions (such as fitting together adjacent notes, for instance). It's also worth mentioning the creation of specific objects and toys for each case, such as the "Sound Box" (Caixa Sonora), presented by Fernandes (2011), where each inner face of the box contains materials to exemplify and work on a sound parameter, and the "Magic Chest" (Baú Mágico) which redefines the set of available musical instruments for classes and utilizes them, among other activities, to add sound to stories. In addition to practical and functional adaptations, each inventive and artistic customization of the resources used will likely contribute significantly to the educational experience, offering new possibilities for interactions and meaningful relationships.

Reinforcing the parallel with elements from digital games, for example, it would be possible to review the quality of stimuli and feedback provided by an activity, even if analog, as the goal is to enhance the experience of the teaching and learning process, regardless of the use of digital or non-digital resources, whether high or low cost and technology. In the "Skyscraper Game" (Jogo do arranha-céu), Guia and França (2015) propose the placement, with alternating player turns, of tokens with note names on a game board featuring a track that ascends from the base to the top of a building. For the game, they also suggest an alternative rule where the need for a sequential turn is abolished, altering the temporality of the activity and encouraging a state of attention among all players. What kind of feedback do the students receive as they progress in the game? How much does this add to the immersion, clarity, and significance of the activity? By considering these questions, it's possible to seek specific solutions for interaction points generated by the "Skyscraper Game" activity, such as real-time performance by the teacher of the notes as they are placed on the game board. What is the quality of the feedback? A vocal execution could be possible, perhaps limited by the teacher's vocal range or the quality of notes outside of it; Instrumental performance adds new timbres and possibilities. It might be possible to imagine the development of a digital application that adds sound to the notes, progressively introducing more harmonic/textural density as students progress on the game board, culminating in a pompous and rewarding finale such as a fanfare or rich harmonic/textural execution on the last note. This could also add rhythm to the activity by causing the sound to gradually fade during moments when there's a delay in advancing on the game board. Whichever path is taken, it enriches the experience and expands the possibilities of interactions, results commonly experienced in musical practice due to the elements that surround it such as significance, challenge, progression, fantasy (intrinsic), immersion, motivation, protagonism, integration, among many others.

It's worth noting that it's possible to integrate the issue of the quality of stimuli and feedback with the importance of the music teacher's notion as a performer, who is skilled in musical execution to ensure immersion, fluency (and temporality), organicity, and clarity of the experience during the class. Also, a good example of a technological resource related to performance would be the use of a loop pedal by the music teacher, as it allows enriching arrangements for solo performance through real-time recording of sections to be played in a loop simultaneously with each other and the instrumentalist's performance, enabling, for instance, the execution of more complex textures with a bass line, harmonic accompaniment, percussive accompaniment, and melody (Duarte, 2015).

Regarding games and play, it's always worth mentioning the issue of their apparent "childishness," as they are generally more associated with a younger audience. In this work, it is believed that the use of games and play should not be avoided due to concerns about the supposed childishness of these resources. Furthermore, all the versatility presented supports and offers various options and customizations to overcome the perceived childishness if it were a concern for application with more adult audiences. Moreover, studies in various ways encourage the revival of the language of childhood as something extremely beneficial (Mateiro & Ilari, 2016; Rivero & Rocha, 2019). A good example of a teaching proposal based on games, play, and playful activities for the adult audience is the MILMESA method, aimed at higher education, which has some of the following objectives: General and artistic development in an interdisciplinary way of verbal and non-verbal forms of expression; Use of games and playful aspects of education; Development of the notion, concept, and achievement of artistic literacy; Encouragement of a comprehensive understanding of

personal, social, artistic, and educational proficiency through general artistic knowledge (Leonido et al., 2023).

After presenting the numerous resources offered by the fields of study and market encompassed by music and games, and briefly discussing how their presence creates new opportunities for interactions and meaningful relationships, the focus on the student's experience, their involvement, and how, during the use of these tools, this primary objective should remain at the core of the matter, is emphasized.

