Gamification with the Universal Game Heuristic to Develop a Mobile Web Game for Learning Viena Karelian Dialect and Culture

University of Oulu
Faculty of Information Technology and Electrical Engineering / Information Processing Science / INTERACT
Master's Thesis
Triando Damiri Burlian
2 May 2019

Abstract

Learning Viena Karelian dialect and culture require an innovative approach to increase the willingness of learners to learn in a fun and an effective way. Karelian is an endangered language with only around 35,000 speakers, in contrast with 640,000 people who live in the Republic of Karelia. If the number of speakers slowly decrease every year and there are limited ways to learn, then those problems may lead this endangered language to be extinct in the future. Therefore, gamification approach was used to design and build an educational game from non-gaming contexts. In this research, a functional prototype was built to learn Viena Karelian dialect and culture, where the beginner learners, from English and Finnish speakers, can learn with desktop, tablet, and smartphone devices. Design science research was used as the research method and the universal game heuristic was used as the design cycle. A functional prototype that can be accessed by using web browsers was built with Laravel PHP framework and Bootstrap frontend framework. Learners can play the game and explore various features to learn Viena Karelian dialect and culture. Testing phase was conducted in the 3rd international GamiFIN conference with 38 players and 12 received feedback, and the result shown that the game motivated the test participants to play, with 91.7% positive engagement. The feedback is available for further improvement of Viena game development project and as a foundation to develop similar games for other Karelian dialects and culture.

Keywords
bootstrap frontend framework, design science research, gamification, karelian culture, karelian language, laravel php framework, universal game heuristic, viena karelian dialect

Supervisor
Dr. Leena Arhippainen – University of Oulu
Dr. Xiaofeng Wang – Free University of Bozen-Bolzano

Published paper

Damiri Burlian, T., Sharmila, P., Alavesa, P., & Arhippainen, L. (2019). Revitalizing Viena Karelian Dialect and Culture with Gamification. In *The 3rd International GamiFIN Conference*. Levi, Finland: CEUR Workshop Proceedings. April 8 – 10, 2019.

Research-In-Progress paper

Damiri Burlian, T., & Arhippainen, L. (2019). Gamification of Learning Viena Karelian Dialect and Culture with a Mobile Web Game. To be submitted: *The 2019 International Conference on Advanced Computer Science and Information Systems*. Bali, Indonesia: IEEE. October 12 – 13, 2019.

Foreword

Foremost, *alhamdulillah* (all the praises and thanks be to Allah). I would like to sincerely thank my supervisors, Dr. Leena Arhippainen and Dr. Xiaofeng Wang, who supported, guided, and helped me to complete my master's thesis. I would like to thank Dr. Mikko Rajanen, who helped me for the feedback as the master's thesis opponent. I am thankful to Prof. Barbara Russo, Ph.D., Ovais Ahmad, Elena Gabardi, and all staff of the European Masters Programme in Software Engineering (EMSE) who contributed to my study and scholarship in Free University of Bozen-Bolzano (Italy) as my first year university and University of Oulu (Finland) as my second year university.

Thanks to *Karjalan Sivistysseura* – Karelia Cultural Society (established in 1906) for funding the VIENA-PELI project and Febyola Tiara Putri as a UI/UX expert who helped me in the design phase. I would like to express my thanks to all my family and friends who give direct and indirect contributions to me. Finally, special thanks to Indah Ayu Fauziah.

Triando Damiri Burlian

Oulu, 2 May 2019

Contents

Figures

Tables

1. Introduction

Karelian is a minority language with only around 35,000 speakers, in contrast with the total population of 640,000 people in the Republic of Karelia (Klementyev, Kovaleva, & Zamyatin, 2013; Rosstat, 2010). This situation shows there is less than 6% of the total population in the Republic of Karelia that can speak Karelian language, mostly because the official language is Russian (Klementyev et al., 2013; Salonen, 2017). There is a need to revitalize the language and culture of Karelian with a unique solution for different age groups and language backgrounds.

Previously, the teaching of Karelian language and introduction of culture are focused on the small scale and traditional approach by organizing language courses (Karjalainen, 2018; Riionheimo, 2018). In this research, gamification approach was used to make an educational game from non-gaming contexts, which were the teaching of language and culture. The game that was developed in this research is an interactive, fun, and convenient to use with the implementation of mobile web responsive. The game prototype was built mainly with Laravel PHP framework and Bootstrap frontend framework, which is available online[1] and can be accessed with desktop, tablet, and smartphone devices that have web browsers such as Google Chrome, Firefox, and Opera.

Language and culture are non-gaming contexts and usually can be learned from formal studies, books, social interactions, and as native languages. Gamification approach can be used to develop games from non-gaming contexts by applying game design elements, where it increases the motivation and engagement of players (Deterding, 2012; Deterding, Khaled, Nacke, & Dixon, 2011). The motivation and engagement of players are important to increase the effectiveness in language and culture learning. Moreover, educational games that are built with gamification approach can improve the fun experiences and knowledge acquisition, rather than by using only face-to-face learning in the classroom (Backlund & Hendrix, 2013). Those facts motivated the researcher to develop an educational game to learn Viena Karelian dialect and culture.

Karelian language is divided into two dialects, which are Karelian Proper and Olonets Karelian. Moreover, Karelian Proper is divided into North Karelia (Viena/White Sea), and South Karelian (Klementyev et al., 2013; Salonen, 2017; Sarhimaa, 2011). The goal of this research is to help English and Finnish speakers to learn Viena Karelian dialect and culture, therefore the long-term plan is to increase the opportunity between new learners and Viena Karelians to communicate in the future. Learning while playing can make players feel that they are entertained with the game and can gradually increase their language skills and knowledge about a culture.

Knowledge acquisition is the main goal of educational games where players can attain new information and experiences for teaching purposes (Boyle et al., 2016). It increases the motivation and willingness of learners to learn, instead of using a traditional method of teachings such as learning from books. Educational games provide a better learning environment than by using a traditional approach, and it usually implemented as desktop games and mobile games (Backlund & Hendrix, 2013; Ferdig, 2009; Giessen, 2015). Moreover, gamification of language learning was the common implementation with

[1] LearnVienaKarelian.tk

positive results and can increase the motivation of learners in the English teaching program (Amoia, 2011; Giessen, 2015).

There were no existing mobile web responsive games to learn Viena Karelian dialect and culture. The researcher was involved in this project since September 2018 and made the first non-functional prototype with other researchers to gather early feedback from the test participants. The researcher as one of the authors published a paper (Damiri Burlian, Sharmila, Alavesa, & Arhippainen, 2019) about the first non-functional prototype in the 3rd international GamiFIN conference at Levi, Finland. The development of the first non-functional prototype was important to get preliminary user experience information for the next game development.

The games that inspired the researcher were Duolingo, Mondly, and Garden of Times. Duolingo and Garden of Times were used as basic references in the first prototype. However, Garden of Times was not used in the second prototype, since the game focuses on the entertainment aspects rather than educational purposes. Additionally, Mondly is a quite complex game with too many 3D animations aspects rather than focuses on the educational context and simple elements. Therefore, Duolingo was used as the main reference in the second prototype because it has simpler user interfaces, the gameplays are more focus in the learning aspects, many active learners around the world, and the researcher has played this game since 2013.

Duolingo is a language learning game that can be played on the web platform, Android operating system, and iOS operating system. It offers many languages to learn such as Spanish with 21.3 million learners, French with 12.5 million learners, and German with 7.02 million learners. (Duolingo, 2018). The second functional prototype was developed with mobile web responsive and as the focus in this thesis, by using the feedback and evaluation from the first non-functional prototype, and Duolingo as the main reference for design elements.

The purpose of this research was to develop a game with gamification approach in the mobile web responsive platform, specifically for desktop, tablet, and smartphone devices, so the beginner learners can learn Viena Karelian and culture in a fun and effective way. The application allows learners to play by using web browsers without installing the game in their devices. A playtest was conducted with 38 learners and 12 received feedback in the 3rd international GamiFIN conference, ages from 20 to 50 years old. This game artifact and evaluation from the testing phase became inputs for further development of Viena game development project. Moreover, the result is available as a foundation to extend the game for other dialects and culture of Karelian. Thus, two research questions were formulated:

- RQ1: How the universal game heuristic can be used to develop a game from non-gaming contexts to learn Viena Karelian dialect and culture?
- RQ2: What are the advantages and disadvantages of using the universal game heuristic in the language learning and culture game of Viena Karelian?

Design science research was used as the research method to answer those research questions and the universal game heuristic was used as the design cycle. The research objective was exaptation, where similar solutions can be gathered from related works and a similar language learning game as references, which were used for a new problem of Viena game development. The result of this research can be extended for other dialects and culture of Karelian as a further research opportunity and knowledge contribution in the future.

The main contributions were the general context to gamify Viena Karelian dialect and culture, the design concept and elements, the developed software artifact, the plan for release and support of the game for a scalability in the future, the evaluation of using the universal game heuristic, the concept plan to expand the game for other dialects and culture of Karelian, and the language learning model.

The following thesis structures consist of: Literature review related to gamification, game heuristic, Laravel PHP framework, and Bootstrap frontend framework are described in Chapter 2. The research objective of exaptation, research method of design science research, and design cycle of the universal game heuristic are presented in Chapter 3. The implementation by using the universal game heuristic from the context phase, design phase, production phase, testing phase, and release and support phase, are described in Chapter 4. The evaluation of implementation from the fourth chapter is described in Chapter 5. Research questions and theoretical implications are addressed in Chapter 6. Summary, limitations, and suggestion for the future work of the research are presented in Chapter 7.

2. Literature Review

This chapter explains the literature review of gamification, game heuristic, Laravel PHP framework and Bootstrap frontend framework. The first section presents the definition of gamification and successful gamification projects. The second section describes the related work of game genres and game heuristics. The third section presents similar educational games to learn language and culture that were used as design references. The fourth section gives an overview of Laravel PHP framework and Bootstrap frontend framework.

2.1 Gamification

Gamification is the use of game design elements in non-gaming contexts to develop games (Deterding, 2012; Deterding et al., 2011). The purpose of gamification is to increase the motivation and engagement of users (Kapp, 2012; Sørensen & Meyer, 2007). Several examples of non-gaming contexts are books, face-to-face learning, and social interactions to learn language and culture in educational settings. Gamification of learning is the common project implementations that can increase the positive engagement and the motivation of users (Amoia, 2011; Hamari, Koivisto, & Sarsa, 2014).

Gamification can make learning environments more attractive and focus on educational elements. Game design elements for gamification are simpler than pure-entertainment games because it focuses on the knowledge acquisition and learning process (Backlund & Hendrix, 2013; Boyle et al., 2016). For example, the elements are levels, progress status, and score (Deterding, 2012). Thus, the elements can be applied in non-gaming contexts to develop educational games with simpler features than games for pure entertainment (Backlund & Hendrix, 2013).

Gamification can be applied for educational purposes, that focus on the learning environment rather than entertainment (Backlund & Hendrix, 2013). Educational games are better than traditional teaching methods such as face-to-face learning in the classroom and it is usually implemented as games in the computer and mobile platforms (Backlund & Hendrix, 2013; Ferdig, 2009; Giessen, 2015). The main goals of educational games are to increase the effectiveness of the learning process and knowledge acquisition (Boyle et al., 2016). Users can learn while playing the games with interesting and attractive gameplays for educational purposes.

Moreover, educational games focus on engagement, simpler features, gameplays, and learning activities (Boyle et al., 2016; Kapp, 2012). Those aspects increase the willingness of users to learn and increase the effectiveness of knowledge acquisition. Furthermore, educational games should easy to play and focus on the educational aspects rather than social interactions in pure entertainment games (Heeter et al., 2003). Social interactions are less in the educational games because it helps users to focus on the learning process and educational elements.

A recent study of an educational game to learn English shown that gamification approach achieved better knowledge acquisition to improve listening, reading, and writing skills (Suh, Kim, & Kim, 2010). Furthermore, those skills can be taught with audio and video materials to increase the effectiveness of learning, rather than by using only written texts (Backlund & Hendrix, 2013). Additionally, there are four skills of listening, reading,

writing, and speaking that can be taught in language learning games (Stanley & Mawer, 2008; Wouters, Van der Spek, & Van Oostendorp, 2009).

2.2 Game Heuristics

A heuristic is a practical method to achieve an optimal solution from problem solving and self-discovery of previous research (Pinelle, Wong, & Stach, 2008). In game development, heuristic refers to design principles, usability, and rules that are based on the game's evaluation (Clune, 2007; Pinelle et al., 2008). The game's implementation with game heuristics shown better results, because the evaluation models from existing games are used as a benchmarking and comparison to developing future products (Desurvire & Wiberg, 2009; Mylly, 2011). The implementation with game heuristics cannot guarantee the result to be perfect, but it provides a structured implementation process to develop a new product with a specific goal and genre (Mylly, 2011).

There are seven game heuristics that were evaluated and defined in the (Mylly, 2011) as basic references to develop a future game. Each game heuristic has five phases and it can be used as a design cycle in the design science research method. The game heuristics were mostly based on computer games. However, there were a few evaluations based on console games. Moreover, game heuristics can be used in many platforms such as in the mobile web platform, because the models were defined at a general level. (Mylly, 2011). There are seven genres of game heuristics which are:

- Strategy Genre
  Strategy genre is a game genre that makes players to focus on the decision making and strategic decision for many possibilities of gameplays (Barraclough, Conroy, & Lee, 2004). For example, a strategy video game on the computer platform is a war game. Players can use different tactics to play the game and make a correct and strategic decision to win the game (Aha, Molineaux, & Ponsen, 2005). The games usually available as online games because it allows many players to play with each other and compete in the strategic gameplays.
- Role-Play Genre
  Furthermore, role-play genre is a game genre that makes players feel that they are the main characters in the game and they play as fictional subjects in the game (Smyth, 2007). For example, a role-playing game in the mobile platform is the sims. Players can select a character gender, an appearance, a house, and a job. The goal of this game genre is to discover a specific storyline such as a father in a family and enjoy the game features for pure entertainment (Hunicke, LeBlanc, & Zubek, 2010).
- Action Genre
  Moreover, action genre is a game genre that focuses on the physical and visual elements of character, in order to make players play with other human players or computer players (Green & Bavelier, 2003). For example, an action game on the computer platform is a fighting game. Players can select a character and they can play with other players. The main focus in this genre is a visual experience, where players can fight with each other and they really feel that they fight with other players (Green & Bavelier, 2003).
- Simulation Genre
  Another game genre is the simulation genre, that simulate the real-life situation and engage the cognitive process of particular activities (Traci Sitzmann, 2011). For example, the simulation game is the flight simulator, where players can act as a pilot and other player as a staff in the airport. Players can play in a real-time

situation and they can interact with other players via online, as they really simulate the real situation in the airport. However, this game is specific to activities as the players cannot simulate other activities such as act as a passenger in the plane.

- Sports Genre
  Furthermore, the sports genre is a game genre that focuses on sports activities with at least two players (Kagan & Solomon, 1997). Players are humans and artificial intelligence, or humans and humans. One example of a sports game is a football game on the computer platform. Players can select one team and play with another player to win a single match or a specific football tournament. The visual elements and players interaction are the key components in this genre because it increases the interactions between players attractively (Kagan & Solomon, 1997).
- Adventure Genre
  Moreover, the adventure genre is a game genre that makes players explore an interactive gameplays and focus on the narrative story (Dickey, 2006). For example, an adventure game is the walking dead, where players play as one of the fictional characters to survive in the zombie apocalypse. The purposes of this genre are entertainment and edutainment to explore the game world (Pivec, 2007). The stories are pre-defined, and players can select many combination paths to finish the storylines.
- Universal Genre
  Universal genre is a game genre that covers all common genres in general contexts (Mylly, 2011). For example, a universal game is Duolingo, a language learning game, where learners can learn languages to increase the listening, reading, writing, and speaking skills (Ye, 2014). Duolingo offers many topics and levels to learn while the contents are always updated by language communities. This heuristic genre focuses on the general level, where other genres might be too specific to be implemented in game development (Mylly, 2011).

All game heuristic models can be used to develop new products as a workflow of the development process. Each heuristic model has five phases, which are context phase, design phase, production phase, testing phase, and release and support phase (Mylly, 2011). Game heuristics are used to evaluate the playability, usability, and designs from existing games as models to develop future game products (Desurvire, Caplan, & Toth, 2004; Desurvire & Wiberg, 2009). Game developers can utilize those phases to follow an optimal solution of game development project based on the previous systematic evaluation.

2.3 Similar Language and Culture Learning Games

In the previous research, a non-functional prototype was developed and used to gather early feedback from the test participants. The result of the early stage of this project was published in the 3rd international GamiFIN conference (Damiri Burlian et al., 2019). In the first prototype, Duolingo and Garden of Times were used as references, where Duolingo focuses on language learning, and Garden of Times focuses on cultural learning. Both games can be played online for free on the mobile web platform. The relevant features were adapted from those games to develop the first non-functional prototype with simple features and focus in the learning activities.

Duolingo is a language learning game in the Android operating system with more than seven million users and almost has five stars rating in the Google Play (Google, 2019). This application offers many languages to learn for free with in-game advertisements. There are several topics to learn such as basic topic, foods, drinks, greetings, and numbers.

Each topic increases the skills of listening, reading, writing, and speaking with many gameplays. Those variations are included in every topic and the difficulty is increasing for every level, for example, after users finished the first level, they can play the second level, which is harder than the previous one. The variations to learn languages in the Duolingo are presented in **Table *1***:

Table 1. Gameplay Variations in the Duolingo game

Learning Objective	**Description**
A noun	Select one picture that represents the noun
A sentence	Select multiple words of buttons to form a sentence
Sentence completion	Select a word button to fill the gap of the sentence
Listening	Select multiple words of buttons to form a sentence
Listening and writing	Write a word or a sentence from the pronunciation
Sentence translation	Write the sentence translation
Word pairs	Tap pair words until there is no word left
Speaking	Speak a word or a sentence from the written text

Moreover, Duolingo uses streak counts, progress status and score points to show learning progress (Duolingo, 2018). This application has similar features that are described in the (Deterding, 2012), where simple features and progress status are used to increase the engagement and learning activities. The first non-functional prototype in this research adapted the features of select multiple words of buttons, select one picture that represents the noun and score points (Damiri Burlian et al., 2019).

