



## ieTIC2022: Livro de Atas

Editores

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## Interfaces de usuário tangíveis na composição musical: aplicações para pedagogia e pesquisa

### Tangible user's interfaces for music composition: applications for pedagogy and research

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#### Abstract

Tangible Users' Interfaces represent a recent field research in human-computer interfaces. Current studies demonstrated that physical interaction and tangible learning allow students to: (i) increase levels of interest and motivation; (ii) be a usefulness instrument in the process of teaching, learning, and play music; and (iii) boost their creative expression. All the methodological procedures were conducted considering the standards for systematic reviews of Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement. Eligibility criteria are based on the PICO approach, study design, and date. For the topic we have chosen: (1) participant (young students from primary education); (2) intervention (research associated with tangible users' interfaces in primary education); (3) outcome (music creation/composition); (4) study design (cohort, case-control and cross-sectional); and (5) language (English, Portuguese, or Spanish). In this paper we summarize pedagogy and research evidence and discuss practical applications of Tangible Users' Interfaces in music composition for the primary education.

**Keywords:** *tangible users' interfaces, music composition, systematic reviews.*

#### Resumo

As Interfaces de Usuários Tangíveis representam um recente campo de pesquisa em interfaces homem-computador. Estudos atuais demonstraram que a interação física e a aprendizagem tangível permitem que os alunos: (i) aumentem os níveis de interesse e motivação; (ii) ser um instrumento de utilidade no processo de ensinar, aprender e tocar música; e (iii) impulsionar sua expressão criativa. Todos os procedimentos metodológicos foram conduzidos considerando as normas para revisões sistemáticas de Preferred Reporting Items for Systematic Reviews e declaração de Meta-Análises. Os critérios de elegibilidade são baseados na abordagem PICO, desenho do estudo e data. Para o tema escolhemos: (1) participante (jovens alunos do ensino primário); (2) intervenção (pesquisa associada a interfaces tangíveis de usuários no ensino primário); (3) resultado (criação/composição musical); (4) desenho do estudo (coorte, caso-controle e transversal); e (5) idioma (inglês, português ou espanhol). Neste artigo, resumimos a pedagogia e as evidências de pesquisa e discutimos aplicações práticas de Interfaces de Usuários Tangíveis na composição musical para o ensino primário.

**Palavras-chave:** *interfaces de usuário tangíveis, composição musical, revisões sistemáticas.*

## 1 Introduction

Music has been a part of human societies since ancient times and people of all cultures listen to and play music every day. However, the process of learning to

play music is not so easy, it requires learning music theory with symbols and sheet music and this process can easily make students feel bored. Thus, there has been a huge involvement of new technologies in music teaching as a pedagogical resource to facilitate this process and motivate musical learning for students (Finney & Burnard, 2007). Tangible Users' Interfaces (TUI) represent a recent field research in human-computer interfaces and represent the easiest way to connect the physical and digital world. Because of that, TUI are simply the most natural way for children interact with technology, especially the learning process (Rodić & Granić, 2022). Due the constant evolution and development of technology in the twenty-first century, and the increase implication of digital resource in education field, current studies in music education have demonstrated that physical interaction and tangible learning allow students to: (i) increase levels of interest and motivation; (ii) be a usefulness instrument in the process of teaching, learning, and play music; and (iii) boost their creative expression (Waranusast, Bangngoen, & Thipakorn, 2013). Contemporary children are considered digital natives since they were born and raised in the middle of technology's age (Kivunja, 2014). The positive impact of technology in education are knowing by the experimentation and creation effect of turning the process of learning easier (Finney & Burnard, 2007) and because of that, many countries have already increased the uses of the new technologies in schools, primarily in teaching-learning process. One of the dimensions of essential learning associated to the area of music education where the composition of musical pieces, through the combination and manipulation of diverse elements of music (timbre, dynamics, pitch, rhythm, and form), using different resources (voice, body, sound objects, musical instruments, technologies, and software) (Ministério da Educação, 2018).