To better understand the experience of the target audience in education, one must consider the context in which their lives are embedded. And, as mentioned earlier, understanding the impacts of technology on the world and individuals is crucial to delve into this context and how interactions between mediums and individuals occur. Technology, along with technological and communicational advancements and revolutions, directly influences the spatiotemporal relationships that human cognition conforms to, brings about significant changes in how people perceive and understand the world, and progressively shapes the contexts in which the education's target audience is immersed through socio-cultural transformations (Santaella, 2010). Considering this relationship between technology and the perception of the world, the importance and dimension of gamification aspects, such as immersion and temporality, as discussed in this work, are redefined. This also allows for another point of dialogue with the interactive and expressive nature of music and games.

Regarding human development, when investigating studies in this field, significant convergences with educational paradigms are found. Education directly benefits from the knowledge produced by the science of human development and uses it to understand, structure, carry out interventions, and promote teaching methodologies that effectively foster learning processes in the educational context (Dessen & Junior, 2008, p.190). The authors also provide an overview of studies in the field, mentioning Piaget, Vygotsky, Wallon, and Bronfenbrenner, and from their development, it's possible to highlight demands for: Contextualized, multifaceted, pluralistic, integral, and interdisciplinary views and proposals; Abandonment of predetermined and one-directional stances, valuing creativity, inventiveness, and ethics in processes; Recognition of the importance of bidirectionality of interactions and world experiences for self-construction; Placing the individual as a reference point for the science of human development and education, without disregarding the collective; Integration of different human aspects such as cognition, motor skills, emotions, and their social, cultural, historical, and temporal contexts.

Regarding cognitive, motor, and affective aspects, the literature in the field demonstrates that auditory perception and affective connection with others begin even before birth. The auditory influence that the fetus receives can impact its emotionality, stimulate its memorization capacity (Mabille, 1990; Leonido et al., 2023). "Music, especially classical music, plays an important role in child development: it not only enhances the baby's auditory acuity but also stimulates the left hemisphere of the brain and regulates heart rhythm" (Mabille, 1990, p. 15). Music also has a significant influence on the direct development and functioning of children's brains, involving different tempos, gestures, rhythms, and intonations as a form of communicative and expressive art language (Weigsding & Barbosa, 2014). It is evident that music education stimulates the development of auditory perception, attention, concentration, creativity, motor coordination, memory, reasoning, motivation, sociability, balance, cultural integration, as well as a sense of importance and belonging to the collective process of experiences and knowledge acquisition.

Just as the panorama of human development science described earlier, when discussing the study of music and some of its recent paradigms as found in David Elliot, Benett Reimer, and Keith Swanwick, it is possible to relate their propositions and define music as a human practice, endowed with a complex network of interrelationships with the social, cultural, political, and economic panorama (Fonterrada, 2008, p. 177). Music, much like games, is permeated with interactions on various levels, ranging from the direct influence on the sound outcome during musical practice to the very origin of the musical event, stemming from the interaction of the sonic event in the physical environment with human cognition. There is much to discuss when it is realized that both fields, music and games, offer potentially interdisciplinary propositions that promote the holistic development of the individual by integrating, throughout their processes, social, cultural, cognitive, affective, motor, and temporal contexts. These are based on the interactive bidirectional experience of the individual's internal experience with the external environment (Fonterrada, 2008; Dessen & Junior, 2008).

Conclusion

It is believed that the present work has generated a dialogue that, despite its comprehensiveness, is in line with the studied paradigms, as it seeks to relate many and varied areas of study in a multifaceted, interdisciplinary, and contextualized manner, and according to the proposed demands and potentialities, such as the quest for versatility to better delve into understandings, problem-solving, and the enhancement of inventiveness during the processes. The dialogue has also reinforced the integrative, organizing, and potentiating nature of music and games, aligned with the paradigms of human development, as beneficial to support a good and appropriate implementation of technological resources in education.

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