Furthermore, Garden of Times was used in the first non-functional prototype because it has many players on Facebook with gameplays of cultural learning (Facebook, 2018). Players can play a specific storyline and finding a hidden object from different cultural scenes. However, the gameplays in this game is purely for entertainment, rather than offers a specific learning objective to learn a new culture. Additionally, Mondly as a language learning game has too many 3D gameplays and complex features. Thus, the Garden of Times and Mondly were not used as references in the second functional prototype in this research.

2.4 Laravel PHP Framework and Bootstrap Frontend Framework

Predecessor Hypertext (PHP) is an open source language for web development and it is used as a core language along with other languages such as HTML, CSS, and JavaScript (Olanrewaju, Islam, & Ali, 2015). This language can be used on the Apache web server to process and render web applications. There are many PHP frameworks that make web implementation easier and better performance than developing a new web application from scratch. One of the PHP frameworks that widely used by software developers is Laravel PHP framework (Pop & Altar, 2014).

Laravel uses model-view-controller architecture to handle complexities by dividing it into three layers (Olanrewaju et al., 2015). This architecture makes the code to be more structured and organized, increase the performance, and increase the modularity. For example, the code structure is organized by different folders and libraries that represent each functionality of a layer. Moreover, the performance of this framework can be tested by running complex database queries in one-time requests to the server (Das & Saikia, 2016).

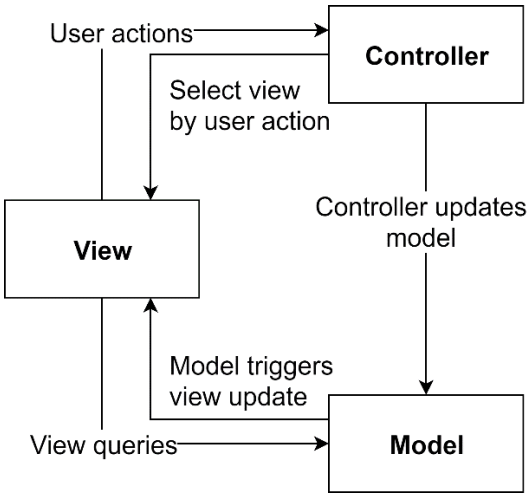


Figure 1. Model-view-controller in Laravel PHP Framework (adapted from Verma, 2014)

The architecture of model-view-controller on Laravel PHP Framework is presented in **Figure *1***. Model is a layer for database, object-relational mapping, and active records (He, 2015). Object-relational mapping is an encapsulation concept of a raw database query to human-readable syntax, by transforming objects and database in memory (Chen, Ji, Fan, & Zhan, 2017). This feature in Laravel is called Eloquent and it helps the software developer to make the code more structured and readable for long-term development.

Moreover, the view is a layer for user interfaces and handle the interface presentations and interactions by manipulating HTML, CSS, and JavaScript languages (Cui, Huang, Liang, & Li, 2009). Additionally, the controller is a layer to handle the logic and data transfer between the model and view layers (Olanrewaju et al., 2015). This layer can be used with standard PHP libraries and mixed together with Laravel pre-defined functions (Nguyen, 2015).

Furthermore, a frontend framework is used to make the user interface looks more attractive, lightweight, and responsive (Shenoy & Prabhu, 2018). Bootstrap is a powerful frontend framework to develop responsive user interfaces and can adjust with a mobile view (Jain, 2015). This framework consists of HTML, CSS, JavaScript languages (Jain, 2015). It supports responsiveness in the desktop, tablet, and smartphone devices. Thus, Bootstrap frontend framework was used in the view layer to make the user interfaces more responsive, more structured, good layouts, and increase the usability.

3. Research Methodology

This chapter describes the research objective and research method of this research. The first section presents the research objective of exaptation and formulated research questions. In the second section, design science research is described as the research method and the universal game heuristic is explained as the design cycle. Moreover, the reason for choosing the research method, and all phases of the universal game heuristic are included in the second section.

3.1 Research Objective

There are four contribution types in the knowledge contribution framework, which are the improvement, invention, routine design, and exaptation as presented in **Figure *2*** (Anderson, Donnellan, & Hevner, 2011; Gregor & Hevner, 2011). Improvement type is the development of new solutions for existing problems. Furthermore, invention type is the development of new solutions for new problems. Additionally, exaptation type is the development of similar solutions for new problems. Lastly, routine design type is the development of existing solutions for existing problems. (Gregor & Hevner, 2013).

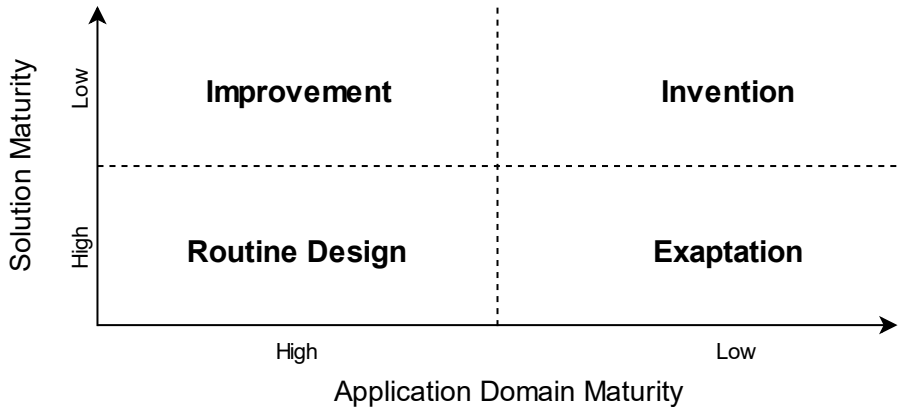


Figure 2. Knowledge Contribution Framework (adapted from Gregor & Hevner, 2013)

In this research, the research objective is exaptation, where gamification approach and a similar game to learn language and culture were adapted for new problems in Viena Karelian game development project. Those new problems were addressed by using design science research as the research method. The research objective was formulated into two research questions:

- RQ1: How the universal game heuristic can be used to develop a game from non-gaming contexts to learn Viena Karelian dialect and culture?
- RQ2: What are the advantages and disadvantages of using the universal game heuristic in the language learning and culture game of Viena Karelian?

The first research question (RQ1) was about to find a way to gamify the non-gaming contexts to learn Viena Karelian dialect and culture, by applying the universal game heuristic as the design cycle. The game is available for beginner learners to learn the dialect and culture, ranging from 20 to 50 years old, where the researcher focused on the adult users. The concept of gamification and development phases were applied and conducted to develop a game that is interested to play and learn. Therefore, the educational purposes and knowledge acquisition were achieved in this game artifact.

Moreover, the second research question (RQ2) focused on the evaluation of using the universal game heuristic in Viena Karelian dialect and culture game. The advantages and disadvantages of using this heuristic were defined as the result of the evaluation of this heuristic. The result became an input whether the universal game heuristic was already properly defined as a universal genre and to improve in some aspects of this heuristic. Therefore, the heuristic was validated and improved, so it can be used for another development of games in the future, and other researchers can choose this heuristic based on the advantages and disadvantages that are described in this research.

3.2 Research Method

Design science research is a research method to answer research questions that are related to human problems (Hevner & Chatterjee, 2010). Problems are addressed with the development of innovative artifacts that contributes to scientific knowledge and can be validated by scientific processes (Gregor & Hevner, 2013). The successful artifacts are observed and validated, so the researchers can answer research problems by applying unique solutions in the developed artifact (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007). Therefore, this research method was used in this research to develop an innovative solution by developing a game artifact to learn Viena Karelian dialect and culture.

Moreover, design science research is used to provide an opportunity to develop innovative artifact (Edelson, 2002). The developed artifact was used to address the research questions by observing and evaluating the result. An artifact is an innovative solution that is used for the validation of research goals (Offermann, Levina, Schönherr, & Bub, 2009). The result may be achieved by iterative processes of design science research activities and collaboration among researchers to achieve better design principles and developed artifacts (Plomp, 2013). The design science research cycles in **Figure *3*** is used as the basis of Information System research framework (Hevner, 2007):

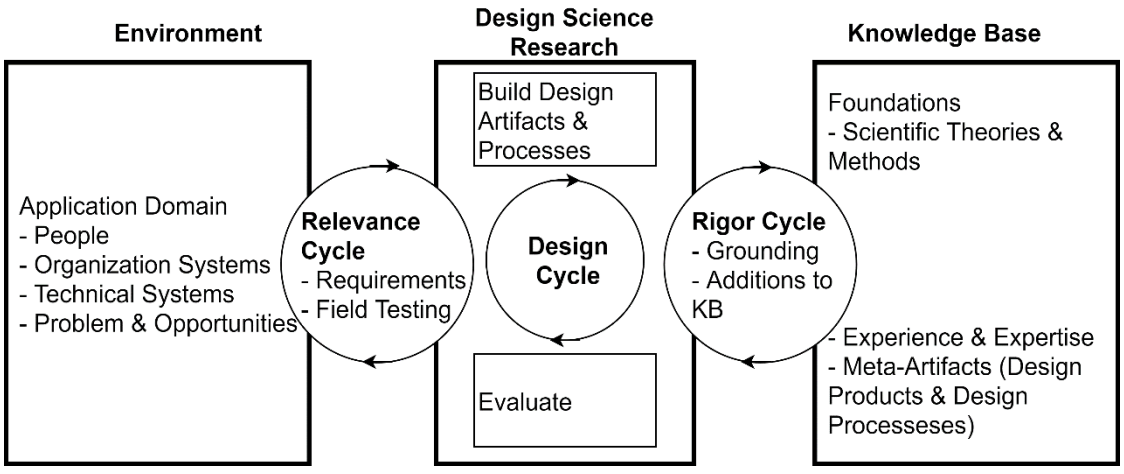


Figure 3. Design Science Research Cycles (adapted from Hevner, 2007)

3.2.1 Design Science Research Components and Activities

In the environment scope, there are four components related to the application domain, which are people, organization systems, technical systems, problem and opportunities as presented in **Figure *3***. The relevance cycle utilizes the iterative inputs from the environment activities. The design cycle focuses on building the artifact and evaluation

activities, which the result is used in the relevance cycle and rigor cycle. The rigor cycle utilizes the iterative inputs from the knowledge base area as foundations in the design science research activities. The requirements and field testing activities from the relevance cycle are related to design science research activities, and the grounding and additions to KB activities from the rigor cycle are related to the design science research activities. (Hevner, 2007).

The processes of design and development are related to a design cycle, where the result can be done iteratively to get the desired result of artifacts. The evaluation activity may include any knowledge from a knowledge base such as scientific theories and methods to support the activities and results in the design science research. Design principles are defined in the early phase of design science research. Previous research and existing knowledge are used to design and develop artifacts. The result of design science research is different from the regular implementation of IT artifacts, where the regular IT artifacts only used well-established knowledge for common problems. (Hevner, 2007).

3.2.2 The Universal Game Heuristic as the Design Cycle

The design cycle is the main activity in the design science research cycles, which are consists of the building of artifacts and evaluation activities through the whole processes (Hevner, 2007). Moreover, the design cycle in design science research is defined to develop artifacts and conduct the research. The universal game heuristic from (Mylly, 2011) was used as the design cycle in this research, as presented in **Figure *4***:

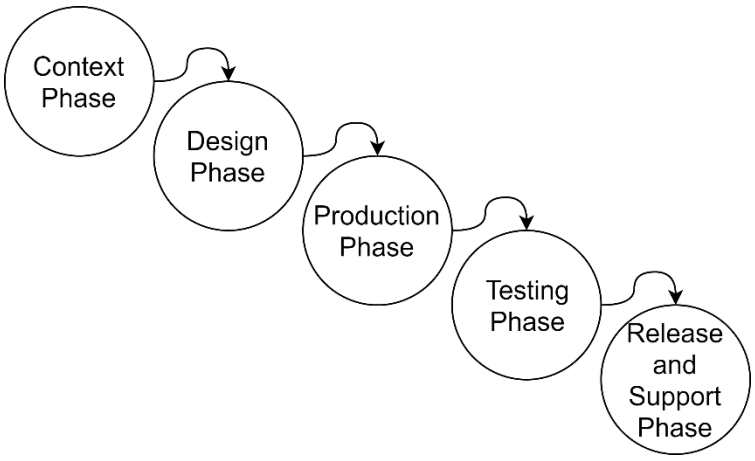


Figure 4. Phases of Game Heuristic

Context Phase

The first phase is the context, which is used to define the main goal and unique values to attract players (Mylly, 2011). The components in the context phase mainly about the concept and as a foundation to conduct all phases. The game was developed with mobile web responsive of Laravel PHP framework and Bootstrap frontend framework. This technology allows the players to play from desktop, tablet, and smartphone devices without a specific operating system. The game provides a challenging learning material and fun activities to keep the players want to learn in the long term. In educational games, it is very important to keep the game interesting, balanced and motivated the users (Carro, Breda, Castillo, & Bajuelos, 2002; Kiili, 2005).

Design Phase

Moreover, the second phase is design, which is used to design game elements that players might want to play (Mylly, 2011). The design elements are very important to finalize before the production phase since the production phase takes more effort to develop a game prototype. The design software that was used in this research was Balsamiq. Balsamiq was used to create wireframes as basic concepts of design elements. Design elements should focus on user engagement, where it attracts users to use the products by providing attractive user interfaces (Sutcliffe, 2009).

Production Phase

Furthermore, the third phase is production, where a game artifact is developed based on the design elements from the previous phase (Mylly, 2011). The developed game artifact should be playable, and the technology depends on the goal from the main context. In this research, the game is available for responsive web platforms, which can be accessed from web browsers of desktop, tablet, and smartphone devices. The mobile web responsive is supported by HTML5 as the better version than HTML to develop mobile web applications (Serrano, Hernantes, & Gallardo, 2013). Moreover, Laravel PHP framework can be used to develop a dynamic website with the localization feature (Awale, 2018). This localization feature allows the game to be playable for English and Finnish speakers, as there is only need one game to be developed with two different languages localization.

Testing Phase

Additionally, the fourth phase is testing, where test participants are gathered to conduct the game testing. A test evaluation focuses on the gameplays and user experience of the game. (Mylly, 2011). In this research, test participants were from participants of the 3rd international GamiFIN conference with ages from 20 to 50 years old. The participants played the game and filled a survey form based on user experience aspects, whether the desired user experience aspects were met. Moreover, some participants gave a comment about game improvement in the future.

Release and Support Phase

Lastly, the fifth phase is release and support, which is used to prepare the game to be released and ready to play. Moreover, the game is maintained by providing a contact form to players in the game, so they can contact the respective contact person to handle problems and answer questions. (Mylly, 2011). In this research, the game information is available online at LearnVienaKarelian.tk. Learners can find any information about the game and submit any feedback for the future development of the game. Moreover, the questions can be developed further as frequently asked questions (FAQ), where players can find an answer easily and increase user experiences (Burke et al., 1997).

4. Implementation

This chapter explains how the universal game heuristic as the design cycle had been used in this research. This chapter consists of context phase, design phase, production phase, testing phase, and release and support phase. The universal game heuristic was adapted from (Mylly, 2011), which was very helpful to conduct a practical game implementation from the planning of context to the preparing of game release based on the structured heuristic processes.

4.1 Context Phase

The target learners for this game artifact are English and Finnish speakers, range from 20 to 50 years old. The game was made with simple features and easy gameplays, thus people from any age groups can play it without any difficulties and can give any feedback with a feedback form in the game. The game was developed with a widely-used and user-friendly Bootstrap CSS framework. This framework supports the development of unique user interface and can be used to provide a responsive interaction to learners.

The game flow consists of dialect and cultural learning with several topics and levels. For example, topics are food and drink, clothing, and furniture. Each topic consists of three levels, which are easy, medium, and hard. The game flow is presented in **Figure *5***.

