

**Gamification in Educational Music
Applications:**

A Systematic Review on the Literature

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Abstract

Gamification is utilizing game features and operating models in environments that are not fundamentally game-like. The purpose of gamification is to increase the user's motivation, enthusiasm, and commitment to a subject, which is why it has started to become commonly used as a tool implemented in learning platforms.

This bachelor's thesis reviews gamification in educational music applications. The work examines how user interfaces of educational music applications utilize game elements to maintain users' motivation and engagement in learning. A systematic review comprising 11 publications that analyse the effects of gamification through user tests and surveys were selected as the material for this work. The structure of this work was conducted in accordance with Moher's (2013) PRISMA -model.

Based on the reviewed material, gamification was perceived as a useful tool in the design of music applications and was seen to increase users' motivation and engagement in learning music. In addition, the literature review found some game elements that emerged in music applications more often than others. These included points and levels. However, it turned out that the applications that evoked engagement and motivation the most in users were the ones that used game elements judiciously, taking the age and music knowledge of the users into consideration.

Keywords Gamification, Music Applications, User Interfaces

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Tiivistelmä

Pelillistäminen on pelien ominaisuuksien ja toimintamallien hyödyntämistä sellaisissa ympäristöissä, jotka eivät perusluonteeltaan ole pelimäisiä. Pelillistämisen tarkoituksena on kohottaa käyttäjän motivaatiota, innostuneisuutta ja sitoutuneisuutta tiettyä aihetta kohtaan, minkä takia sitä on alettu käyttämään menetelmänä oppimisalustojen suunnittelussa.

Tämä kandidaatin tutkielma käsittelee pelillistämistä opetuksellisten musiikkisovelluksien käyttöliittymissä. Työssä selvitettiin, miten musiikkisovelluksien käyttöliittymät hyödyntävät pelillistämistä ylläpitääkseen käyttäjien motivaatiota ja sitoutumista oppimiseen. Työ suoritettiin systemaattisena kirjallisuuskatsauksena mukaillen Moherin (2013) PRISMA-mallia. Työn aineistoksi valikoitui 11 julkaisua, jotka käsittelivät pelillistämisen vaikutuksia musiikin oppimiseen käyttäjätestien ja kyselyiden avulla.

Aineiston pohjalta todettiin, että pelillistäminen koettiin hyödylliseksi keinoksi musiikkisovelluksien suunnittelussa, sillä se lisäsi odotetusti käyttäjien motivaatiota ja sitoutumista musiikin eri osa-alueiden oppimiseen. Lisäksi aineistosta nousi esiin sellaisia pelielementtejä, jotka koettiin musiikkisovelluksissa yleisesti hyödyllisiksi. Näitä olivat mm. pisteet ja tasot. Kuitenkin selvisi, että toimivassa sovelluksessa pelillisiä ominaisuuksia on käytetty harkitusti ottaen sovelluksen käyttäjien ikä ja musiikin tuntemus huomioon.

Avainsanat Pelillistäminen, musiikkisovellukset, käyttöliittymät

Table of Contents

- 1. Introduction**
 - 1.1 Background, Scope & Research Question.....7.
 - 1.2 Structure.....8.
- 2. Methods**
 - 2.1 Review Procedure.....9.
- 3. Results**
 - 3.1 Overview of Game Elements.....11.
 - 3.2 Game Elements in Educational Music Applications.....13.
 - 3.3 Effects of Game Elements in Educational Music Applications.....15.
- 4. Discussion**
 - 4.1 Limitations.....17.
 - 4.2 Conclusions.....18.

Key concepts

Music:

”Music is the art of combining vocal or instrumental sounds (or both) to produce beauty of form, harmony, and expression of emotion.” (Allen, 1992)

Serious games:

”Serious games are games or game-like interactive systems developed with game technology and design principles for a primary purpose other than pure entertainment.” (Kankaanranta and Neittaanmäki, 2009)

Affordance:

“The quality or property of an object that defines its possible uses or makes clear how it can or should be used.” (Merriam-Webster Dictionary, 1992)

Tables & Figures

Table 1. Search Phrases..... 9.

Figure 1. PRISMA Flowchart (Moher, 2013).....10.

Table 2. Game Elements (BunchBall, 2017).....11.

Table 3. Game Elements Included in Reviewed Studies.....13.

Picture 1. Avatars (Birch, 2017).....14.