## 2 Methodology

The most important steps regarding the development of a systematic review are the organization of the protocol. The first step concerning the set of terms used to search of studies related TUI for music composition with primary students. For these reasons, the specified resulting in the following searching were: (tangible AND music AND interface); (tangible AND music AND composition); and ("music education" AND "tangible user interface"). It was searched for all the studies that have those specific terms in the publication title, abstract or the list of keywords. The second step concerning the databases used for the searching: (i) Web of Science, (ii) Scopus, and (iii) Scielo. The third step were related with the definition

of the inclusion/exclusion criteria used in this study. About the inclusion criteria, we used the following studies:

- Studies published at the last 5 years (2018-2022);
- Open access Studies;
- Studies that report the use of TUI for music composition with primary school's students;
- Studies that describe the relations between TUI and the application for pedagogy and research;
- Studies published written in English, Spanish and Portuguese.

About the exclusion criteria we excluded the following studies:

- Studies that do not mention the use of TUI for music composition or primary school's students;
- Studies that do not focus the applications of TUI for pedagogy and research.

Related on minimize bias, at this study two researchers were working autonomously in double-check process. This study aims to summarize, examine, and assess evidence of the effectiveness of TUI in the music composition field. All the methodological procedures were conducted considering the standards for systematic reviews of Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement. For this systematic review we searched Web of Knowledge, Scopus, ScieELO, and forward and backward citations for studies published between database from 2018-2022 (we have chosen articles published in the last 5 years as a selection criterion because this is a recent field of investigation in music education). Eligibility criteria are based on the PICO approach (P - Students from primary school; I - Tangible User Interface; Co - Music education / Music composition), study design, and date. Exclusion criteria mostly are unrelated, duplicated, unavailable full texts, or abstract-only papers. For the topic we have chosen: (1) participant (young students from primary education); (2) intervention (research associated with tangible users' interfaces in primary education); (3) outcome (music creation/composition); (4) study design (cohort, case-control and cross-sectional); and (5) language (English, Portuguese, or Spanish). From 479 records we selected 7 studies that satisfied the inclusion criteria for the analysis. Studies' qualitative evaluation was made by 2 independent reviewers using the Quality Index.

The most important steps regarding the development of a systematic review protocol were specified in the following. First, the set of terms used to search the

primary studies related to TUI in music composition. The results of the following searching string:

Chart 1: Research results from database.

Database	Key-words	Records
Web of Science	tangible AND music AND interface	103
	tangible AND music AND composition	27
	music education AND tangible user interface	19
Scopus	tangible AND music AND interface	57
	tangible AND music AND composition	244
	music education AND tangible user interface	29
Scielo	tangible AND music AND interface	0
	tangible AND music AND composition	0
	music education AND tangible user interface	0

The exclusion criteria for the records were: (1) published before 2018-2022; (2) non access records; and (3) unrelated to the topic of the research.

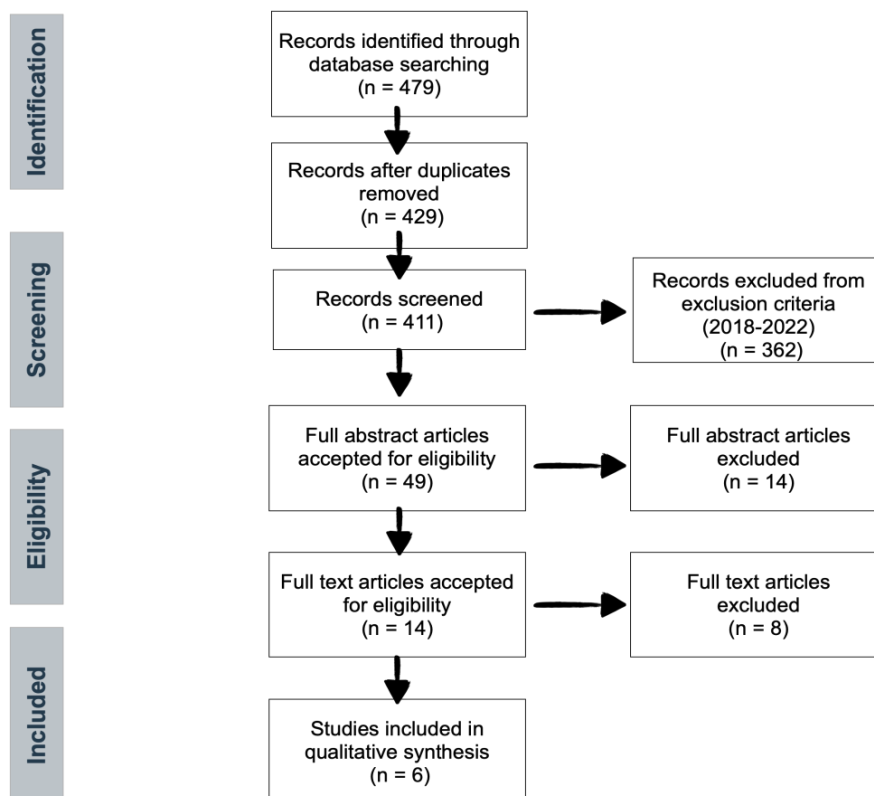


Figure 1: Flow chart of the results (Prisma, 2020).