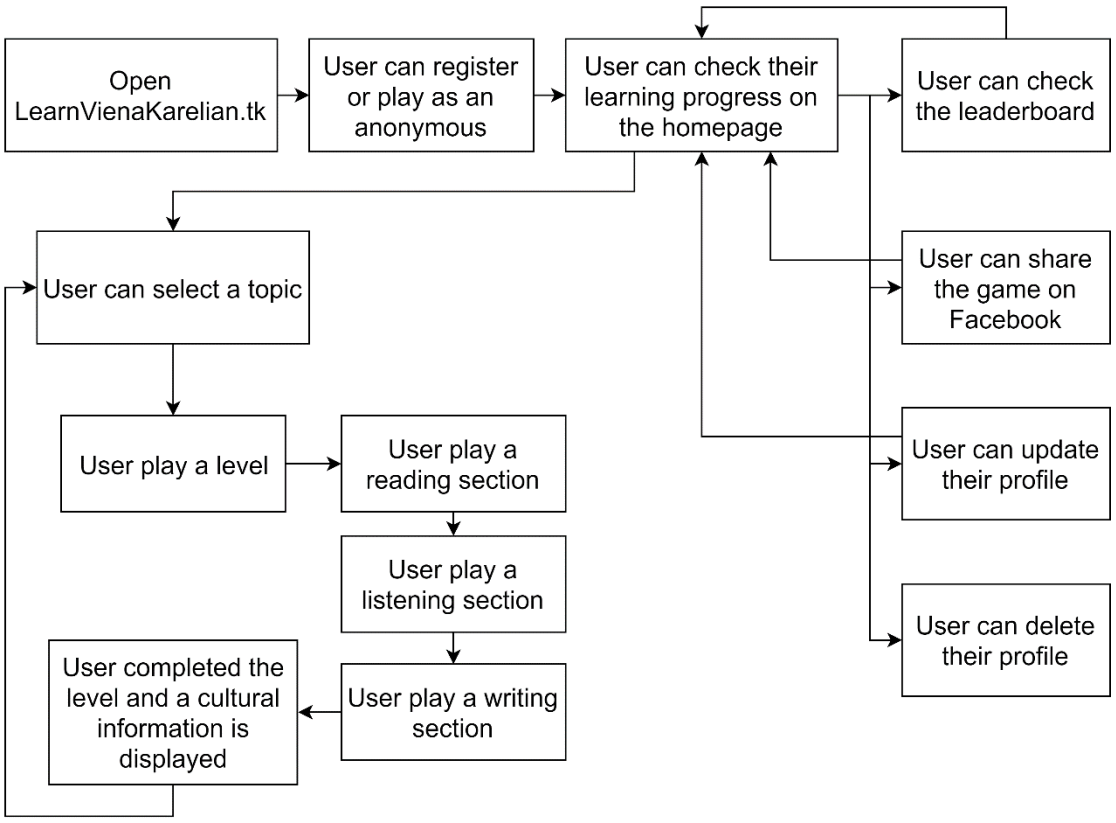


Figure 5. Game Flow

The goal of this game is to learn Viena Karelian dialect and culture in a fun and effective way. Language is learned by playing different topics and levels, and culture is provided as information on every completed level. The topics are food and drink, clothing,

furniture, seasons, body, number, days and months. The examples of every topic in level easy are presented in **Table 2**. More details of game contents can be found in the game repository[2].

Table 2. Examples of Level Easy

Topic	English	Finnish	Viena Karelian
Food and drink	Apple	Omena	Omena
Clothing	Sweater	Villapaita	Villapaita
Furniture	Chair	Tuoli	Stuula
Seasons	Spring	Kevät	Kevät
Body	Hand	Käsi	Käši
Number	One	Yksi	Yksi
Days and Months	Monday	Maanantai	Enšiarki

Learners can learn the dialect and culture with a single player mode. Moreover, learners can play the game every day to achieve a better understanding of Viena Karelian dialect and culture, where the progressive achievement of topics can be found on the home page. The in-game time is based on real-life time, so learners can see their weekly score and they can track their learning progress. The game platforms are desktop, tablet, and smartphone devices with minimum width 320px to 1281px (portrait). The game can be accessed with web browsers such as Google Chrome, Firefox, and Opera. Different topics and levels provide multiple possibilities to be completed that can be seen in **Table *3***.

Table 3. Skills and Levels

Skill	Level	Learning Objective	Description
Reading	Easy	A word	Select a picture that represents a Viena Karelian word
Reading	Medium	A simple sentence	Select a sentence that represents a simple Viena Karelian sentence
Reading	Hard	A complex sentence	Select a sentence that represents a complex Viena Karelian sentence
Listening	Easy	A word	Select a picture that represents a pronunciation of Viena Karelian word
Listening	Medium	A simple sentence	Select a sentence that represents a pronunciation of simple Viena Karelian sentence

2 https://github.com/triandotriando/learnvienakarelian/blob/master/database/seeds/LearningObjectivesTableSeeder.php

Skill	Level	Learning Objective	Description
Listening	Hard	A complex sentence	Select a sentence that represents a pronunciation of complex Viena Karelian sentence
Writing	Easy	A word	Write a word translation from a Viena Karelian word
Writing	Medium	A simple sentence	Write a sentence translation from a simple Viena Karelian sentence
Writing	Hard	A complex sentence	Write a sentence translation from a complex Viena Karelian sentence

Furthermore, cultural information is displayed after a level completion. Several examples of cultural information are:

- (English) The most known version of the Kalevala (New Kalevala) was first translated to Swedish in 1841. Finally, in 2015 The Kalevala was published in its originating Karelian language (Viena Karelian).
- (Finnish) Tunnetuin Kalevalan versio (Uusi Kalevala) käännettiin ensimmäiseksi ruotsiksi vuonna 1841. Viimein vuonna 2015 Kalevala käännettiin sen alkuperäiselle Karjalan kielelle vienankarjalaksi.
- (English) The Kalevala, the Finnish national epic, has been translated into over sixty languages and it is Finland's most translated work of literature. Raisa Remšujeva translated the Kalevala in Viena Karelian.
- (Finnish) Kalevala, Suomen kansalliseepos, on käännetty yli 60 kielelle ja se on Suomen kirjallisuuden käännetyin teos. Raisa Remšujeva käänsi Kalevalan vienankarjalaksi.
- (English) The most commonly known version of the Kalevala (New Kalevala) was published in 1849. It includes 22,795 verses and is divided into 50 folk stories.
- (Finnish) Kalevalan tunnetuin versio ilmestyi vuonna 1849 ja se sisältää 22,795 säkeistöä jaettuna 50 kansantarinaan.

More details of cultural information can be found in the game repository[3]. The language contents and cultural information were provided by the first supervisor, Dr. Leena Arhippainen, as she has a project of the VIENA-PELI with *Karjalan Sivistysseura*, Karelia Cultural Society in Finland, and she is currently learning Viena Karelian dialect as her focus.

4.2 Design Phase

The game elements and settings are based on Viena Karelian dialect and culture to keep the interest of learners. The figure assets of cultural information in-game were adapted

[3] https://github.com/triandotriando/learnvienakarelian/blob/master/database/seeds/CulturalInformationTableSeeder.php

from Viena Karelian books[4,5], newspaper[6], books by Olga Karlova (Karlova, 2011) and Pekka Zaikov (Zaikov, 2013), The Dictionary of Karelian (Dictionary of Karelian, 2009), and some pictures such as mittens and Heimopäivät were from Dr. Leena Arhippainen. Mock-up of user interfaces were developed with a cloud service, https://balsamiq.cloud, that can be used to design wireframes with very minimum effort that focuses on the low-fidelity design. This application offers 30 days trial for free and can be used together synchronously with other people. The landing page of this game is presented in **Figure 6**.

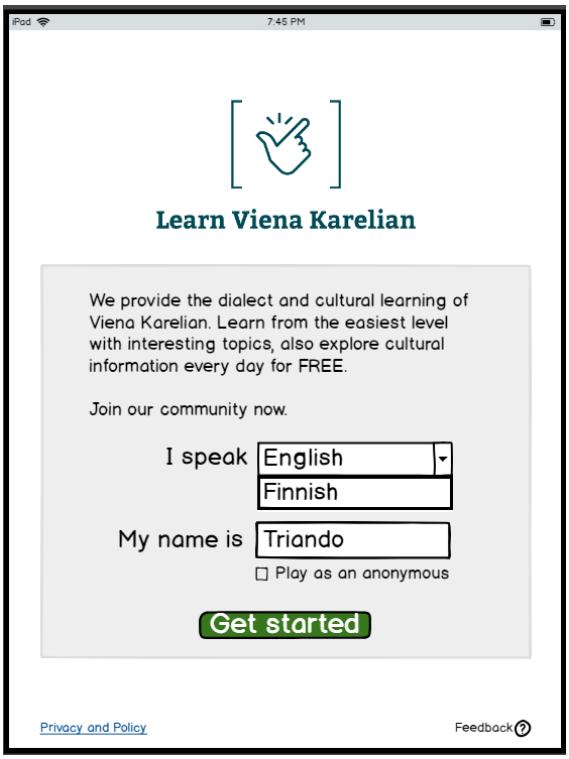


Figure 6. Landing Page Wireframe

Moreover, the game was provided with different topics and levels, where the game difficulty is gradually increasing from easy to hard level. The home pages in English and Finnish is presented in **Figure 7**. Each star represents the completion of each level from easy, medium, and hard. Moreover, learning progress can be viewed as a weekly rank and weekly score. Learners can share this game with several social media, so their friends can learn together and compete in the leaderboard.

[4] Ruppijeva, J. (2017) Šanalipaš. PERIODIKA. Petroskoi, 2017.

[5] Lönnrot, E. Kal'evala vienankarjalakši. Karjalan Šivissyššeura ry. Helsinki, 2015.

[6] http://omamua.ru/

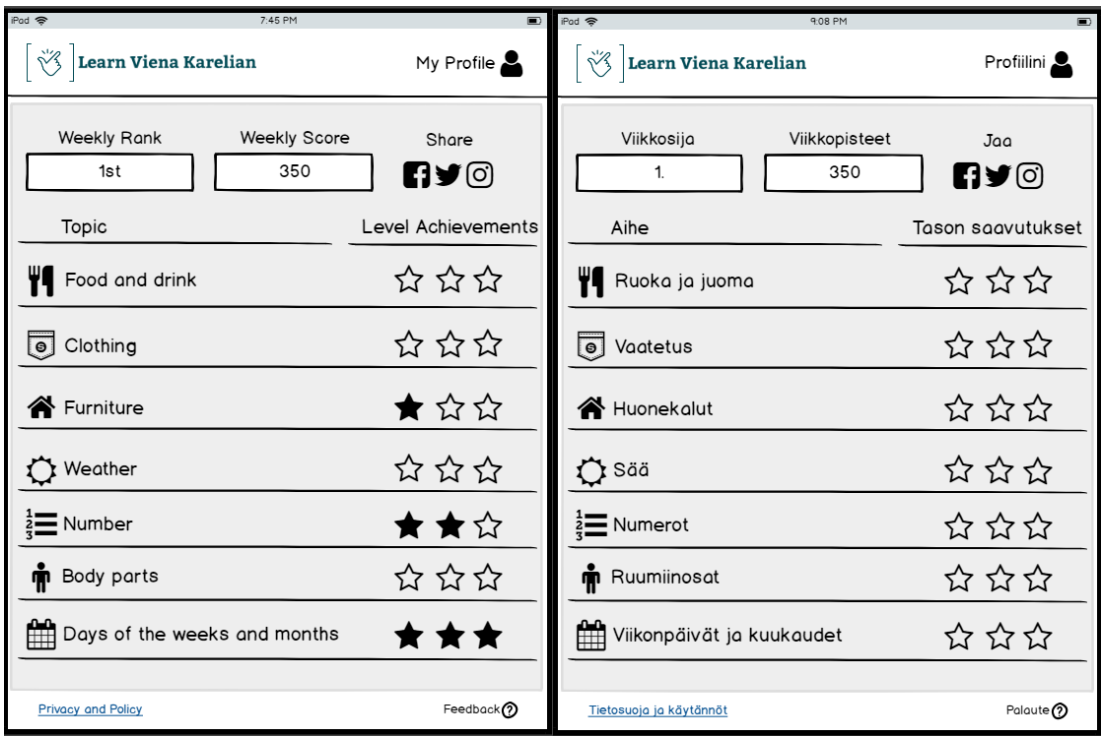


Figure 7. Home Page Wireframe in English and Finnish

The gameplay of reading section of level easy in **Figure *8*** is to select a picture that represents a Viena Karelian word. Furthermore, the same question is repeated with the same clue, so learners can guess the answer based on the same clue. Status of completion and total score are displayed without overlapping any contents. Learners can see the status and score easily, so they can track their learning progress. The game is provided with a very common topic (e.g. food) and an easy level at the beginning, so learners can play it without a tutorial. The first level is very important to attract learners to play the game for a long time.

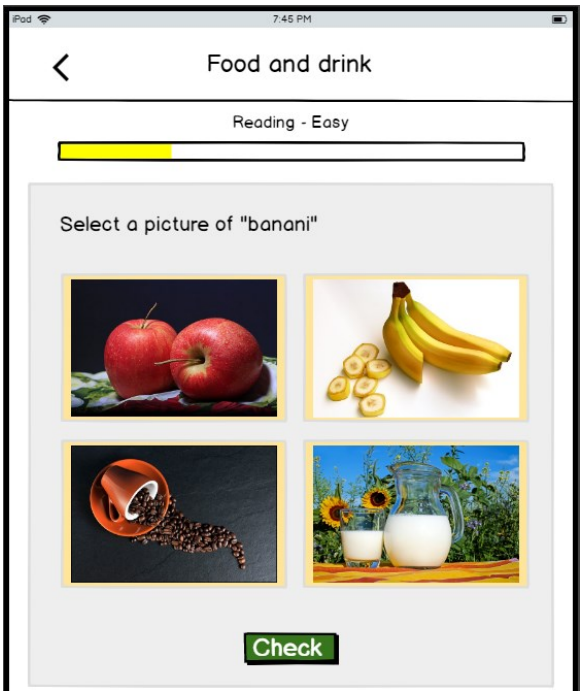


Figure 8. Reading - Easy

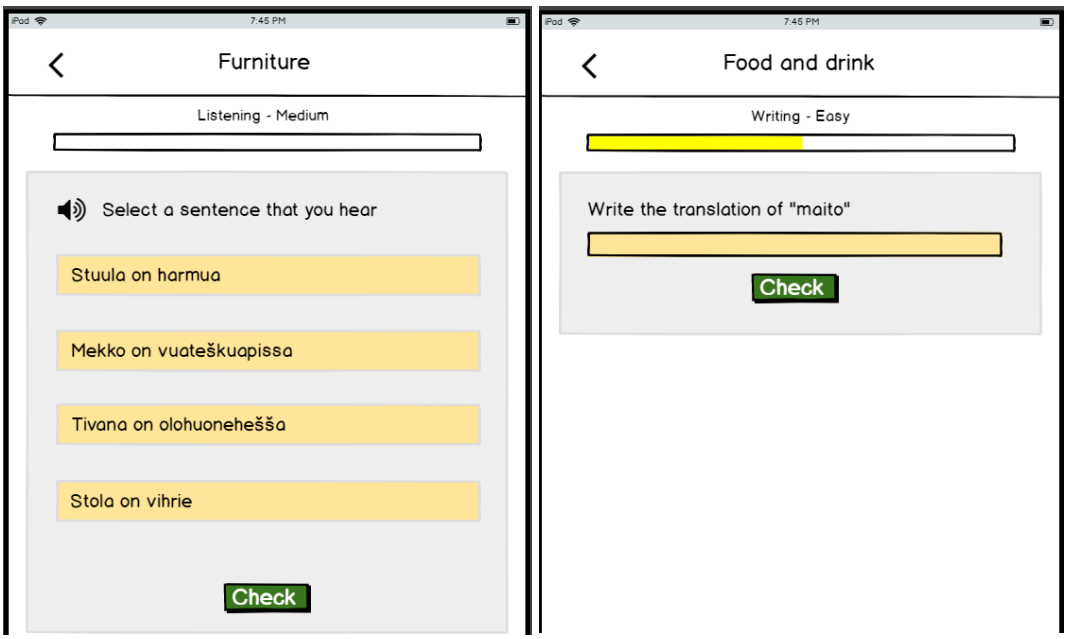


Figure 9. Listening - Medium and Writing - Easy

The elements and settings are voices for the listening section and general contents to learn with different topics and levels, as presented in **Figure *9***. The game is available for desktop, tablet, and smartphone devices, so only one controller that was needed to be designed. The game interfaces were built with the widely-used Bootstrap CSS framework to ensure simplicity and conveniently. Images were download from several websites which provide open source and free images, such as:

- https://pixabay.com
- https://www.pexels.com
- https://unsplash.com
- https://www.freeimages.com
- http://www.i2symbol.com/text2image
- https://hatchful.shopify.com/

The design was evaluated and revised by an independent UI/UX researcher from Indonesia, Febyola Tiara Putri. She revised the design elements and positions, so learners can find it easy to use the game and interesting to play for a long time. For example, she suggested changing the menu in **Figure *9*** with only one back button, where learners can focus on the current gameplays, rather than put all menu on the top of the pages. Moreover, the user interfaces were revised to be simpler and reduce unnecessary elements such as remove several unnecessary buttons and links on a page.

4.3 Production Phase

The game design was used in this phase to make working user interfaces, based on Bootstrap CSS framework and Laravel PHP framework. The language contents consist of words, sentences, images, and audios. Words and sentences were derived mostly from Leena Arhippainen, then the audios were generated automatically from https://soundoftext.com. The game repository at https://github.com/triandotriando/learnvienakarelian can be accessed public and everyone can suggest future updates in the repository. Moreover, the game was deployed in the https://aws.amazon.com/ec2 cloud server and published at

http://LearnVienaKarelian.tk to make learners easy to play the game with only using web browsers without a specific requirement of an operating system.

The desktop view is presented in **Figure *10*** and the tablet and smartphone views are presented in **Figure *11***. The game automatically adapts the screen resolution and shown as a responsive mobile web with a base template from https://startbootstrap.com/themes/sb-admin-2. This responsiveness is supported by Bootstrap CSS framework. Moreover, the game can be used in English and Finnish language, where learners can play it with their language backgrounds. This feature is supported by the localization of Laravel PHP framework.