Table 4. Effects of Gamification in Reviewed Studies16.

1. Introduction

1.1 Background, Scope & Research Question

Gamification refers to imbuing services, activities, and systems with affordances similar to ones in games attempting to affect user behavior (Koivisto and Hamari, 2019).

Gamification can offer engagement and motivation for the user, which is why it has become a powerful tool in situations where the user lacks these qualities. Learning music could be such a situation per se. Gamifying music applications challenges traditional music learning models as it not only provides motivation and engagement for the user in a unique way but also, offers a chance for the user to learn playfully. Gamification could change the way music is learned, taught, and even perceived as a subject.

However, implementing gamification in a music application is not trivial. For gamification to be effective in educational situations, the application's user interface should implement affordances that engage and motivate the user in their desired way. Otherwise, there is a possibility that the user quits using the application, and even a possibility for the user to quit pursuing the hobby because of the unengaging user experience of the application. To counter this issue, application designers are constantly testing new methods to keep the user engaged and motivated. Therefore, in the field of gamification, the situational use of game elements has aroused the interest of researchers.

As a general field of research, gamification has received a lot of attention since the rise of motivational information systems in the late 20th century (Koivisto and Hamari, 2019). On the other hand, gamification is still in its early stages when considering applications that teach creative activities. This is apparent in educational music applications where gamification is just starting to introduce itself. In 2017, the field of music was one of the least researched fields of study regarding technology-supported instruction (Chauhan, 2017). Today, it has gained some recognition, however, the research in the field is still succinct.

This bachelor's thesis is therefore conducted to gather and summarize information about the field of gamification in educational music applications. To establish a scope for the literary search, the review focuses threefold:

- 1) on gamification and game elements.
- 2) on the implementations of these game elements in music applications.
- 3) on the engagement and motivation these elements convey for the user of the application.

To proceed, this thesis presents a systematic literature review on literature of gamification in educational music applications. The following research question was chosen regarding the ambitions and limitations of this work.

- What game elements have been implemented in educational music applications to evoke motivation and engagement among users?

1.2 Structure

The structure of this work follows Moher's (2013) PRISMA guidelines for a systematic literature review. The review consists of 4 chapters. The second chapter introduces the methods for the literary review. It presents the literature search process as well as reports the literature exclusion process. The third chapter defines general gamification concepts and conveys key knowledge to the reader about the game elements that are central to this thesis. The chapter then employs these game elements in the context of music applications. The last section of the chapter assesses these elements and their effects on the user. Finally, the fourth chapter draws together most significant findings of the study and some ideas arising from them. The chapter motivates for future research as well as discusses areas of success and development in the review.

2. Methods

A systematic review was chosen as a method of research for this thesis because it offers for a clear and comprehensive overview of the research area. This is important because the area of research is small. Therefore, efforts need to be made in order to prevent search gaps from happening. To keep uniform structure, the thesis follows the PRISMA-checklist (Moher, 2013) on guidelines for a systematic literature review.

2.1 Review Procedure

The research material was gathered using Aalto University -supported databases: scopus, web of science, IEEE Xplore and Science Direct with search parameters: title, abstract and keywords. In the start, “Gamification” is used as a search phrase to display the variety of publications on the subject. This resulted to almost 11 000 results. Then, search phrases “music” and “design” are added for further definition. This narrows the results to the thousands. Lastly, wildcards *educat**, *learn**, *pract**, *teach**, *engag** and *motivat** are used to refine the search to fit the research question. All search phrases were formulated according to the search logic of each data base. Table 1 describes the quantity of results as well as the delimitations of the search.

Search Phrase	Scopus	Web of Science	IEEE Xplore	Science Direct
Gamification	10 858	8 207	1 766	3 768
Gamification AND Music	1 515	59	17	448
Gamification AND Music AND Design	41	40	7	433
Gamification AND Music AND Design AND (<i>educat*</i> OR <i>learn*</i> OR <i>teach*</i> OR <i>pract*</i>)	30	33	3	282
Gamification AND Music AND Design AND (<i>educat*</i> OR <i>learn*</i> OR <i>pract*</i> OR <i>teach*</i>) AND (<i>engag*</i> OR <i>motivat*</i>)	17	18	-	234

Table 1 – searches conducted 4.7.2022

Together, a total of 206 records were reviewed by the eligibility of their titles. After some exclusion, 66 considerable records were found. These records included journal articles, conference papers and proceedings. From these records, duplicates, non-English papers, and papers with unavailable PDF: s were removed, resulting in 38 papers reviewed based on abstracts. Ultimately, 11 papers were found to be relevant for this study. These included journal articles (7/11), conference proceedings (3/11) and a conference paper (1/11). The conducted literature search was documented, downloaded, and parsed using End Note 20 reference management tool. The full process of the literature search is reported in Figure 1.