### 3 Results

In this paper we summarize pedagogy and research evidence and discuss practical applications of Tangible Users' Interfaces in music composition for the primary education. A total of 6 studies were identified for inclusion in the review.

Chart 2: Studies identified for the review.

Source	Participants	Objetives or Applicability	Year	Tangible Interface	Local
1) Palaigeorgiou & Pouloulis	15 students (9-10 years old)	The aim of evaluating both the set of the music tangible interfaces and the instructional approach Creative tangible interface-Body triggers, music images,etc	2018	2x Makey Makey	Greece
2) Cuadrado et. al	180 students (6-12 years old)	Sound experimentation and Music language learning	2018	Touch the sound-learning system Two diferente learning apps	Spain
3) Micheloni, et al.	51 students (6-11 years old)	Playing an instrument (piano) allied to an educational path	2018	Musa (video game)	Italy
4) Rossmly & Wiethoff	7 students (5-6 years old)	Increase music creation by making music through constructions with solid block	2019	COMB	Germany
5) Jiany & Gupta	N/A (9-12 years old)	Music development like tonality, chords progressions, consonance/dissonance, strong/weak resolutions (music composition)	2019	Harmonious	USA
6) De la Cruz & Bhatia	N/A (5-10 years old)	Technical elements from electronic circuits and pentatonic scales	2018	Paper Piano	USA

### 4 Discussion

In a first analysis, it is possible to verify that all six articles were published between the years 2018 and 2019, with no other work published so far that approach this theme. A possible reason for this fact may be related to the COVID-19 pandemic

that emerged in late 2019 and early 2020 and made the use of face-to-face practices and investigations impossible. Another quick analysis concerns the places where the studies were implemented, limiting this type of investigation to Europe (with countries like: Greece, Spain, Italy, and Germany) and the United States of America.

Regarding the musical content addressed in the articles, we can see that in all six of them musical creativity is worked on (e.g., musical creation and exploration). On music theory (e.g., reading and writing music) only articles 2), 5) and 6) address such content. From the perspective of collaborative or individual work practices, only the studies elaborated in articles 1) and 6) refer to the use of collaborative practices among students. Articles 3), 4) and 5) present individual practices and article 2) does not refer to the type of practice used in its study. Thus, it is possible argument that the uses of TUI in music education compositions fields help the student and the teacher in four ways:

- Creativity: for improve divergent definitions
- Pedagogical practices: for incorporated different methodologies
- Collaborations: for improve a collaborative and collective work
- Transformation: for improve knowledge, practices, and contexts with technology.

Learning to play a musical instrument usually requires a few years of training, which can be a factor in dropping out or lowering motivation levels to engage in music learning experiences. This problem has led to new areas of research, namely making music with TUI, looking for ways to engage students in learning, performing, creating, and improvising music. (Palaigeorgiou & Pouloulis, 2018).

In this way, tangible interfaces explore the difficulties between listening and making music, balancing them. With the introduction of these devices, musical and performative interaction, and motivation increases, making music creation almost as instantaneous as music listening, combining elements from the field of music, technology, science, creativity, and psychology. There are several interfaces mentioned in the selected articles, regardless of the goals and functions for which they were chosen by the researchers, these tools demonstrate to have the power to reinvent music learning processes, creating, and playing while letting children's musicality flourish. In this way, children move from being consumers of technology to creators with technology. The literature has noted that exploratory interaction with music interfaces is fun and enjoyable in and of itself, however, being able to orchestrate students' musical activities is seen as "tricky" since there are "still" no

ready-made recipes available. This is one of the focal points of research in this field, the need for investigation of tangible interfaces in the classroom, as it still seems to be an unknown topic in schools.

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