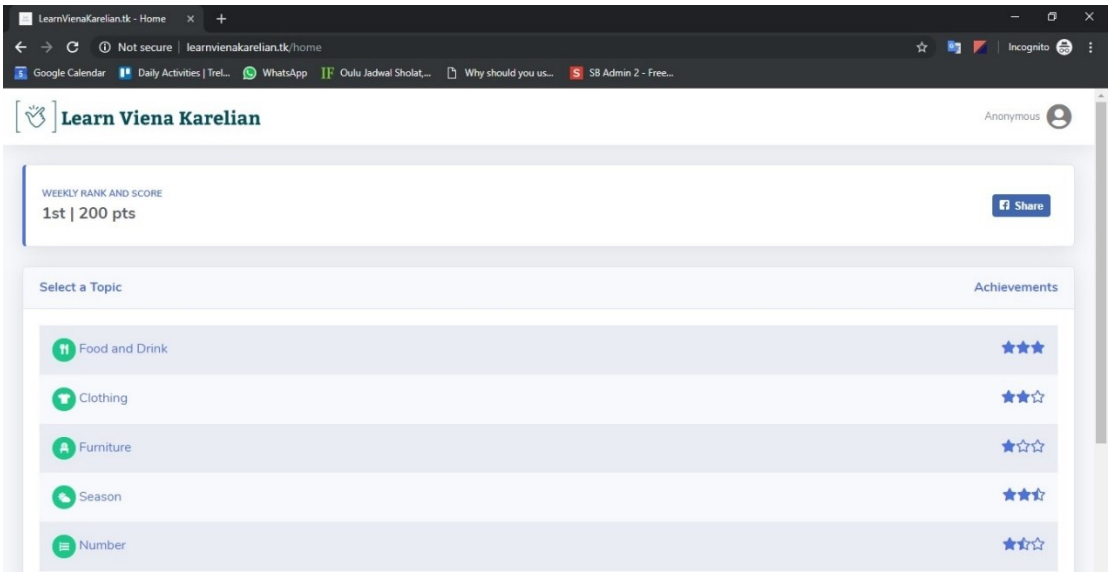


Figure 10. Home Page on a Desktop Device

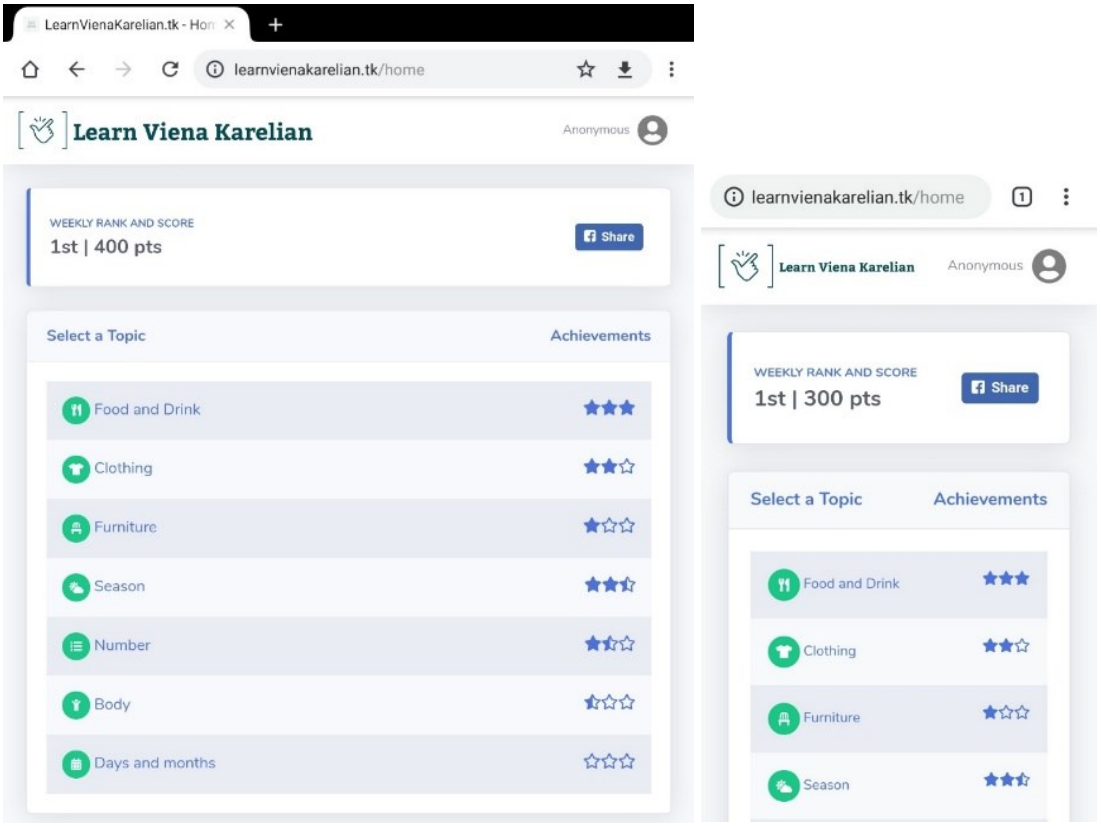


Figure 11. Home Pages on a Tablet and Smartphone Devices

There are two language backgrounds in this game, which are English and Finnish. Those languages were implemented in the localization feature of the Laravel PHP framework. The comparison between English and Finnish localization is presented in the code snippets below:

(English) *learnvienakarelian/resources/lang/en/default.php*

```
<?php
return [
    'weeklyRankAndScore' => 'Weekly Rank and Score',
    'selectATopic' => 'Select a Topic',
    'achievements' => 'Achievements',
    'help' => 'Help',
```

(Finnish) *learnvienakarelian/resources/lang/fi/default.php*

```
<?php
return [
    'weeklyRankAndScore' => 'Viikkosija ja pisteet',
    'selectATopic' => 'Valitse aihe',
    'achievements' => 'Saavutukset',
    'help' => 'Auta',
```

Furthermore, learners can leave the game in the middle of gameplay without losing a score, so they can continue the gameplay later with a progress bar to track their progress. This game supports multiple platforms of desktop, tablet, and smartphone devices. Learners can only use web browsers without any specific operating system and without installing the game. User interfaces are responsive, so the game will adapt to its current platform.

The technology frameworks that were used were the Laravel PHP framework and the Bootstrap CSS framework. Those frameworks are the latest web technologies and widely used by many developers. Therefore, the game system can be ensured with those latest frameworks, where many updates are made to fix any possible bugs. Learners can choose to play as an anonymous, where some learners think that they want to share their information and can play securely. However, learners can put their name when they register the game and update their profile, so they can compete with other learners in the weekly leaderboard.

In the listening section, learners can play the audio to answer the correct option. Volume control can be changed while listening to the audio and audio can be played several times before learners can pick a correct answer. Gameplays were developed based on the game reference of Duolingo, where many user interactions were made as simple as the game reference. Learners can play the game easily without a tutorial because the gameplays are very intuitive to be played and it can increase the user experience of the game. Gameplays were made same for multiple platforms, which are desktop, tablet, and smartphone devices.

4.4 Testing Phase

Learners can open the game URL, then register or play as an anonymous. After that, they can check the homepage to play a topic. The gameplay will be played automatically when learners pick a topic. Three different skills of reading, listening, and writing are presented at every level, so learners do not need to perform a specific decision to continue the next

step. Control in every gameplay is easy to use, where learners can choose one topic, and then play all skill sets of reading, listening, and writing with only a next button.

It is very important to make the game layout that is consistent across the whole user interfaces. This game utilizes a consistent layout, where there are several main components that are reused in every user interface, and other pages only need to utilize a specific component without a need to reimplement from scratch. Moreover, the game difficulty makes the beginner learners of Viena Karelian can easily play the game, also people who have a background of Viena Karelian or Finnish language can play the game with a minimum effort than other language backgrounds, yet the difficulty is made to be still challenging for all levels of learners.

There were 38 players and 12 received feedback from the testing phase. Test participants were from conference participants of the 3rd international GamiFIN conference. The leaderboard after the testing phase (April 10th, 2019) can be seen in **Figure *12***.

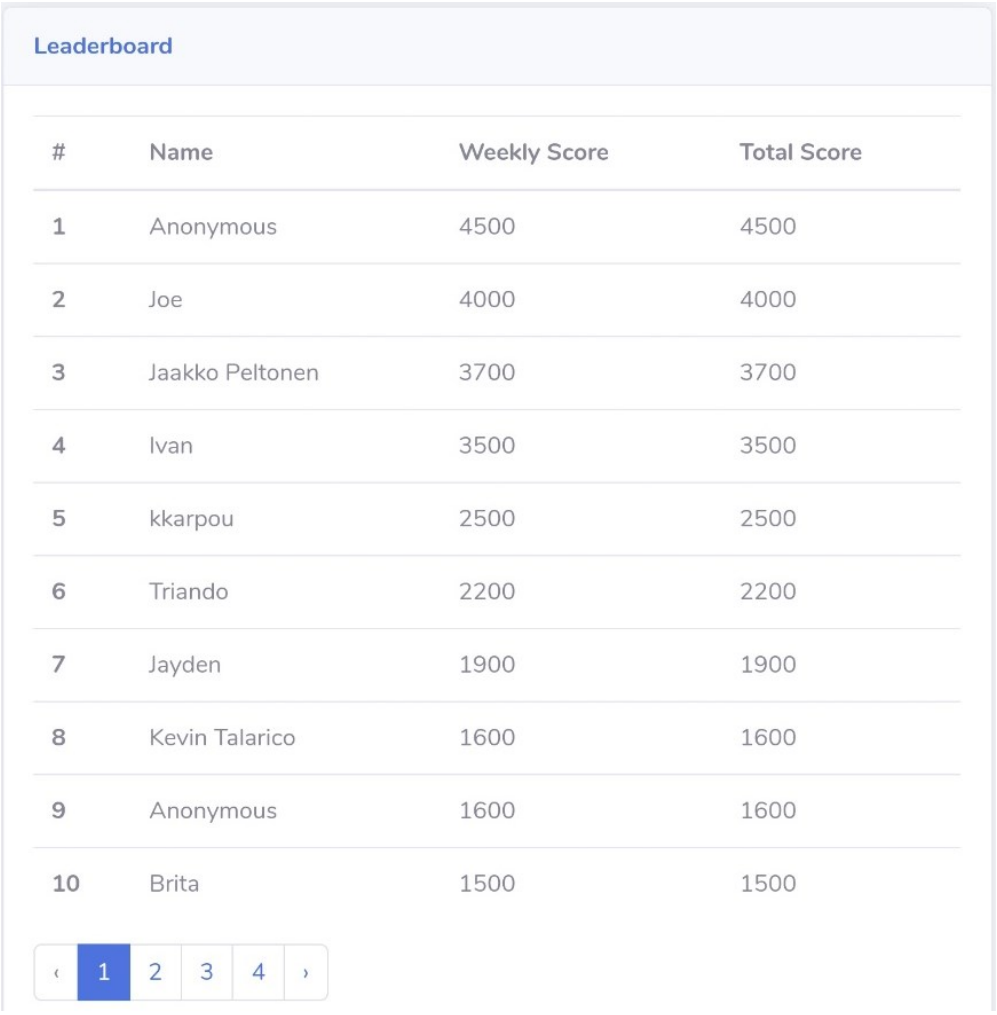


Figure 12. Weekly Rank on the Leaderboard (April 10th, 2019)

The online questionnaires can be accessed at http://learnvienakarelian.tk/feedback, which is directed to the URL of https://forms.gle/o8JuCdXWwFerueMy7 to make learners easy to open the questionnaires. The questionnaires consisted of two sections, which were background in **Table *4*** and user experience study in **Table *5***. The adjectives were adapted from (Sunnari, Arhippainen, Pakanen, & Hickey, 2012) and applied in this study for the mobile game context.

Table 4. Background Section

Name	Type	Description
Birth year	Number	The birth year field was used to determine the age of learners.
Gender	Options: Female, Male, Prefer not to say	The gender field was used to determine the gender distribution.
Nationality	Text	The nationality field was used to determine the distribution of nationality.
Native Finnish	Options: Yes, No	The native Finnish field was used to check if the learner was a Finnish or not, thus it can be determined whether the Finnish learners can easily to play the game rather than non-Finnish speakers.
Education	Text	The education field was used to determine the distribution of education.
Occupation	Text	The occupation field was used to determine the distribution of occupation.

Table 5. User Experience Section

Name	Type	Description
Difficult to use – easy to use	5-point scale	These scales were used to determine the adjective selections from (Sunnari et al., 2012) that represent how learners felt about the game.
Useless – useful	5-point scale	
Visually unpleasant – visually pleasant	5-point scale	
Too technical – creative	5-point scale	
Businesslike – playful	5-point scale	
Dull – entertaining	5-point scale	
Frustrating – inspiring	5-point scale	
Unapproachable – approachable	5-point scale	
Restrictive – empowering	5-point scale	
Inconsistent – consistent	5-point scale	
Serious – fun	5-point scale	
Dated – novel	5-point scale	
Is the game engaging?	Options: Yes, No	This question was used to determine positive and negative engagement at general level.
Any comments?	Text	Learners can suggest any update and feedback for future releases.

Name	Type	Description
How much do you play mobile games?	Options: Not at all, Just tried, not really use, 1-4 times a month, 1-2 times a week, Daily	This question was used to determine the frequency of mobile games familiarity.
How much do you use language learning games?	Options: Not at all, Just tried, not really use, 1-4 times a month, 1-2 times a week, Daily	This question was used to determine the frequency of language learning games familiarity.

4.5 Release and Support Phase

After several development iterations, I played the game, so I can feel the real situation and can learn Viena Karelian dialect and culture by myself. Moreover, I asked my supervisors and a UI/UX researcher from Indonesia to play the game, so they can notice if there was any critical issue that must be solved before the testing and final release of this game. Furthermore, FAQ can be made later after several questions and feedback in the game are received. There is one feedback form in the game that can be used for learners to give questions and feedback for future development.

While preparing the game for the testing phase, there were several critical bugs that need to be fixed. The bugs were fixed before the testing phase and it was required a lot of effort to make sure that the new updates did not break other features. Moreover, there is a need to connect the game with Viena Karelian community. For example, Viena Karelian community can create a Facebook page, so learners can share their thoughts about the game and the game community will grow larger.

After several months of deployment, the game can be analyzed to get the most played topic and the feedback that can be improved in the next future releases. The updates of language contents should balance between one topic to each other. Therefore, the difficulty is still reasonable to be played. There is a need to put information every major release, therefore learners can easily notice and adapt with new changes that have been made.

The game is accessible with web browsers for desktop, tablet, and smartphone devices. There is only one requirement that must be applied in every device, which is JavaScript to make an interaction between learners and the game. Making a mobile web game can utilize an instant update without any approval from learners to update the game. Developers can easily update through the server, then the game will be updated in any second and ready to be played online. The game updates are applied automatically without interfere learners to do a manual update. Thus, this issue can make easy for learners to play without any annoying notification to update the game. The game is available to access at http://LearnVienaKarelian.tk and any future updates are synchronous with a repository at https://github.com/triandotriando/learnvienakarelian.

5. Evaluation

This chapter explains the evaluation of testing phase that was conducted in the 3rd international GamiFIN conference at Levi, Finland between 8 to 10 April 2019. This chapter consists of target users, game engagement, and gameplays evaluation. The first section explains the initial target user and the test participants relationship, and how they perceived this dialect and culture learning game. The second section explains positive engagement from the test participants based on several user experience adjectives. The third section explains the suggestion and feedback from the test participants about the current game artifact.

5.1 Target User

The test participants were given two URL to play the game and fill the questionnaire form. From 38 players, there were 12 received feedback from the testing phase. The game and feedback URL were:

- Game URL: http://LearnVienaKarelian.tk
- Feedback URL: http://LearnVienaKarelian.tk/feedback

Some of the test participants conducted the game evaluation with the researcher and other test participants conducted the game evaluation online. Most of the test participants were expert, for example, game design specialists and researchers. Therefore, the evaluation result was more reflect the situation of people who know the game applications rather than people who have fewer experience of game applications and technology. The background of test participants was:

- Age: 20 to 47 years old
- Gender: 9 males and 3 females
- Native Finnish: 2 people
- Education: 3 bachelors, 1 master, 8 PhDs

Table 6. Nationality

Name	Total
Brazilian	1
Finnish	4
Greek	1
Indonesian	1
Italian	1
Russian	2
Taiwan	1
Ukraine	1

Table 7. Occupation

Name	Total
Game Design Specialist	2
Professor	2
Researcher	6
Student	1
UI/UX Designer	1

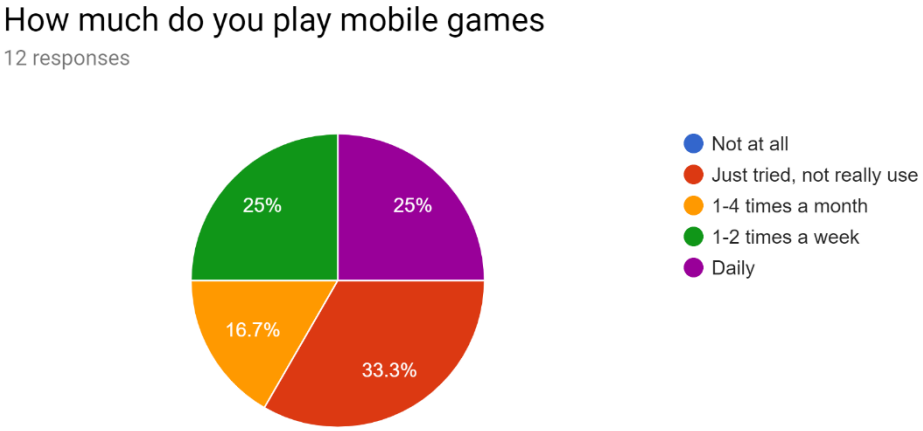


Figure 13. How much do you play mobile games?

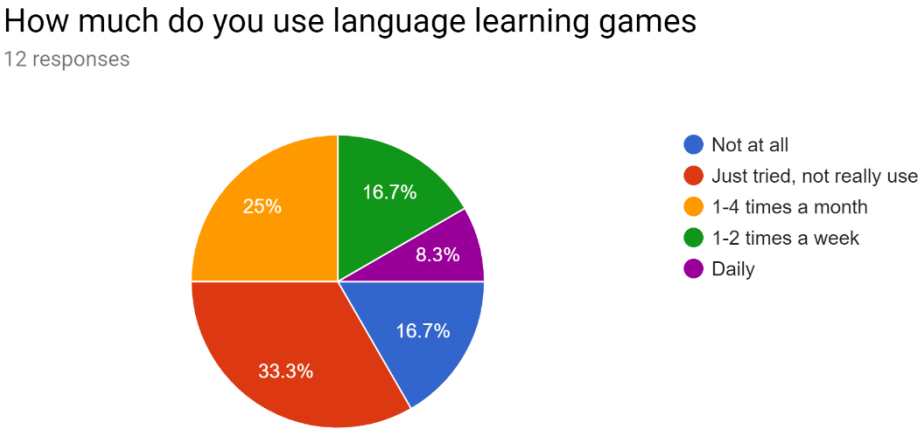


Figure 14. How much do you use language learning games?