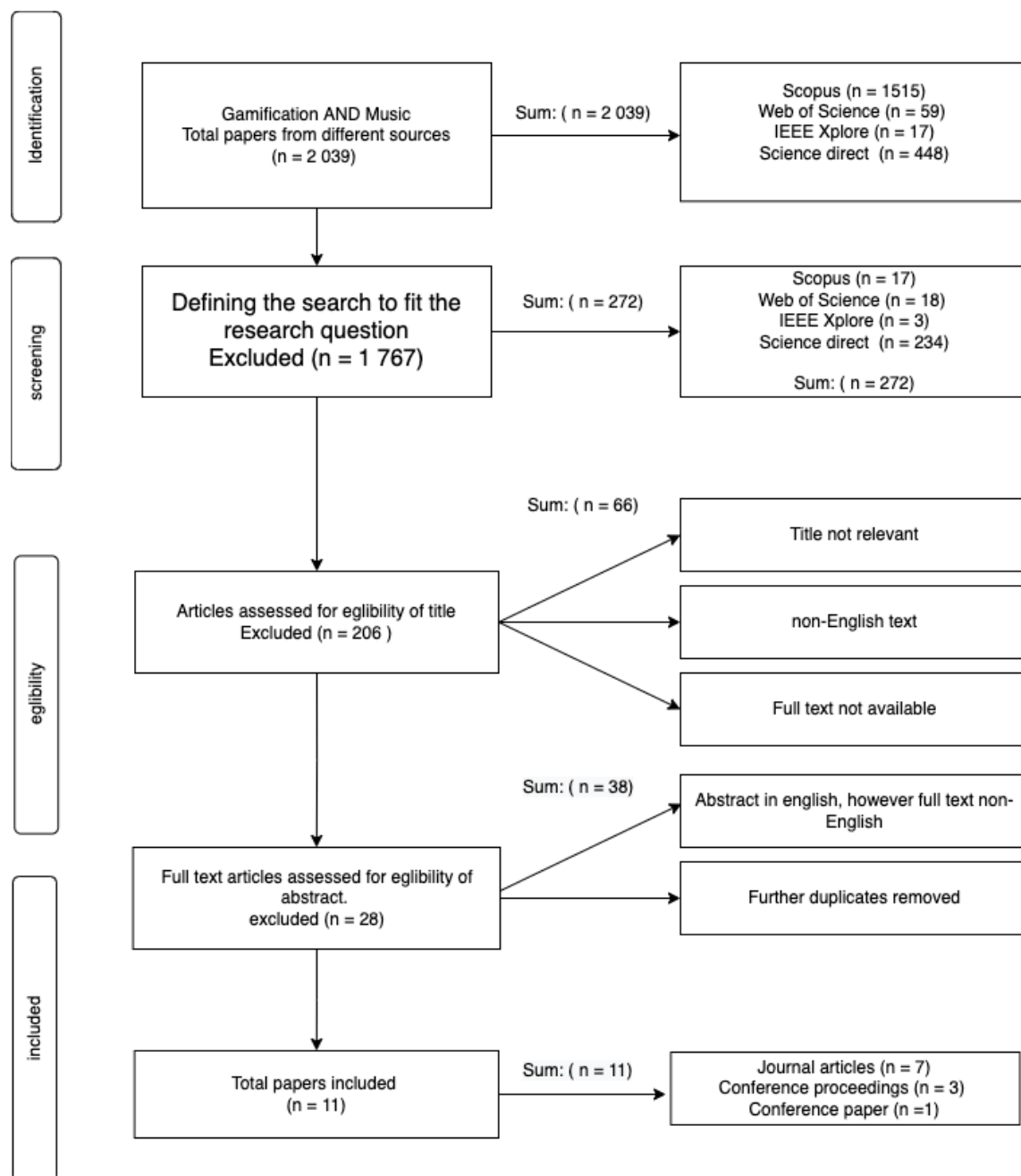


Figure 1 – PRISMA Flowchart (Moher, 2013)

3. Results

3.1 Overview of Game Elements

Game elements are the building blocks that convey gamefulness through the user interface of an application. In the case of educational applications, game elements aspire to engage and motivate the user in the form of game mechanics and game dynamics. Game dynamics are the underlying systems that govern how the game works, while game mechanics are the specific actions players take within the game to interact with those systems (Hunicke et al., 2004). A typical example of a game mechanic is points, whereas achievement and progress are game dynamics that points aspire to convey.

