

# INVERTED DICTATION GAMES FOR HOME AND REMOTE EAR TRAINING

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## ABSTRACT

We present two inverted dictation ear training games, now included in the upgraded Troubadour platform for music theory learning. The Troubadour platform offers e-learning games for ear training in rhythm, intervals and harmonies in an open-sourced and user-centred environment. With now added inverted dictation games, the platform offers a new modality of ear training, which enables the students to practice their voice or instruments individually without the necessity of the teacher's presence while practicing.

## 1. INTRODUCTION

In 2020, the Troubadour platform (<https://trubadur.si>) was developed [1] to aid the music theory learning process with automated ear-training exercises. In contrast to several music-training-related apps and products, the music theory and ear training do not achieve the level of popularity among the self-taught users. In addition, it is difficult to use commercial platforms that do not offer the flexibility of adjusting the content based on the different curricula, which is often state-defined and regulated. The motivation for developing such learning platform lays in its accessibility, both as a free product, as well as the availability of the source code<sup>1</sup>. For the music-related training, the platform offers an accessible tool for music training using automated exercises, complementary to the scope of the existing learning management systems, such as Moodle. The platform allows students to receive personalized, automatically generated and graded exercises guided by the teacher, as well as direct feedback on their performance. The platform employs several gamification elements to increase the students' motivation—such as direct feedback, scores,

<sup>1</sup> [https://bitbucket.org/ul-fri-lgm/troubadour\\_production](https://bitbucket.org/ul-fri-lgm/troubadour_production)



Figure 1: New Troubadour 2.0 version - mobile interface.

levels, leaderboards, avatars, and badges—while enabling the teachers to regulate and modify the automatically generated exercises and monitor the students' progress.

In the last three years since its launch, the Platform was evaluated, where the results showed a significant performance increase in conventional exams in several test groups, which used the Troubadour platform, compared to control groups [1, 2], as well as longitudinal studies of using the Troubadour platform as a remote-learning tool during the Covid-19 pandemic, used both in-class and remotely [3].

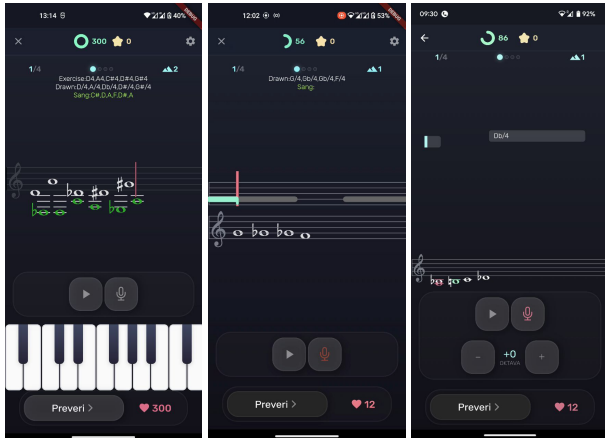
In the recent months, we published Troubadour mobile application for both Android<sup>2</sup> and iOS<sup>3</sup> platforms, along with the re-designed user interface (Fig. 1). The Troubadour platform offers a mobile-first user experience

<sup>2</sup> Play store: <https://play.google.com/store/apps/details?id=si.trubadur.v2>

<sup>3</sup> App store: <https://apps.apple.com/si/app/trubadur-si/id6449623053>

49 for existing rhythmic, interval and harmony games avail-  
 50 able both as mobile app and web interface<sup>4</sup>.

## 51 2. INVERTED GAMES



(a) First version (b) Second version (c) Third version

**Figure 2:** Inverted interval dictation game. During the development, we explored three versions. The final version contains the piano roll as a real-time visual aid, showing the sang pitch in a form of a blue box (left part of the screen).

## 52 3. VERSION 2.0

53 To aid the lack of IT support within the music schools, the  
 54 Troubadour platform now supports a multi-tenancy model,  
 55 therefore using a single hosted instance for multiple music  
 56 schools. New user roles of school administrator and super-  
 57 admin were added to retain the full control of the user man-  
 58 agement by an employee of each school, while the super-  
 59 admin role is now used to add new schools, school admin-  
 60 istrators and configure the system globally (e.g. adding  
 61 new games into mobile and web apps).

62 In addition to the Troubadour’s conventional dictation  
 63 games, where the user listens to a dictation and inputs their  
 64 response using a keyboard [4], we developed inverted dic-  
 65 tation games for intervals and harmony training. In these  
 66 games the role of the user is inverted to provide the re-  
 67 sponses in a form of a dictation. Their response is trans-  
 68 formed from audio into symbolic form using Yin algorithm  
 69 implemented as a Flutter package, which worked suffi-  
 70 ciently for single pitch detection in a combination with dy-  
 71 namic threshold of the input signal. To aid the user expe-  
 72 rience of the developed games, the dictation is supported  
 73 by a piano roll, which gives the user direct feedback about  
 74 the height of their pitch in real time. We tested several  
 75 versions of the interface with the target groups of music  
 76 school students.

77 Preliminary research of the students’ and teachers’ user  
 78 experience with the inverted games showed positive feed-  
 79 back in terms of the newly added interfaces (Table 1).

<sup>4</sup> Available at: <https://trubadur.si>

	2nd version	3rd version	$\delta$
<b>Attractiveness</b>	1.633	1.792	0.159
<b>Perspicuity</b>	2.000	2.094	0.094
<b>Efficiency</b>	1.400	1.750	0.350
<b>Dependability</b>	1.350	1.156	-0.194
<b>Stimulation</b>	0.950	1.250	0.300
<b>Novelty</b>	0.750	1.750	1.000

**Table 1:** Results and differences between second and third iterations of the interface.

80 Additionally, the students’ feedback indicated significant  
 81 need for games of this type. While we experienced some  
 82 issues with different mobile devices, specifically different  
 83 threshold levels and microphone capabilities, these were  
 84 addressed with addition of dynamic threshold during the  
 85 audio capture process. This challenge could be further re-  
 86 solved by including a wizard-like process at the first app  
 87 use, to obtain the individual device characteristics and ad-  
 88 justing the audio capture process accordingly.

## 89 3.1 Conclusions and Future work

90 The inverted games were included in the updated mobile  
 91 app in early August 2023. Current verbal feedback is posi-  
 92 tive, as the games are gaining popularity among both the  
 93 students and the teachers. We are planning a longitudi-  
 94 nal evaluation with the whole collection of the games in  
 95 early spring 2024. Concurrently, multiple music schools  
 96 are joining the platform, which will enable us to gather  
 97 feedback from a variety of schools and proficiency levels.

98 We are currently developing the inverted rhythmic dic-  
 99 tation game, which is planned to be included in the produc-  
 100 tion version of the Troubadour applications within the next  
 101 few months. Due to an increasing number of games, the  
 102 leaderboard and profile views will be redesigned to accom-  
 103 modate multiple statistics for a larger number of games.  
 104 To ease the administrative overhead, the hosting instance  
 105 of platform will be split into multiple instances targeting a  
 106 single level of music schools per instance. The source code  
 107 of the platform remains free to access<sup>5</sup>.

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