The target age groups range from 20 to 50 years old, therefore the test evaluation can cover the initial target of this game artifact. The number of male and female participants were nine and three respectively, thus the result may not reflect the real result between male and female participants. There were only two native speakers of Finnish in this testing phase, so the result was not representative enough to be assessed whether the native Finnish participants perform better than other participants. The education,

nationality, and occupation between participants were quite varied, therefore the received feedback was quite good and representative as an initial result to gather how the test participants felt about the game, especially for the positive engagement. The familiarity of test participants about mobile games and language learning games were adequate to represent the result of this evaluation, where the participants at least have experience with mobile games and only one participant who never play a language learning game.

5.2 Game Engagement

There were 12 five-point scales to identify the user experience adjectives and one binary question to identify the engagement of this game artifact. The five-point scales were given a weight of each point:

- 1st scale: -2
- 2nd scale: -1
- 3rd scale: 0
- 4th scale: 1
- 5th scale: 2

The engagement of this game was 91.7% positive and 8.3% negative. Moreover, the 12 five-point scales are presented in the **Table *8***.

Table 8. Result of 12 Five-point Scales

Name	**Selected Adjective**	**Total**	**Percentage to Adjective Target (total/ 12 x 2)**
Difficult to use – easy to use	Easy to use	16	66.67%
Useless – useful	Useful	12	50.00%
Visually unpleasant – visually pleasant	Visually pleasant	8	33.33%
Too technical – creative	Creative	6	25.00%
Businesslike – playful	Playful	7	29.17%
Dull – entertaining	Entertaining	7	29.17%
Frustrating – inspiring	Inspiring	3	8.33%
Unapproachable – approachable	Approachable	12	50.00%
Restrictive – empowering	Empowering	2	8.33%
Inconsistent – consistent	Consistent	12	50.00%
Serious – fun	Serious	-1	-4.17%
Dated – novel	-	0	0.00%

Based on the result of 12 five-point scales in **Table *8***, the game was easy to use, useful, approachable, and consistent with more than 50% result in selected adjectives. Moreover, the game was quite visually pleasant, creative, playful, and entertaining with more than 25% result in selected adjectives. Furthermore, the game was very few inspiring and empowering with more than 8.33% result in selected adjectives. The game was neither dated and novel with 0% result to selected adjective target. However, the game was experienced by the test participants as a serious game rather than a fun game with -4.17% result in the selected adjective.

5.3 Gameplays

The gameplays consist of seven topics, which are food and drink, clothing, furniture, seasons, body, number, days and months. Each topic consists of three levels of easy, medium, and hard. Each level has three different skills, which are reading, listening, and writing. The levels and skills are presented in **Figure *15***, where the knowledge of learners gradually increase when they complete every skill on every level. Every level completion will be presented cultural information to attract learners to learn about Viena Karelian culture. There were several feedback and suggestions from the test participants to improve the gameplays in the future.

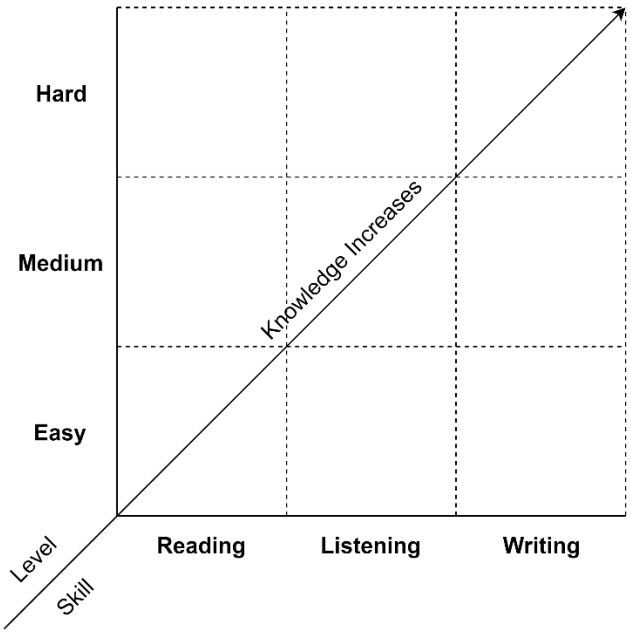


Figure 15. Language Learning Model

The first feedback was to improve the information about the correct answer. For example, after learners answer the correct option, they will receive an explanation and comparison in Viena Karelian, English, and Finnish. Another aspect can be improved with more fun gameplay such as in reading and listening in easy level, where learners can play just pick a card. This gameplay can be adapted from https://tinycards.duolingo.com, where many learners learn with fun gameplay and pick interesting cards based on the selected topic.

The second feedback was to improve the language contents, where there are three levels of easy, medium, and hard. The medium and hard levels were too hard. Therefore, the language contents need to be validated before the game release to the public. The third feedback was to add interpretation of misspelling such as “Sumer” and “Summer”. This

feature can help non-native speakers to answer the correct option without feeling so confused with a misspelled answer.

Moreover, there were some typos such as "He eat soup" and "What is your favorite cloth?". There is a need to validate the grammar of language contents to prevent small grammar mistakes in the gameplays. The fourth feedback was to validate the listening section gameplay. Learners will be presented audio that is the same s the previous section (reading). The test participants thought that it was too easy to guess the audio even without listening to it. Therefore, the test participants can easily to cheat on this listening section without listening to the audio.

The fifth feedback was to validate the images that have a similarity with each other. For example, “porridge” and “soup” images have a similar visual appearance. Some of the test participants got a wrong answer because they thought they already choose the correct image. This problem can be solved with some hints such as why learners got a wrong answer on a similar image and the similar images can be removed to prevent a confusion of learners.

The sixth feedback was to change the stars icon on the home page. Some of the test participants thought it was only performance information, but they realized that it was a progress status of each topic. For example, if the test participants already completed easy and medium levels, they got two full stars and one empty star. This problem can be solved by applying the most common icon to display the progress status of levels.

The seventh feedback was about the phrase exercise of writing sections. Some of the test participants thought the exercises were hard. They need to remember the exact answer in the English phrase, where it was quite hard for non-native English to answer it in English. If the test participants forgot the answer, they cannot go back to the previous section such as reading and listening sections. There is a need to add functionality that make learners able to access the previous sections. The last feedback was about to improve the writing section. Currently, there is no hint in this section, therefore the test participants have no possibility to learn in a correct way. This problem can be solved by providing a hint, and a functionality to go back to previous sections.

6. Discussion

This chapter explains the discussion about revisiting the research questions and theoretical implications. The first section presents the discussion of two research questions, which are the steps to conduct gamification with the universal game heuristic to learn Viena Karelian dialect and culture, and the advantages and disadvantages of using the universal game heuristic. The second section describes theoretical implications based on the literature review.

6.1 Revisiting the Research Questions

RQ1: How the universal game heuristic can be used to develop a game from non-gaming contexts to learn Viena Karelian dialect and culture?

Mobile web responsive was a solution to create the game artifact that is more flexible to play in any devices such as desktop, tablet, and smartphone. Laravel PHP framework and Bootstrap CSS framework were used as the game core in this thesis research. Non-gaming context of learning Viena Karelian dialect and culture are books and formal studies. The main goals of gamification in this research were adapted from (Sørensen & Meyer, 2007), where it can increase the motivation and engagement of users. Those non-gaming contexts were applied in the gamification of this dialect and cultural learning. Learners can learn Viena Karelian dialect and culture with a mobile web responsive game; thus, it increases the awareness of this dialect and increases the opportunity for a long-term goal to facilitate communication between new learners and Viena Karelian (e.g. prospective tourists who want to travel in Viena Karelian areas). The universal game heuristic consists of context phase, design phase, production phase, testing phase, and release and support phase. This game heuristic was used in this research to adopt a systematic way to develop a game based on the previous evaluation that was conducted in (Mylly, 2011). All phases of the universal game heuristic were applied in this research to develop a game artifact. The context phase introduces the initial goal and concept of this game, and as a foundation to conduct further steps. The design phase presents the design of the game based on the game reference of Duolingo, where simple features, gameplays, progress bar, and score were adapted based on (Duolingo, 2018). The product phase explains the development process of this game with the Laravel PHP framework and the Bootstrap CSS framework. Many contents were collected from websites which provide free images, and audios were generated from google translate pronunciation of Finnish language. The testing phase presented the initial evaluation of this game project with several test participants from the 3rd international GamiFIN conference with 38 players and 12 received feedback. The release and support phase present the basic information of this game, feedback form in the game, and plan to develop frequently asked questions (FAQ) to help learners find common questions and answers.

RQ2: What are the advantages and disadvantages of using the universal game heuristic in the language learning and culture game of Viena Karelian?

The universal game heuristic as the design cycle was a part of the design science research method in this thesis. Game heuristics consist of several genres to conduct games development based on the evaluation in a systematic way (Mylly, 2011). There are several advantages and disadvantages of using the universal game heuristic in the development of Viena Karelian dialect and culture game. The advantages are the researcher can conduct a development from initial phase of context to release and support phase in a systematic way, thus the researcher can learn from similar evaluation of the universal game heuristic, and game heuristics can be used to conduct a development or an evaluation with more precise result, but it is cannot guarantee the result to be perfect as it is explained in the (Desurvire et al., 2004; Mylly, 2011). The disadvantages of using the universal game heuristic were the heuristic was not universal enough to cover the language learning genre, thus the result and implementation of using this heuristic only based on the general evaluation of previous games, not evaluation from the language learning games, and some of the universal game heuristic aspects cannot be categorized as universal aspects. The aspects were in the production phase "P1. Make effects and actions of AI fair and visible" and release and support phase "RS10. Provide the players reliable options to make micro-payments, if there are such" (Mylly, 2011). From the P1 aspect, it cannot be generalized that all games can have an artificial intelligent (AI) component. The game artifact of this research only provides the game for single player users without an AI opponent to play with. Moreover, from the RS10 aspect, micro-payments are optional options, where this aspect may not be too relevant to be included in the universal game heuristic. The P1 and RS10 aspects can be removed in the future of this game heuristic, thus the universal game heuristic can stay as a general game heuristic that can fit for universal games.

6.2 Practical Implications

The goal of this research is to help English and Finnish speakers to learn in a fun and effective way. The game was developed with gamification of non-gaming context by using the universal game heuristic. The goal is in line with gamification targets, which are motivation and engagement of learners (Kapp, 2012; Sørensen & Meyer, 2007). Moreover, this game is categorized as an educational game, where the positive engagement is one of the main factors to attract learners to play this game (Amoia, 2011; Hamari et al., 2014).

The gameplays of this game consist of reading, listening, and writing sections. Those sections were adapted based on the language learning skills in (Stanley & Mawer, 2008; Wouters et al., 2009). There are several topics to learn Viena Karelian dialect and culture, thus it can increase the knowledge acquisition and learning process while playing the game (Backlund & Hendrix, 2013; Boyle et al., 2016). This game focuses on the learning environment rather than entertainment, which was adapted from (Backlund & Hendrix, 2013). Furthermore, the implementation of education aspects are more important rather than social interactions in pure entertainment games (Heeter et al., 2003).

The game artifact was developed with very simple features, where learners can choose seven different topics to play and every topic has reading, listening, and writing skills. The concept of simple features was adapted from (Backlund & Hendrix, 2013). Moreover, the game elements consist of levels (easy, medium, and hard), progress status to show the percentage of every completed section, and weekly score in the leaderboard. Those

elements were based on the game elements of gamification that are presented in the (Deterding, 2012).

The game is available as a mobile web responsive game, where it can be accessed from desktop, tablet, and smartphone devices. Learners do not have to install the game and use it in a specific operating system. They can access the game with only web browsers and internet connection. Those platforms were based on the most common implementation of educational games on the computer and mobile platforms (Backlund & Hendrix, 2013; Ferdig, 2009; Giessen, 2015). Moreover, audio materials were used to increase the effectiveness of learning in this game, where it can increase the effectiveness of learning (Backlund & Hendrix, 2013). Furthermore, the game artifact was developed with the universal game heuristic as the design cycle. This approach can help the researcher to develop a game based on the previous evaluation of similar games. Implementation with a heuristic approach is better because it is from a benchmarking and a comparison of systematic evaluations (Desurvire & Wiberg, 2009; Mylly, 2011).

There is a possibility to make a universal game concept for other dialects and culture of Karelian with the mobile web responsive technologies and the current game artifact from this research. Inputs from the existing game artifact can be used by modifying the gameplays, the database structure, and the game assets. Thus, other dialects and culture of Karelian can be gamified with the existing game artifact efficiently without developing a new game from scratch, so the existing artifact components and concept can be utilized for a universal Karelian game. This game artifact can be used as a foundation to develop games for other dialects and culture of Karelian. Database structure and language backgrounds of this game artifact are presented in **Figure *16***.

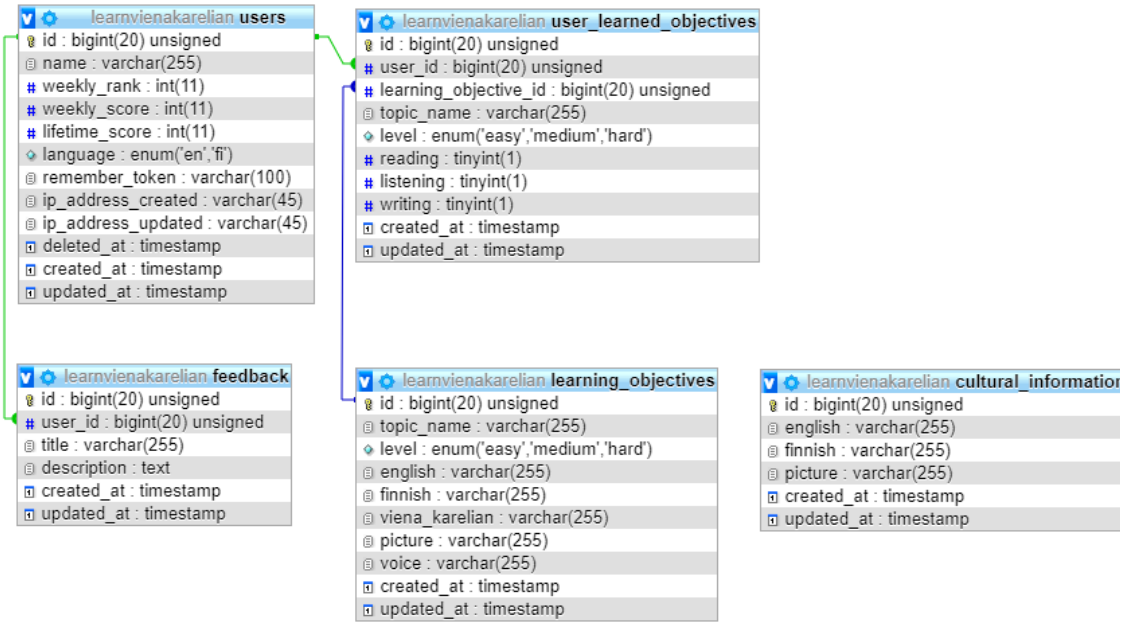


Figure 16. Database Structure

Development of other dialects of Viena Karelian and culture require database structure to be modified for multi-values of the column structure of "learning_objectives" and "cultural_information" tables. The multi-values of several columns are presented in **Table *9*** and **Table *10***. Moreover, the code needs to be modified to cover all multi-values. The code can be accessed at https://github.com/triandotriando/learnvienakarelian for the public.

Table 9. Modified Database Structure for “learning_objectives” Table

Name	Type	Description
id	Integer	Data identifier
topic_name	String	Topic name
level	Enum	Levels of easy, medium, and hard
languages	Multi-values	Cover all language contents from Karelian dialects
picture_languages	Multi-values	Cover all language contents from Karelian dialects
voice_languages	Multi-values	Cover all language contents from Karelian dialects
created_at	Timestamp	Time of creation
updated_at	Timestamp	Time of update

Table 10. Modified Database Structure for “cultural_information” Table

Name	Type	Description
id	Integer	Data identifier
languages	Multi-values	Cover all language contents from Karelian dialects
picture_languages	Multi-values	Cover all language contents from Karelian dialects
created_at	Timestamp	Time of creation
updated_at	Timestamp	Time of update

7. Conclusion

In this research, design science research was used as the research method and the universal game heuristic was used as the design cycle. There are five phases of the universal game heuristic, which are context phase, design phase, production phase, testing phase, and release and support phase. The gamification of Viena Karelian was conducted with the universal game heuristic and the result shown the game artifact motivated the test participants to play the game with 91.7% positive engagement. The advantages of using the universal game heuristic were the game can be developed with a more systematic way and based on several evaluations of universal games. Moreover, the disadvantages were this game heuristic was too general and did not specific for language learning games, therefore there is a need to make a game heuristic for language learning games. Furthermore, the game artifact can be used to extend the game for other Viena Karelian dialects.

7.1 Limitations

There were several limitations in this research that can be improved in future research.

- The picture assets were collected from external websites and it did not cover for the Viena Karelian culture contexts.
- The audio assets were generated manually because currently there is no service to generate voices with Viena Karelian dialect.
- This game focuses on the mobile web responsive rather than a native application such as Android and iOS operating systems.
- There is a need to conduct a test with non-experts such as people who are not familiar with the technology.
- The universal game heuristic that was used as the design cycle was not purely based on language learning games evaluation.