Bunchball, a game consultant company with impact on the spread of gamification, proposed a list of ten widespread game elements. These elements are used as reference points in this literature review and are thereafter compared with the elements found in music games. Table 2 visually displays these elements.











Game Dynamics		Competition	Collaboration	Community	Collection	Achievement	Surprise	Progress (emotional)	Exploration
Game Mechanics	 Points					●		●	
	 Levels	●			●	●		●	
	 Missions (individual & team)	●		●		●	●		●
	 Badges			●	●	●	●	●	●
	 Leaderboards (individual & team)	●	●	●		●			
	 Unlocks					●	●		●
	 Events Feed	●	●	●				●	●
	 Notifications			●				●	
	 Quiz	●		●		●		●	
	 Progress (visual)					●		●	

Table 2 – Game Elements (Bunchball 2017)

Points are a way of measuring the activity that takes place in the game. Points are earned by completing activities that guide the user toward the goals of the game. Typically, points are gained when the player completes a task. In music games, for example, points can be achieved by playing a musical scale correctly (Birch and Woodruff 2017). Points help players by giving them continuous and immediate feedback and regarding to their success in the game (Sailer et al., 2014). In some games, achieving points gets harder as the player gets better at the game. Points are essential in game environments and have been proven to solely motivate users (Sailer et al., 2017).

In various games, accumulating points can raise the player's level. The player's level reflects on the players accumulated achievements and the players status in the gaming community. In addition, leveling up can unlock new tasks and skill tokens in the game. In some games, high-level players can also gain advantage over lower-level players. Levels offer a virtual representation of the real-world skills of the player (Brom, Dreef et al., 2004) and therefore are important in musical applications. The more accurate the measurement between levels and real-world skills is, the fuller the experience can be for the user. In music games, levels might be the most concrete measure of one's musical abilities.

Missions are tasks that the player must complete to receive rewards such as points or badges. The number of points or badges the user receives may depend on how well the task was executed. In music games, the amount of points the user receives from missions are important because they reflect the quality of one's playing. Even though music is reviewed subjectively, there still exists a common perception of measurable quality that points, and badges aim to convey. Missions motivate players to work towards goals, and in music applications, help the player refine their skills.

Leaderboards help the user to put their skills into perspective among other players. Sometimes applications present users the opportunity to socially share their achievements. This brings an element of competitiveness to the game, which can be used to motivate players to strive for higher rankings . On the other hand, players might lose their motivation, if the differences in the leaderboard grow too large.

The elements mentioned in this chapter are suggested by research to have a positive effect on user's performance and activity. Moreover, if the elements are applied conveniently in

the user interface of an application, they can have a positive effect on the user's motivation and engagement towards learning (Hamari, 2017, Sailer et al., 2014).

3.2 Game elements in Educational Music Applications

As a common overview of game elements is now established, this chapter proceeds to bring forward the results of the literature search of game elements, their implementations, and effects in musical games. Some game elements observed in the found literature of musical applications were similar to the elements found in gamification literature in general. (See table 2) Points and score-based elements appeared in most of the studies, associated with levels and visual progress. Regarding to gathered achievements, 4/11 music applications used Avatars as means to store points and to level up their character. Noteworthy was that some otherwise common game elements including goals, badges and unlocks appeared less frequently in the literature. On the other hand, innovative elements such as combat, story, and map were included in the studies even though they might not be commonly associated with music. Table 3 displays these findings.

<i>Game elements</i>	<i>Studies including</i>	<i>Freq.</i>
<i>Points, score</i>	Birch, Brett, Candel, Molero, Volioti, Wang 21, Wang 22	7
<i>Levels</i>	Birch, Dagnino, Molero, Sethawong, Volioti, Wang 21, Wang 22	7
<i>Avatars</i>	Birch, Candel, Dagnino, Volioti, Wang 22	4
<i>Progress (visual)</i>	Candel, Dagnino, Molero, Wang 22	4
<i>Goals</i>	Birch, Wang 21, Wang 22	3
<i>Badges</i>	Birch, Molero, Wang 22	3
<i>Unlocks</i>	Wang 21, Wang 22	2
<i>Leaderboards</i>	Candel , Wang 21	2
<i>Combat</i>	Sethawong	1
<i>Story</i>	Wang 21	1
<i>Map</i>	Wang 21	1

Table 3 - Game elements included in the reviewed studies

Score-based elements were implemented in the musical applications' user interfaces in various ways. One of the more unique ways was in the application Technique Tower (Birch and Woodruff, 2017). In the application, points and levels were displayed in the form of a tower that players had to climb up by playing musical scales. Every floor in the tower represented a level, and every window represented an exercise. According to the study, the active feedback that the scoring system offered proved to increase the player's motivation drastically (Birch and Woodruff 2017).

It turned out that avatars were surprisingly often implemented in musical games. Avatars appeared either as static or dynamic. Static avatars resembled profile pictures; they could be modified but not moved (Carrión Candel and Colmenero, 2022). Dynamic avatars could be controlled by the user and commonly traveled across maps and levels (Brett et al., 2020). Avatars were also implemented in VR- music applications. In VR- music applications the avatar could move in the same manner as the user which enabled the user to fully engage in the game (Volioti et al., 2015). The use of avatars in music games proved to raise engagement as they granted the user autonomy. For example, the user could decide on the character's appearance as well as where it moved. Moreover, avatars provided the user a sense of agency as they portrayed them as the main character of the game. This proved to critically improve users' learning process (Candel, Agustín et al., 2021).



Image 1 – Avatars (Birch 2017)

Game map and a surrounding storyline were among the less common game elements in music applications. For example, in Wang's (2022) study, a game map was implemented for the user to travel in. The map, a 2-dimensional plane, consisted of islands that portrayed levels. As the user progressed, they jumped between the islands finding collectable treasure boxes. Each treasure box opened the user a new instrument to play. An adventurous storyline was crafted behind this scene which proved to engage especially young learners.

Some music games also included external accessories that supported the game experience. In Setthawong and Tancharoen's (2015) study, they implemented a clip-on mirror that allowed the user to use the tablet horizontally. Since the game taught to play the ocarina, a type of flute, the horizontal viewpoint allowed for a similar user experience as to playing a wind instrument. Regarding to the game elements, the ocarina game was the only one using combat as a method of engagement. In the game the user battled virtual enemies by playing the instrument.

Another, more common, extension for music games was VR glasses. For example Molero, Schez-Sobrino et al. (2021) implemented mixed reality in to a piano application. The application assisted the user in playing piano by highlighting the piano keys with colors; green indicating correct notes, and red indicating incorrect notes. The application also included scores, levels, and badges in what the study identified as the "gamification layer". According to the study, the gamification layer "contained the part related to the learning of music, the motivation and the realization of the exercises." (Molero, Schez-Sobrino et al. 2021)

VR glasses were also part of Zhang and Bryan-Kinns, (2022) and Dagnino et al. (2015) studies about learning music to promote intangible cultural heritage. These studies analyzed serious games in teaching indigenous instruments (Zhang and Bryan-Kinns, 2022), singing, and composing (Dagnino et al., 2015). Both games allowed the user to wander and interact in a virtual room. Levels and visual progress proved to be useful in motivating the user since the music the games taught was unfamiliar for most of the users.

3.3 Effects of Game Elements in Educational Music Applications

From the found literature 6/11 studies experimentally reviewed the effects gamification had on users' sense of motivation and engagement as well as users' actual improvement on learning music. The findings from these studies are further discussed in table 4.

Authors	Implementation	Form of music	Game elements used	Effects of gamification Subjective/Objective/Both
<i>(Birch and Woodruff, 2017)</i>	Computer in application supporting music lessons. Research conducted in private piano lessons	Practicing an instrument	Points, levels avatars, goals badges,	Gamification had a significant positive effect on students' attitude and number of technical exercises students mastered. Concluding that gamification boosted student engagement and motivation. Subjective and objective
<i>(Carrión Candel and Colmenero, 2022)</i>	Computer application used in support for music lessons for secondary education students	Music course: general music knowledge and music theory	Points, avatars	Being the main agent highly motivated the students. Subjective
<i>(Molero et al., 2021)</i>	Mixed reality piano application	Practicing an instrument	Points (streak), levels, visual progress	The tool was motivating for beginners, but not as much for advanced musicians. Subjective
<i>(Wang, 2021)</i>	Computer application implemented in music lessons for secondary education students	Music course: practicing music theory and melody	Points, levels, avatar, leaderboard, story, map	Musical games with various game elements are appealing to learners and thus arouse users' motivation for self-regulated learning. However excessive use of game elements proved to distract the user from the initial learning process. Subjective and objective
<i>(Candel, 2022)</i>	Gamifying higher education music classrooms using existing tools i.e. kahoot, quizzes	Music course: general music knowledge and music theory	Points, badges, levels	On higher educational level gamified applications were incapable of increasing interest and motivation because of the complexity and level of proficiency the students had already achieved. Subjective
<i>(Wang, 2022)</i>	Computer application implemented in music lessons Tested for secondary education students and teachers	Music course: Practicing music theory and melody	Points, levels avatars, progress, goals, badges, unlocks	Generally, game-based learning had a positive effect on students' motivation. However, the complex game version proved to be distractive even for young students. Subjective and objective
<i>(Zhang and Bryan-Kinns, 2022)</i>	Gamified virtual reality game	Practicing an instrument	Badges, rewards	Participants invested more time on the application when using gamification mode, indicating immersion and motivation. However, when tested, their learning performance was worse. Subjective

Table 4 – Effects of gamification in the reviewed studies

The results displayed in table 4 indicate that gamification had an overall positive effect on various factors, such as the user's attitude, number of exercises mastered, interest in the subject, motivation for self-regulated practice and on the time immersed in learning (Birch, 2017; Candel, 2022; Wang, 2021; Zhang, 2022)

On the other hand, some research including Wang's (2022) study, pointed that for certain types of users, gamification was a less helpful tool in learning music. For instance, older and more experienced music students felt more distracted by game elements. Also, the easy nature of the games frustrated the experienced players. The study then concluded that the amount of gamification used in the application does not correlate with better learning. Instead, a gameful, yet not overly gamified application proved to have the best results on the the user tests. (Wang, 2022)

4. Discussion

4.1 Limitations

There are some matters of discussion when it comes to the limitations of this review. Firstly, the literature review reviewed the results of 11 papers, which is a surprisingly small amount of literature given the quantity of literature on gamification in other fields. Furthermore, the literature search was conducted in a rigorous, systematic manner, meaning that the resulting 11 publications might actually represent the proportion and leverage music games field has among the gamification field in general. Also, the studies themselves contained a relatively small sample size and in some studies, the sample size was unproportionate regarding to the age between the participants. For example, Wang's (2022) study included 27 young students, but only 18 adults. However, to explain this, most studies were conducted in school environments, where naturally, there are less teachers than there are students. Given the resources, this is understandable.

Another point of limitation is that the studies relied on applications that used a combination of game elements, whilst the effects of singular game elements were seldom studied. Therefore, it is difficult to draw conclusions from the evidence that some particular game element delivered more motivation or engagement to the user than others. In future studies single elements could be studied and categorized.

4.2 Conclusions

This systematic review focused on how gamification has been implemented in today's educational music applications to evoke engagement and motivation in the user. Although only a small amount of literature was obtained as sources for the study, some conclusions could be made. It appears to be that the game elements used in the music field were similar to the game elements found generally in gamification literature, points and levels being the most common game elements implemented in music applications (see table 2 and table 3). This indicates that the educational music application field follows the same footprints as other gamified fields. This might be because the field is still in an incipient stage or due to the fact that general game elements have already been proven as useful.

Positively, all the studies mentioned occasions where game elements evoked motivation and engagement in the user. For example, points proved to convey engagement in the user as they offered the user instant feedback (Birch, 2017; Candel, 2022; Molero et al., 2021; Wang 2022). Whereas levels proved to increase users' motivation as they reflected on the user's real-world skills (Birch, 2017; Dagnino et al., 2022; Molero et al., 2021; Sethawong 2022). Some of the studies found specific contexts, where gamification proved to distract the user. Commonly this happened for older, advanced music players where the user interface did not meet the requirements of the user (Wang, 2022).

To conclude this thesis: Gamification is a tool for enhancing user interfaces and user experiences. It is not making everything a game but using the best elements of games to make the application enjoyable. As technology evolves, gamification will be gradually defined by the needs of users and hopefully find its place in educational musical applications.

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