7.2 Future Research

The game artifact should be developed for Russian speakers, as many Karelian speaks Russian as their native language. Therefore, the Karelians can learn Viena Karelian dialect and it can increase the number of speakers of Viena Karelian and facilitate the communication between new learners and the Viena Karelian speakers in the future. Moreover, a knowledge management system can be developed in the future to handle frequently asked questions (FAQ) from learners. It is very important to develop an online community feature to make learners can interact with each other in a forum. Furthermore, the game should be refined with more fun elements such as https://tinycards.duolingo.com to attract learners to play in the long term.

References

Aha, D. W., Molineaux, M., & Ponsen, M. (2005). Learning to Win: Case-Based Plan Selection in a Real-Time Strategy Game. *International Conference on Case-Based Reasoning*, 5–20. https://doi.org/10.1007/11536406_4

Amoia, M. (2011). A Serious Game for Second Language Acquisition. *CSEDU (1)*, 394–397. https://doi.org/10.5220/0003338503940397

Anderson, J., Donnellan, B., & Hevner, A. R. (2011). Exploring the relationship between design science research and innovation: a case study of innovation at Chevron. *European Design Science Symposium*, 116–131.

Awale, R. (2018). *Designing and Developing a Dynamic Website Using Laravel*. Oulun ammattikorkeakoulu.

Backlund, P., & Hendrix, M. (2013). Educational games - Are they worth the Effort?: A literature survey of the effectiveness of serious games. *2013 5th International Conference on Games and Virtual Worlds for Serious Applications, VS-GAMES 2013*, 1–8. https://doi.org/10.1109/VS-GAMES.2013.6624226

Barraclough, D. J., Conroy, M. L., & Lee, D. (2004). Prefrontal cortex and decision making in a mixed-strategy game. *Nature Neuroscience*, *7*(4), 404.

Boyle, E. A., Hainey, T., Connolly, T. M., Gray, G., Earp, J., Ott, M., et al. (2016). An update to the systematic literature review of empirical evidence of the impacts and outcomes of computer games and serious games. *Computers and Education*, *94*, 178–192. https://doi.org/10.1016/j.compedu.2015.11.003

Burke, R. D., Hammond, K. J., Kulyukin, V., Lytinen, S. L., Tomuro, N., & Schoenberg, S. (1997). Question answering from frequently asked question files: Experiences with the faq finder system. *AI Magazine*, *18*(2), 57.

Carro, R. M., Breda, A. M., Castillo, G., & Bajuelos, A. L. (2002). A methodology for developing adaptive educational-game environments. *International Conference on Adaptive Hypermedia and Adaptive Web-Based Systems*, 90–99.

Chen, X., Ji, Z., Fan, Y., & Zhan, Y. (2017). Restful api architecture based on laravel framework. *Journal of Physics: Conference Series*, *910*(1), 12016.

Clune, J. (2007). Heuristic evaluation functions for general game playing. *AAAI*, *7*, 1134–1139.

Cui, W., Huang, L., Liang, L., & Li, J. (2009). The research of PHP development framework based on MVC pattern. *2009 Fourth International Conference on Computer Sciences and Convergence Information Technology*, 947–949.

Damiri Burlian, T., Sharmila, P., Alavesa, P., & Arhippainen, L. (2019). Revitalizing Viena Karelian Dialect and Culture with Gamification. In *The 3rd International GamiFIN Conference*. Levi, Finland: CEUR Workshop Proceedings. April 8 – 10, 2019.

Das, R., & Saikia, L. P. (2016). Comparison of Procedural PHP with Codeigniter and

Laravel Framework. *International Journal of Current Trends in Engineering & Research*, *2*(6), 42–48.

Desurvire, H., Caplan, M., & Toth, J. A. (2004). *Using heuristics to evaluate the playability of games*. *CHI'04 extended abstracts on Human factors in computing systems*.

Desurvire, H., & Wiberg, C. (2009). Game usability heuristics (PLAY) for evaluating and designing better games: The next iteration. *International Conference on Online Communities and Social Computing*, 557–566.

Deterding, S. (2012). Gamification: Designing for Motivation. *Interactions*, *19*(4), 14–17. https://doi.org/10.1145/2212877.2212883

Deterding, S., Khaled, R., Nacke, L. E., & Dixon, D. (2011). Gamification: Toward a Definition. *CHI 2011 Gamification Workshop*, *12*. https://doi.org/978-1-4503-0268-5/11/0

Dickey, M. D. (2006). Game design narrative for learning: Appropriating adventure game design narrative devices and techniques for the design of interactive learning environments. *Educational Technology Research and Development*, *54*(3), 245–263.

Dictionary of Karelian. Torikka, M. (1st ed.), Joki, L. (2nd eds.) Web application by Vihtari, J. (2009). Retrieved February 22, 2019, from http://kaino.kotus.fi/cgi-bin/kks/karjala.cgi

Duolingo. (2018). Duolingo. Retrieved December 9, 2018, from https://www.duolingo.com

Edelson, D. C. (2002). Design research: What we learn when we engage in design. *The Journal of the Learning Sciences*, *11*(1), 105–121.

Facebook. (2018). Garden of Times. Retrieved December 9, 2018, from https://www.facebook.com/GardensofTime

Ferdig, R. E. (2009). *Handbook of Research on Effective Electronic Gaming in Education*. *Handbook of Research on Effective Electronic Gaming in Education*. IGI Global.

Giessen, H. W. (2015). Serious Games Effects: An Overview. *Procedia - Social and Behavioral Sciences*, *174*, 2240–2244. https://doi.org/10.1016/j.sbspro.2015.01.881

Google. (2019). Duolingo in the Android OS. Retrieved from https://play.google.com/store/apps/details?id=com.duolingo&hl=en

Green, C. S., & Bavelier, D. (2003). Action video game modifies visual selective attention. *Nature*, *423*(6939), 534–537.

Gregor, S., & Hevner, A. R. (2011). Introduction to the special issue on design science. Springer.

Gregor, S., & Hevner, A. R. (2013). Positioning and presenting design science research for maximum impact. *MIS Quarterly*, 337–355.

Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does Gamification Work?-A Literature Review of Empirical Studies on Gamification. *2014 47th Hawaii International Conference on System Sciences (HICSS)*, 3025–3034.

He, R. Y. (2015). Design and implementation of web based on Laravel framework. *2014 International Conference on Computer Science and Electronic Technology (ICCSET 2014)*.

Heeter, C., Chu, C. (Kaitlan), Maniar, A., Winn, B., Mishra, P., Egidio, R., & Portwood-Stacer, L. (2003). Comparing 14 plus 2 forms of fun (and learning and gender issues) in commercial versus educational space exploration digital games. *International Digital Games Research Conference*, 4–6.

Hevner, A. R. (2007). A three cycle view of design science research. *Scandinavian Journal of Information Systems*, *19*(2), 4.

Hevner, A. R., & Chatterjee, S. (2010). Introduction to design science research. *Design Research in Information Systems*, 1–8.

Hunicke, R., LeBlanc, M., & Zubek, R. (2010). MDA: A Formal Approach to Game Design and Game Research. *Workshop on Challenges in Game AI*, *4*(1), 1–4. https://doi.org/10.1088/1751-8113/44/8/085201

Jain, N. (2015). Review of different responsive css front-end frameworks. *Journal of Global Research in Computer Science*, *5*(11), 5–10.

Kagan, M., & Solomon, I. (1997). Interactive multiple player game system and method of playing a game between at least two players. *US Patent 5,618,045*. Google Patents. Retrieved from https://www.google.com/patents/US5618045

Kapp, K. M. (2012). *The gamification of learning and instruction: game-based methods and strategies for training and education*. John Wiley & Sons.

Karjalainen, H. (2018). Elvytys 2018: Karjalan kielen ja kulttuurin elvytyshanke 2018. Retrieved December 22, 2018, from https://www.karjalanelvytys.fi/

Karlova, O. (2011). Vienankarjalan alkeiskuršši. Retrieved April 30, 2019, from http://avtor.karelia.ru/elbibl/karlova/vienankarjalan/index.html#1

Kiili, K. (2005). Digital game-based learning: Towards an experiential gaming model. *The Internet and Higher Education*, *8*(1), 13–24.

Klementyev, Y., Kovaleva, S., & Zamyatin, K. (2013). *The Karelian language in Russia: An overview of a language in context*. Helsinki.

Mylly, S. (2011). *Genre-Based Modular Heuristic Models for Improving Usability During Game Development*. University of Oulu.

Nguyen, Q. H. (2015). *Building a web application with Laravel 5*. Oulun ammattikorkeakoulu.

Offermann, P., Levina, O., Schönherr, M., & Bub, U. (2009). Outline of a design science research process. *The 4th International Conference on Design Science Research in Information Systems and Technology*, 7.

Olanrewaju, R. F., Islam, T., & Ali, N. (2015). An empirical study of the evolution of php mvc framework. *Advanced Computer and Communication Engineering Technology*, 399–410.

Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A design science research methodology for information systems research. *Journal of Management Information Systems*, *24*(3), 45–77.

Pinelle, D., Wong, N., & Stach, T. (2008). Heuristic evaluation for games: usability principles for video game design. *The SIGCHI Conference on Human Factors in Computing Systems*, 1453–1462. https://doi.org/10.1145/1357054.1357282

Pivec, M. (2007). Editorial: Play and learn: potentials of game-based learning. *British Journal of Educational Technology*, *38*(3), 387–393.

Plomp, T. (2013). Educational design research: An introduction. *Educational Design Research*, 11–50.

Pop, D.-P., & Altar, A. (2014). Designing an MVC model for rapid web application development. *Procedia Engineering*, *69*, 1172–1179.

Riionheimo, H. (2018). Elvytys Ja Uhanalainen Karjalan Kieli Hanke. Retrieved December 22, 2018, from http://kianna-hanke.blogspot.com/

Rosstat. (2010). Population size and location in Russian Population Census 2010. Retrieved December 9, 2018, from http://www.gks.ru/free_doc/new_site/perepis2010/croc/perepis_itogi1612.htm

Salonen, T. (2017). *Karelian — a digital language?* Retrieved from http://www.dldp.eu/sites/default/files/documents/DLDP_Karelian-Report.pdf

Sarhimaa, A. (2011). *The Karelian language in Finland: An overview of a language in context*.

Serrano, N., Hernantes, J., & Gallardo, G. (2013). Mobile web apps. *IEEE Software*, *30*(5), 22–27.

Shenoy, A., & Prabhu, A. (2018). Choosing Lightweight Frameworks for Intuitive Web Design. *CSS Framework Alternatives*, 1–14.

Smyth, J. M. (2007). Beyond Self-Selection in Video Game Play: An Experimental Examination of the Consequences of Massively Multiplayer Online Role-Playing Game Play. *CyberPsychology & Behavior*, *10*(5), 717–721. https://doi.org/10.1089/cpb.2007.9963

Sørensen, B. H., & Meyer, B. (2007). Serious Games in language learning and teaching-a theoretical perspective. *DiGRA Conference*.

Stanley, G., & Mawer, K. (2008). Language Learners & Computer Games: From “Space Invaders” to “Second Life.” *TESL-EJ*, 12.

Suh, S., Kim, S. W., & Kim, N. J. (2010). Effectiveness of MMORPG-based instruction in elementary English education in Korea. *Journal of Computer Assisted Learning*, *26*(5), 370–378.

Sunnari, M., Arhippainen, L., Pakanen, M., & Hickey, S. (2012). Studying user experiences of autostereoscopic 3D menu on touch screen mobile device. *Proceedings of the 24th Australian Computer-Human Interaction Conference*, 558–561.

Sutcliffe, A. (2009). Designing for user engagement: Aesthetic and attractive user interfaces. *Synthesis Lectures on Human-Centered Informatics*, *2*(1), 1–55.

Traci Sitzmann. (2011). A Meta-Analytic Examination of the Instructional Effectiveness of Computer-Based Simulation Games. *Personnel Psychology*, *64*(2), 489–528. https://doi.org/10.1111/j.1744-6570.2011.01190.x

Verma, A. (2014). MVC Architecture: A Comparative Study Between Ruby on Rails and Laravel. *Indian Journal of Computer Science and Engineering (IJCSE)*, *5*(5), 196–198.

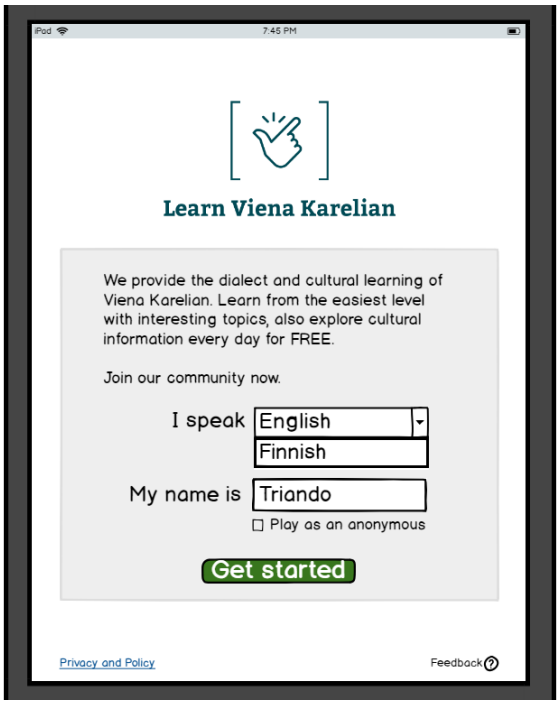
Wouters, P., Van der Spek, E. D., & Van Oostendorp, H. (2009). Current practices in serious game research: A review from a learning outcomes perspective. *Games-Based Learning Advancements for Multi-Sensory Human Computer Interfaces: Techniques and Effective Practices*, 232–250.

Ye, F. (2014). Validity, reliability, and concordance of the Duolingo English Test. *University of Pittsburgh School of Education*.

Zaikov, P. (2013). *Vienankarjalan kielioppi: lisänä harjotukšie ta lukemisto*. Karjalan Sivistysseura ry.

Appendix A. Game Wireframes

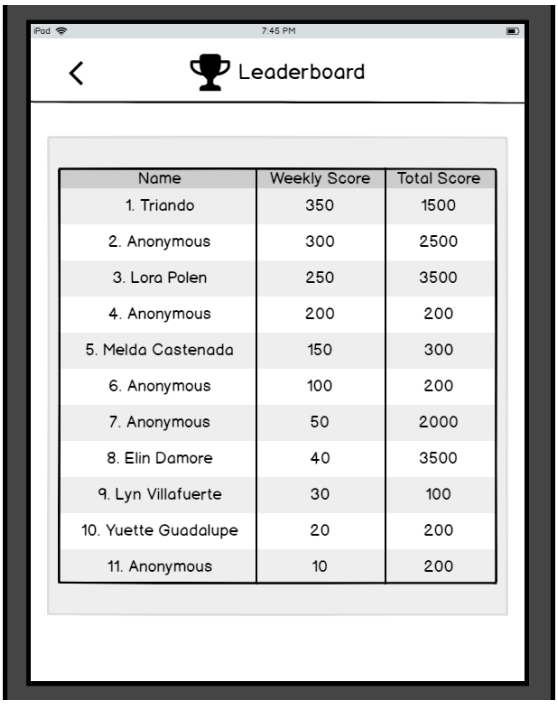
Landing page:

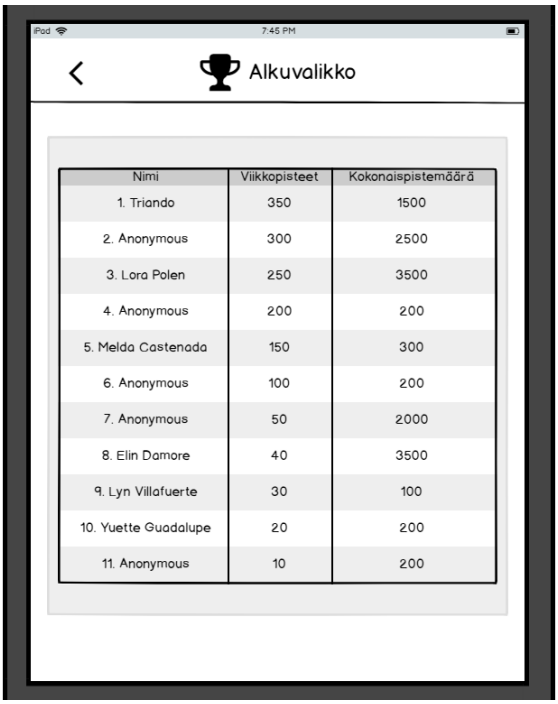


Home page in English and Finnish:

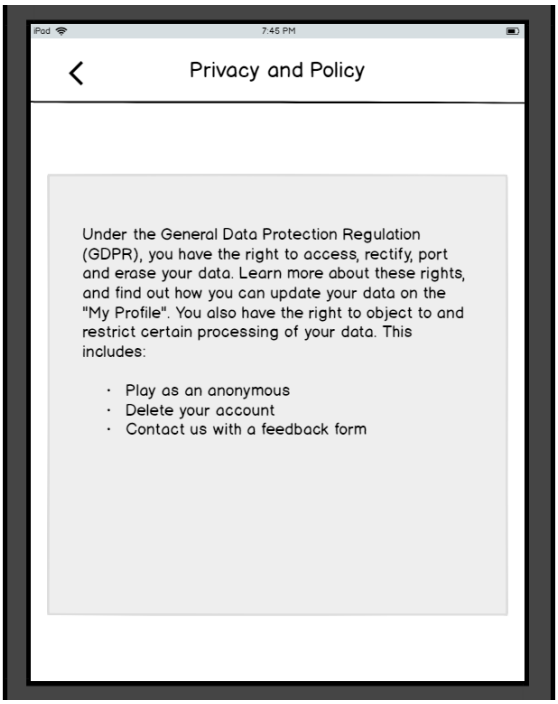
My profile in English and Finnish:

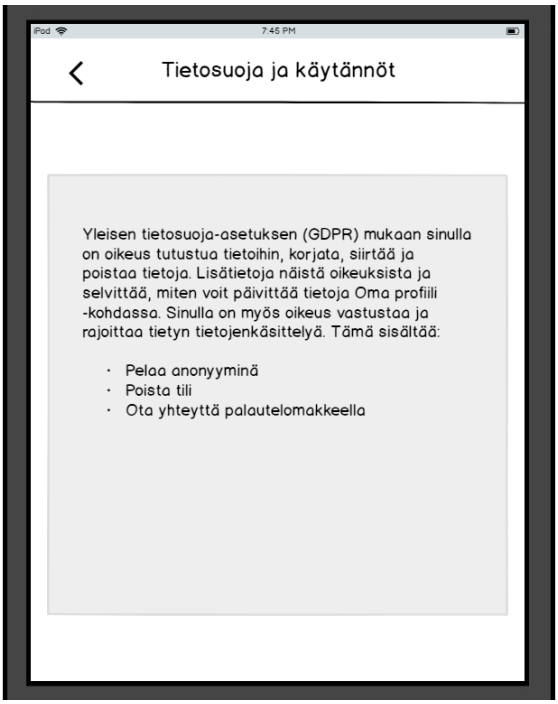
Leaderboard in English and Finnish:



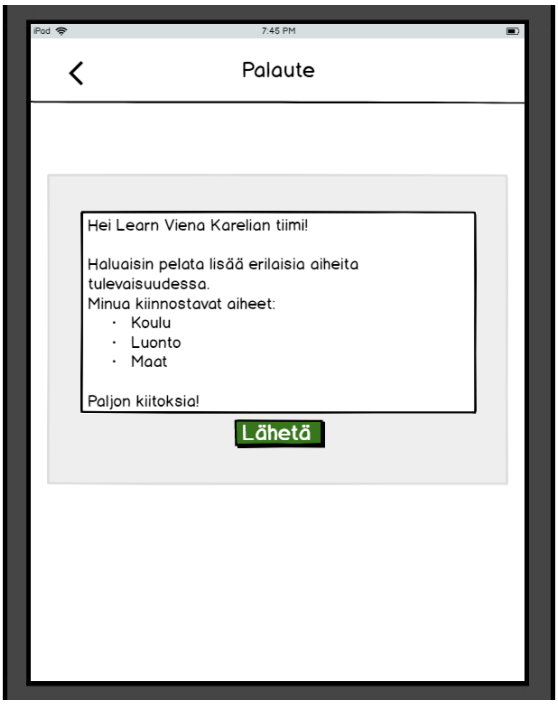


Privacy and policy in English and Finnish:

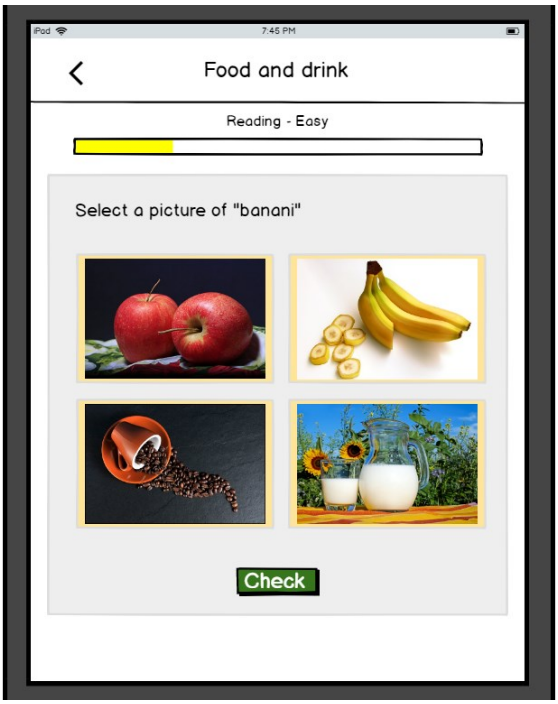




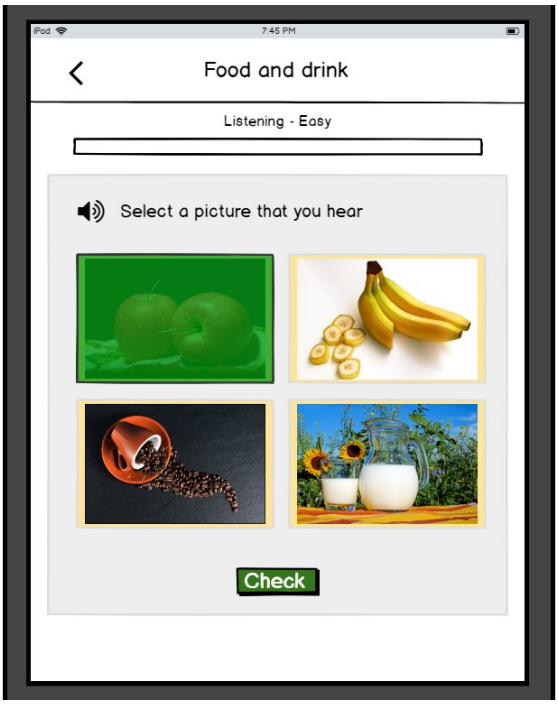
Feedback form in English and Finnish:

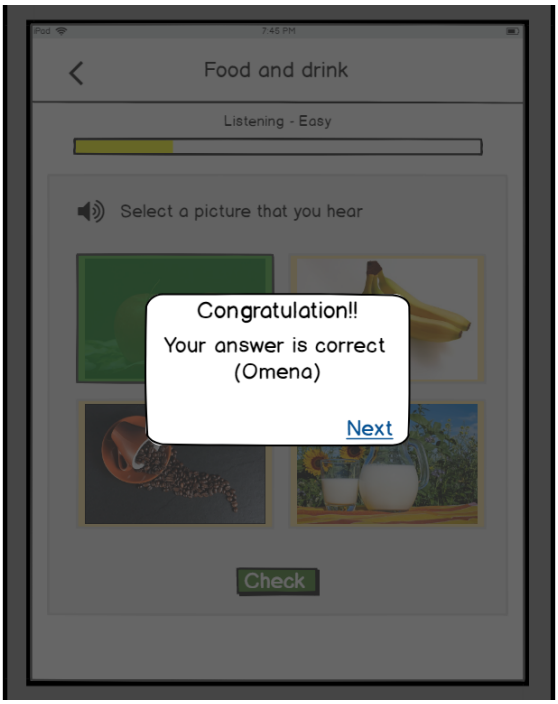


Reading easy:

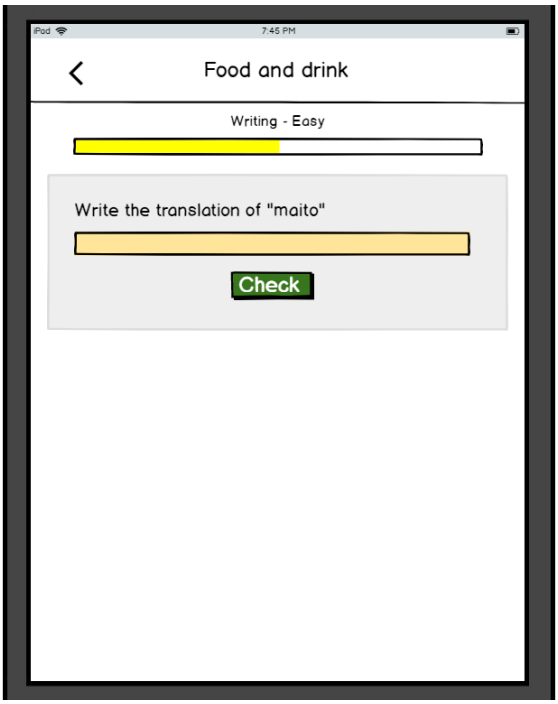


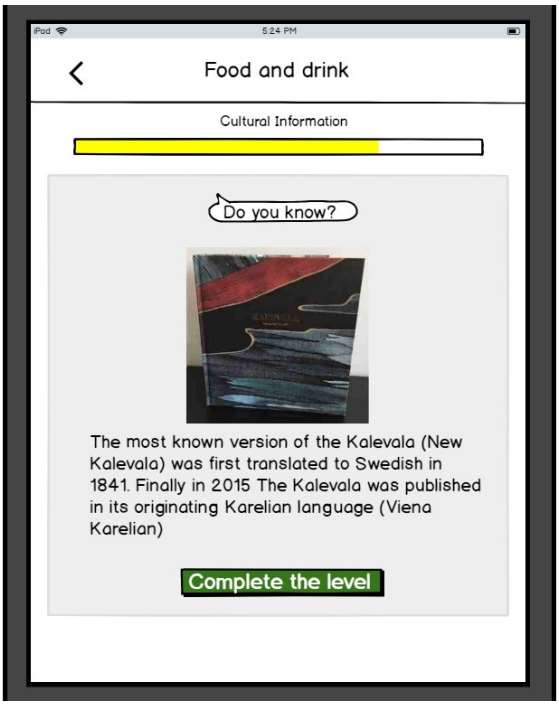
Listening easy and correct notification:



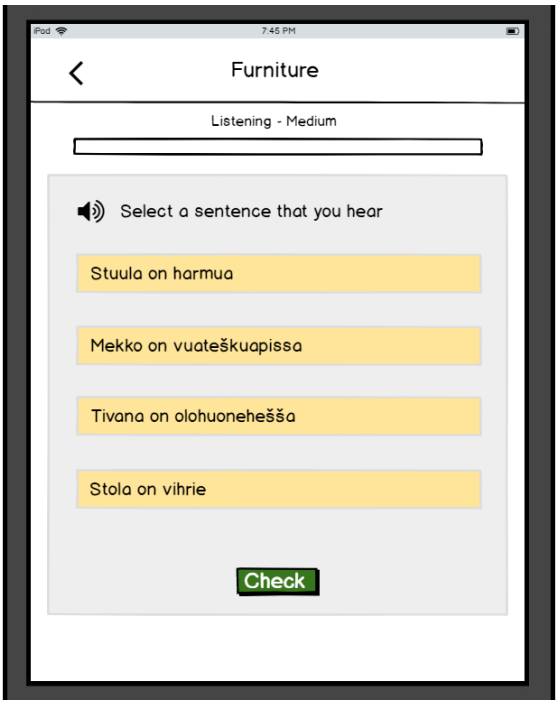


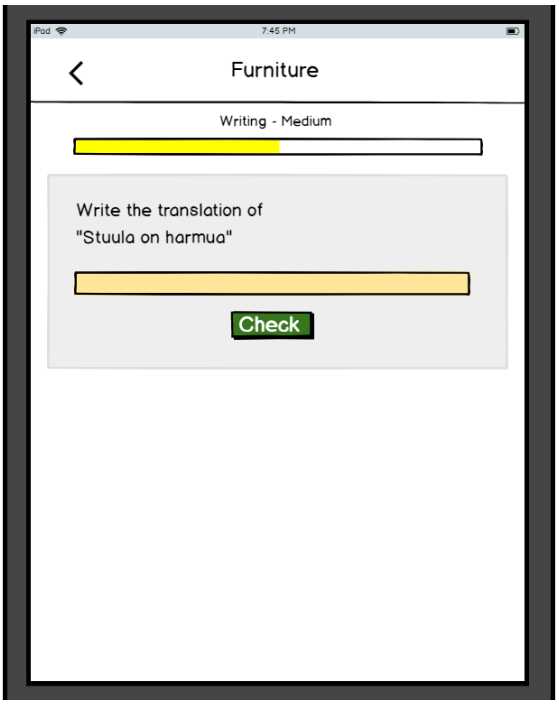
Writing easy and cultural information:



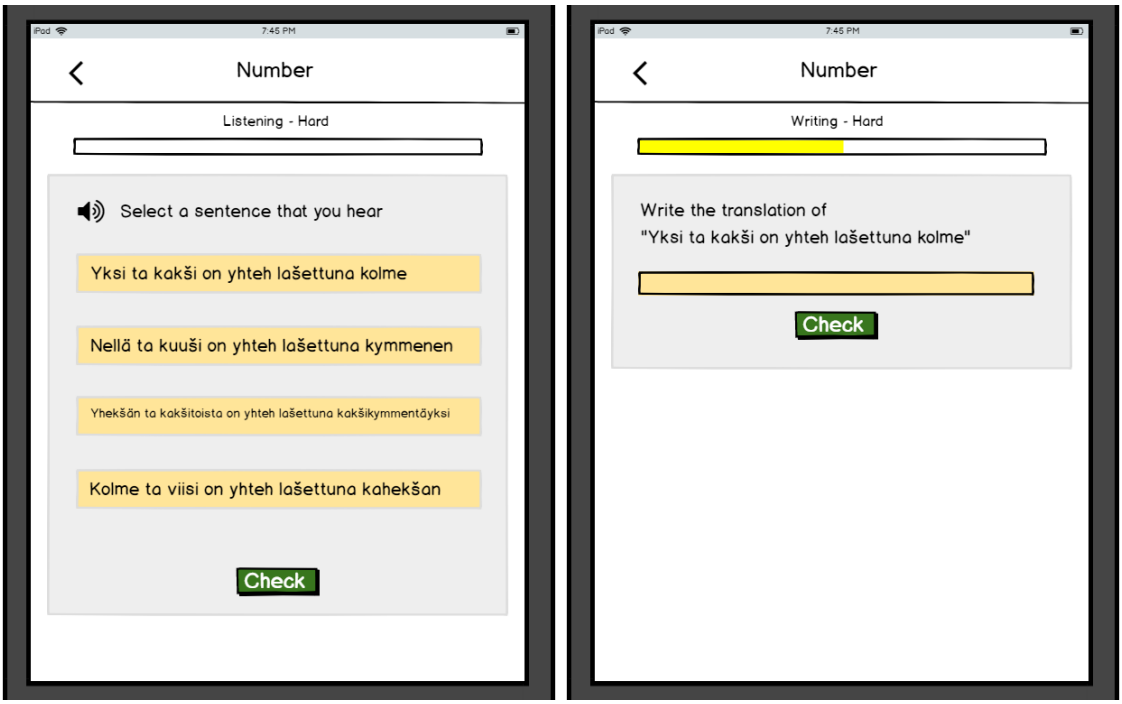


Listening and writing medium:



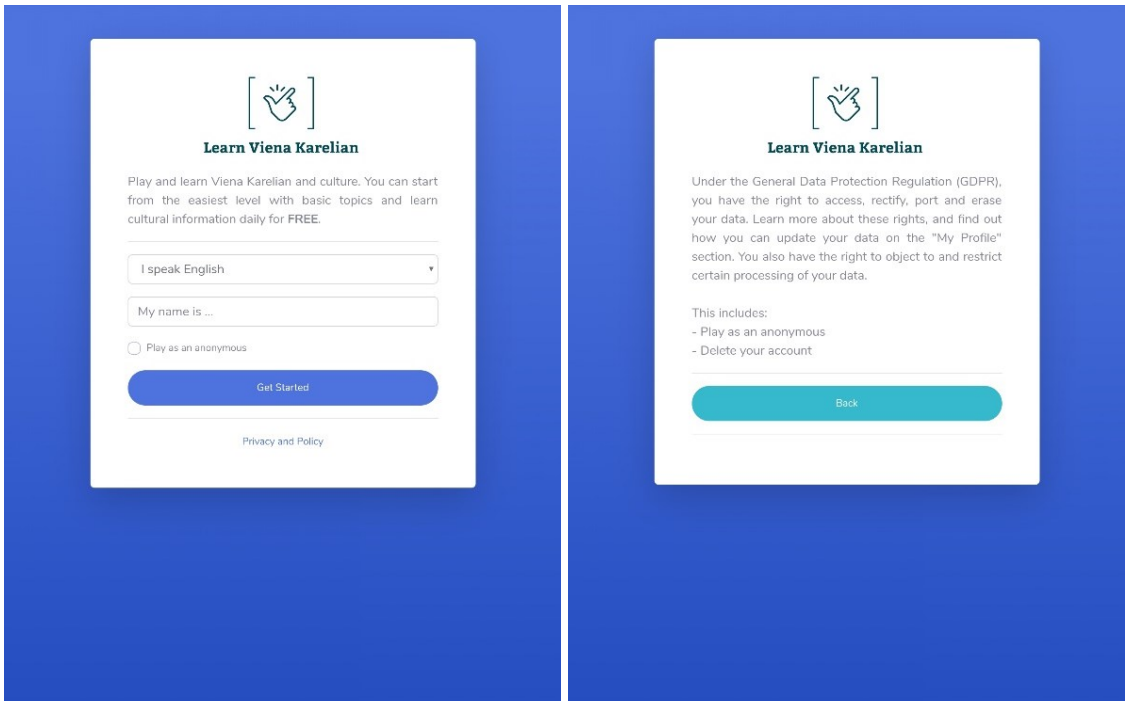


Listening and writing hard:

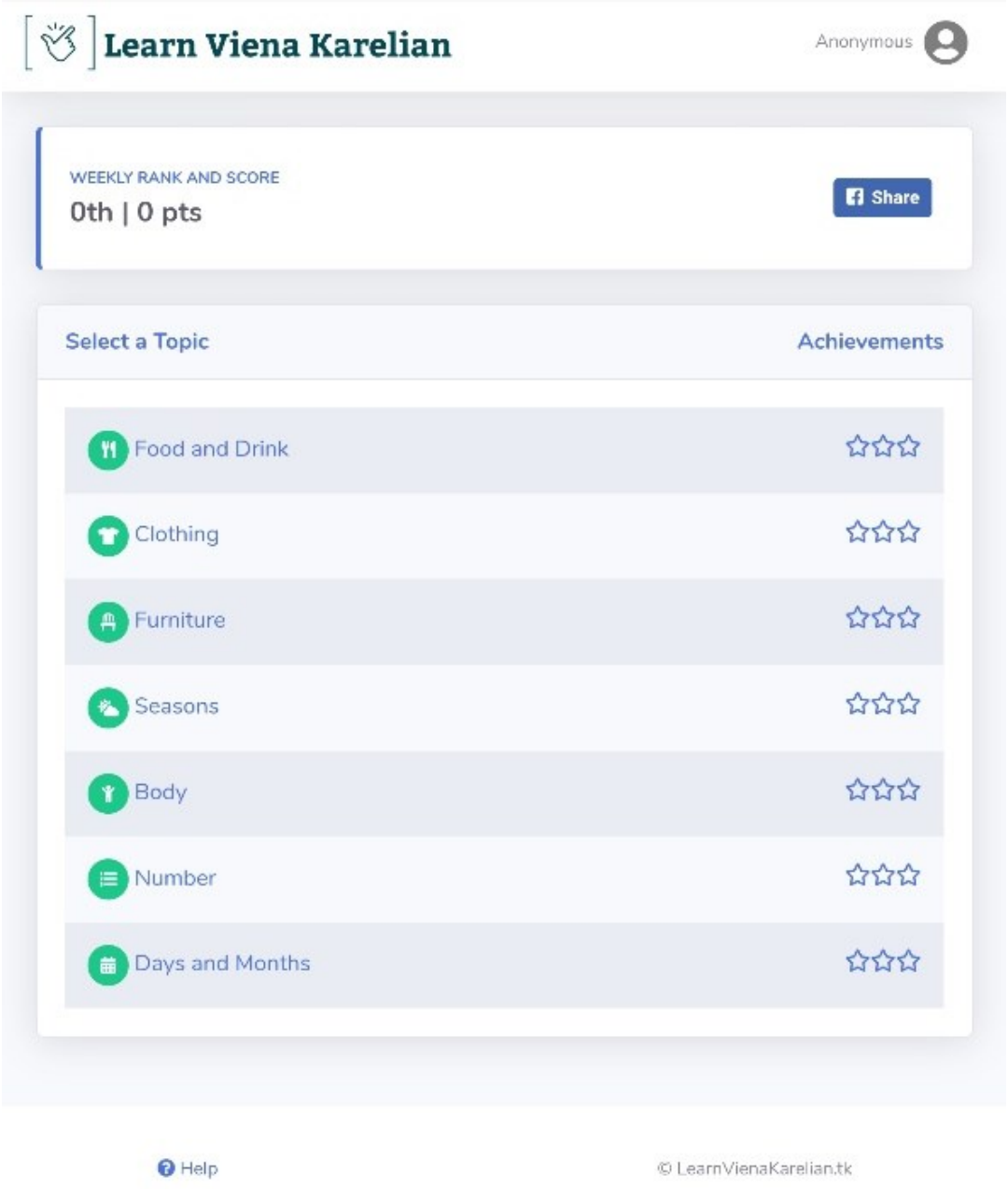


Appendix B. Game Prototype

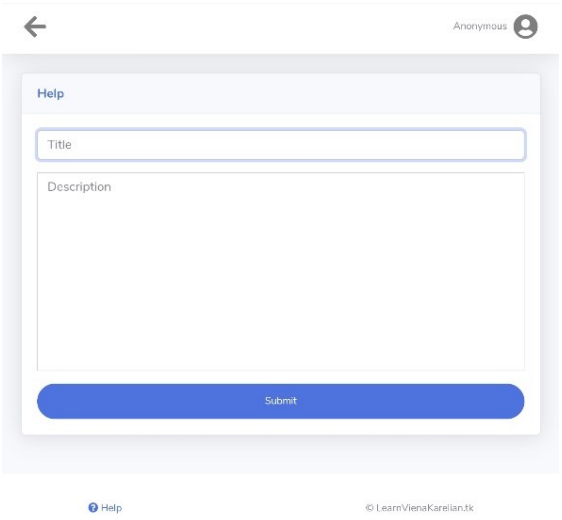
Landing page, and privacy and policy:

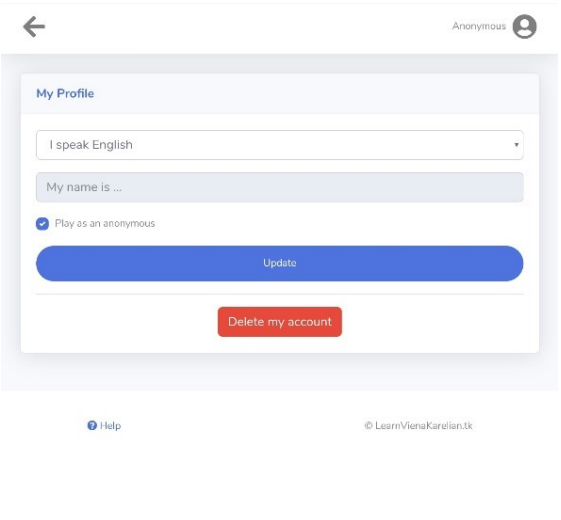


Home page:

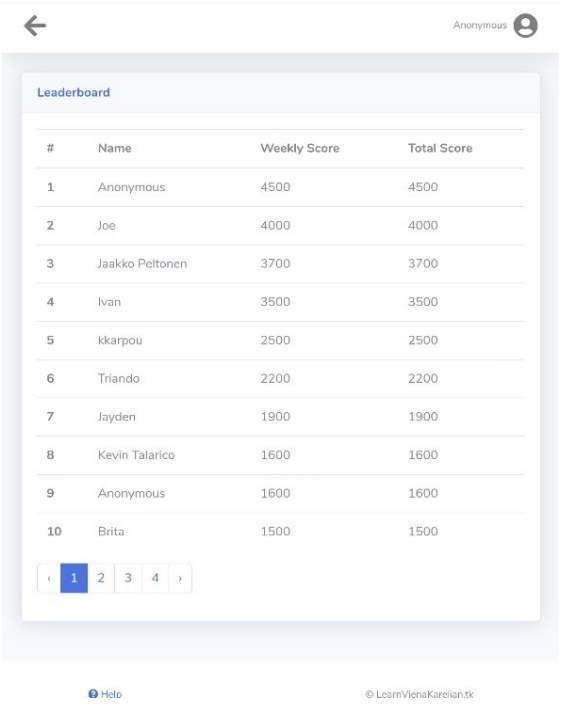

Learn Viena Karelian
Anonymous
WEEKLY RANK AND SCORE
0th | 0 pts
Share
Select a Topic
Achievements
Food and Drink
Clothing
Furniture
Seasons
Body
Number
Days and Months
Help
© LearnVienaKarelian.tk

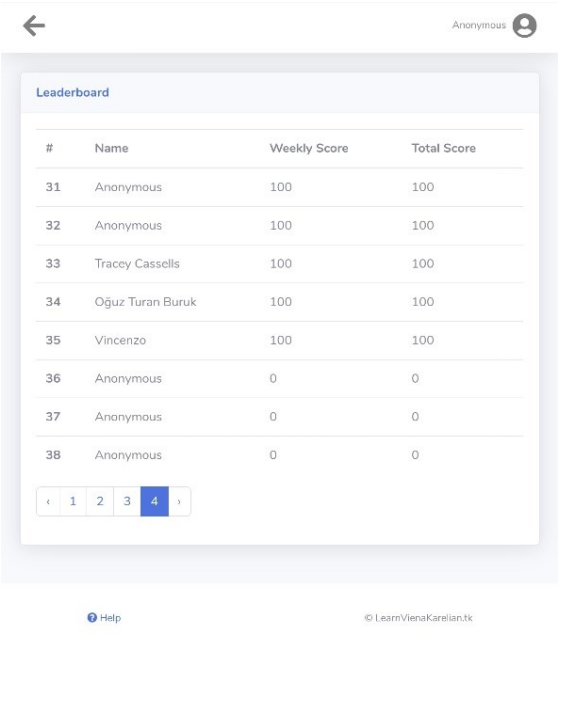
Feedback form and my profile:



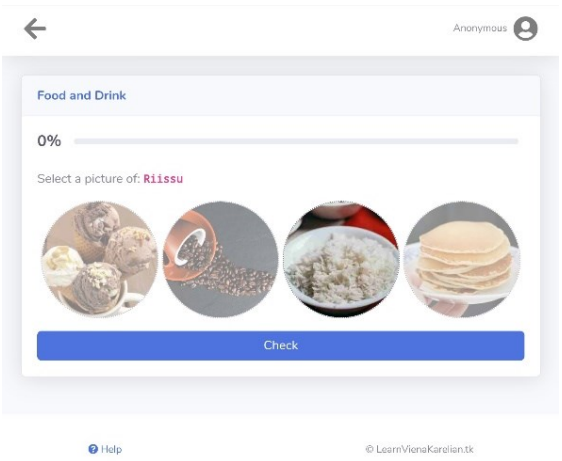


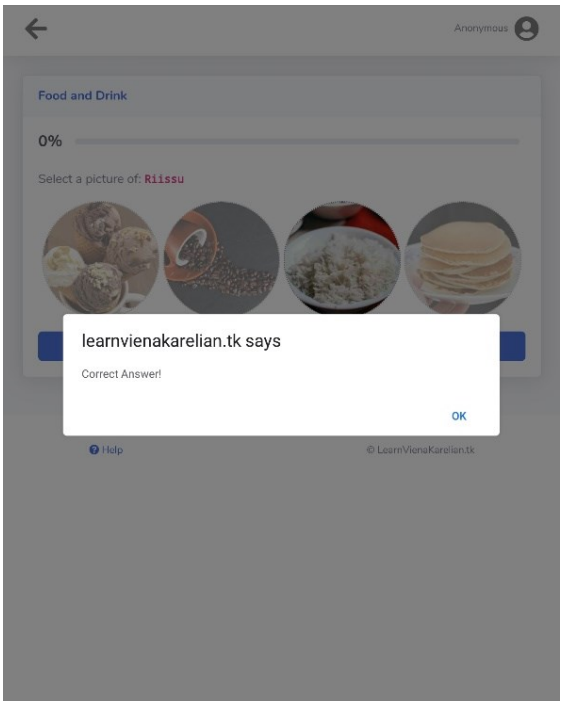
Leaderboard:



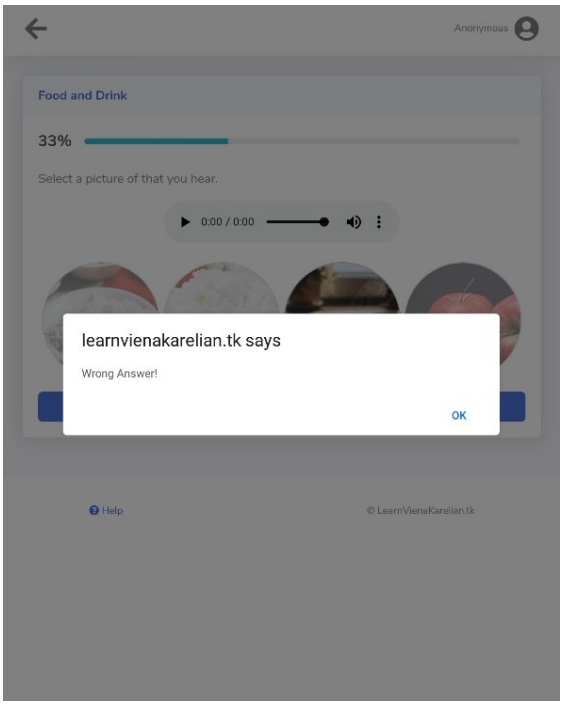


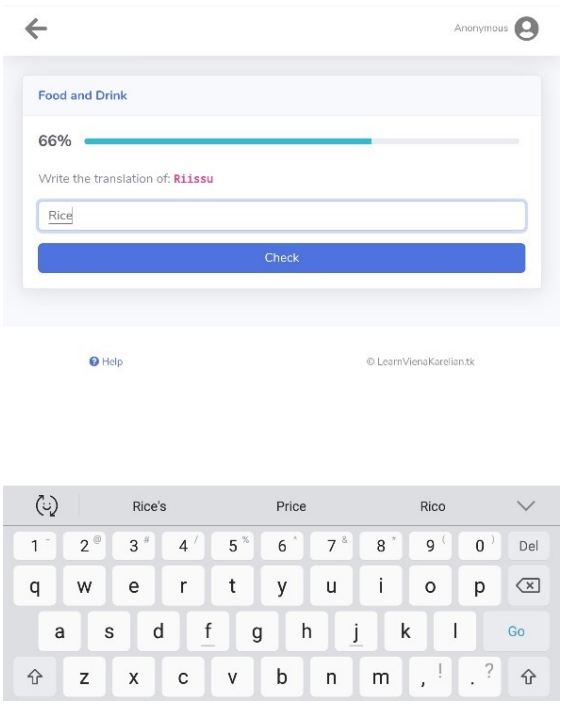
Reading easy and correct notification:



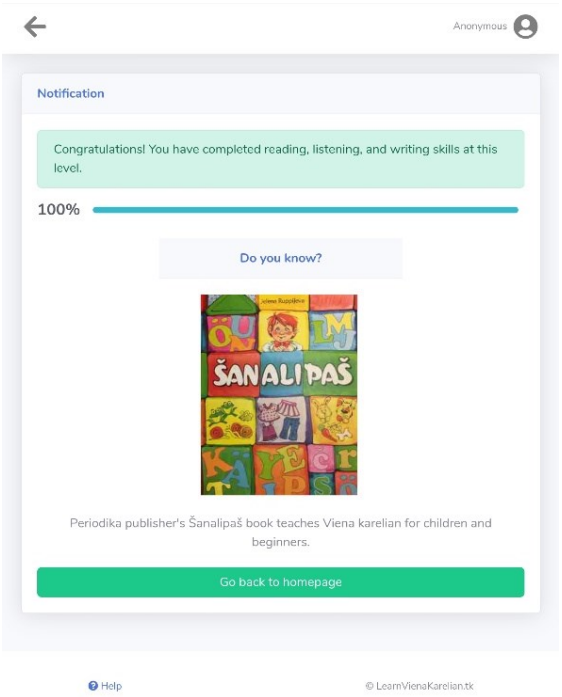


Listening easy with wrong notification and writing easy:

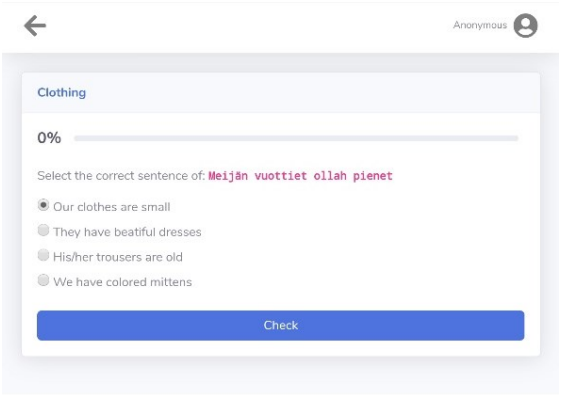


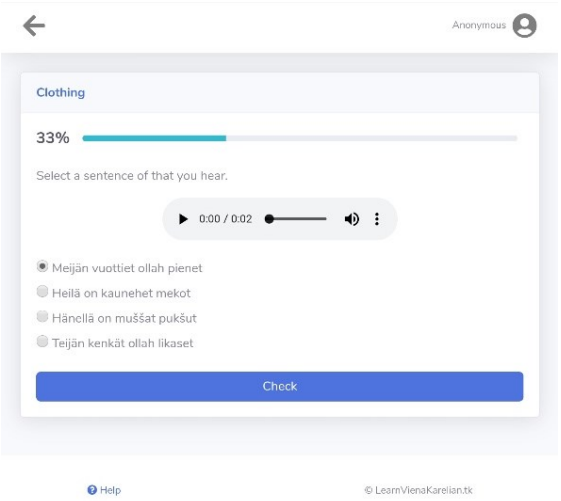


Cultural information:

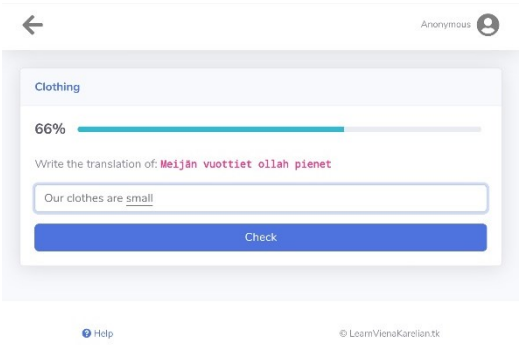


Reading and listening medium:

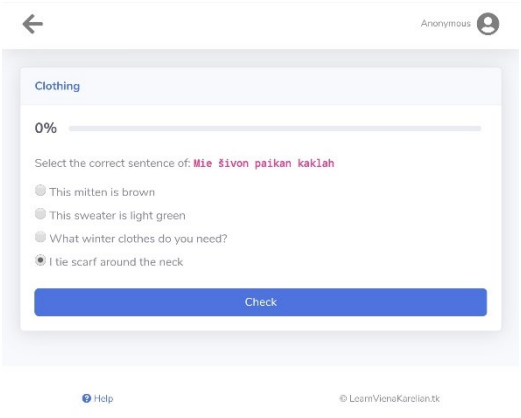


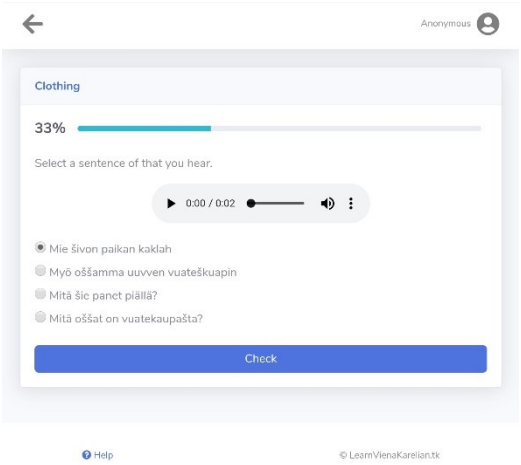


Writing medium:



Reading and listening hard:





Writing hard: