OULUN YLIOPISTO
UNIVERSITY of OULU

Evaluating and Designing Language Learning Games for Minority Languages – Focus on Karelian Language

University of Oulu
Faculty of Information Technology and Electrical Engineering / Degree Programme in Information Processing Science
Master's Thesis
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15.6.2020

Abstract

There are plenty of language learning applications found for smartphone on Google Play store, but only a few of them are for minority language learning, particularly for Karelian language as none of the most popular applications have it listed as an option. Luckily there are few found on the web, but they have their limitations. Both analysing and evaluating them in this study provide a good starting point for designing and developing games further so that one day someone who wants to learn Karelian language can find number of language learning games to choose from. The options for designs would go from having serious borderline gamified applications for language learning to more educational games where effortless learning would be one of the key aspects and having fun is highlighted. The games do not need to be strictly on either mobile or PC, but with the current situation of covid-19 restrictions, the need for digital-based learning games is apparent.

Literature review gives good aspects as to why it is important to do language learning games and as to what aspects should be considered when doing one. The studies on gamification bring forward the usefulness of individual game mechanics that otherwise would not be so carefully thought about when designing games. Giving users achievements and stars as a form of rewards when they succeed makes them stay more motivated when interacting with the game. Design science research provides good set of guidelines for artefact construction phase, where different kind of concepts are first presented based on the cognitive walkthrough and evaluation phases.

In addition to the games that are constructed, a set of design recommendations for further game development are formed to answer the question of what aspects need to be taken into account when developing games for minority language learning. Most of the aspects in the design recommendations are user experience related themes, since the usability aspect of the prototyped games is not on the level that it should be yet.

Keywords
Language learning games, educational games, gamification, game mechanics, minority language, heritage language, design science research, digital-based games

Supervisor
PhD, University Teacher, Leena Arhippainen

Foreword

After doing my Bachelor's thesis on the same subject, it felt natural and interesting to keep doing research more in-depth on educational games and gamified applications.

I would like to thank INTERACT Research group for giving me the opportunity to do research with them and the scholarship that was given to me. Especially I would like to thank my supervisor Leena Arhippainen for guiding me during the study and providing me information about Karelian language and culture. I also thank Mikko Rajanen for being the second inspector of the thesis. Thanks also to my friends Mikko Skarp and Arttu Kärki.

Petri Tanskanen

Oulu, June 13, 2020

Abbreviations

AI	Artificial Intelligence
CALL	Computer-Assisted Language Learning
DGBL	Digital Game-Based Learning
DSR	Design Science Research
EG	Entertainment Game
GL	Game for Learning
L2	Second language
MALL	Mobile-Assisted Language Learning
MGBLLA	Mobile-Game Based Language Learning Applications
MOO	Multiuser Object Oriented
MMORPG	Massively Multiplayer Online Role-Playing Game
PC	Personal Computer
SDT	Self-Determination Theory
UX	User Experience

Contents

1. Introduction

Gamification and serious games are used in multiple different areas, education being one of them. In gamification, the game mechanics of the games are used in a context that is not a game. (Deterding, Dixon, Khaled and Nacke, 2011) Literature on gamification helps in a way that it clearly lists the game mechanics and their purpose (Xu, 2012) and how some game mechanics have different kind of added benefits to the user's activity (Sailer, Hense, Mayr & Mandl, 2017). The use of badges increases the activity of the users on social platforms (Hamari, 2015) where self-determination theory or SDT is used to explain the motivational aspects (Sailer, Hense, Mayr & Mandl, 2017; Barata, Gama, Jorge & Donçalves, 2013). Some game elements like competitiveness can be seen as controversial topic as some users get motivated from it and some get put down (Acquah & Katz, 2020), making it important to characterize the players into different categories based on their player profile (Lopez & Tucker, 2019). Educational games tend to have one clear purpose like teaching vocabulary (Acquah & Katz, 2020) but gamified learning applications usually are formed in a way that they are supporting the user throughout the language learning process (Alsawaier, 2018).

The context where the educational games are used is important and especially now that covid-19 is present, this fact has more emphasis on it. Katz (2020) found out that in many cases the educational games were used by a teacher in a controlled environment. Having someone like a teacher to give feedback can be valuable as in some cases the games do not give good enough feedback or the feedback is missed by the user (Rosell-Aguilar, 2018). The feedback given to the users should also be done in a way that it has clear purpose. (Hamari, 2015)

There are plenty of games available for digital-based language learning and their levels vary from simple hangman type games (Riputandupačas, n.d.) to more complex games like virtual worlds and AI-based training tools (Berns, Isla-Montes, Palomo and Dodero, 2016; Peterson, 2009). The need for different kind of games for different levels of language skills is important as the language learners skills progress (Alavesa & Arhippainen, 2020).

Kunnas (2003) tells how minority languages are in a weak state and how some parents do not want to teach their children the native language, but Rodina, Kupisch, Meir, Mitrofanova, Urek and Westergaard (2020) explain how larger heritage languages have active communities with social interactions in some countries. Ward (2018) discusses the challenging aspects of language learning in minority languages as many of them have different dialects formed. This is also visible in Karelian where one game needs to be made for Livvi Karelian, Viena Karelian and South Karelian (Turunen, Aleksejeva, Paalamo, Giloeava, Karjalainen, 2019).

Finding the existing literature on the topic required looking into other minority languages in the world to find out more knowledge overall about teaching and learning a minority language. On the existing games an expert evaluation was made to gain more knowledge on the subject and to break the games into smaller pieces and components to realize what is important. This data is helpful in the designing process that underwent next in the thesis.

Karelian language proves to bring its interesting little quirks into the research with the way it is divided into different dialects and how there is not a lot of educational material found on the internet on the subject. This gives a better image how hard is it to construct a new educational game for language learning from scratch without existing data sets

although some might be used in the designing process and also it gives feasibility on the time and effort how long does it take to make one from scratch or is it better to try to buy an existing solution from someone and change it into different language.

Research question is as follows:

RQ: What kind of language learning games should be made for minority language learning?

The research question can be divided into two sub-questions:

RQ1: What kind of game mechanics should be used for minority language learning games?

RQ2: What other aspects need to be considered when designing games for minority language learning?

In order to find answers to these questions, literature review and design science research was made. In the beginning of design science research an analysis was made into few of the more popular language learning games found on Google Play store. After that a cognitive walkthrough and a heuristic evaluation into existing Karelian language learning game was made. The findings were used in the process of designing the new artefact.

Structure of the thesis is as follows, first the thesis will go through the existing previous literature about language learning games, educational games and gamification overall, before diving into how the research was conducted, after that the evaluation of the existing games is presented. With the findings in mind a new artefact for language learning is constructed and presented, the findings, limitations and possible future research is then discussed.

2. Literature Review

Prior literature on the topic of educational games for language learning is extensive and has good grounds for future research. However, on the subject of minority or heritage languages, the literature and research are not as extensive. Gamification also is something that needs to be investigated as the papers concerning it have been growing in numbers in the recent years and it can provide important information from slightly different aspect.

Little (2019) did a study where families, that had second language learning as heritage language, were interviewed on their language learning app usage. The three most frequently used apps in these families were MindSnacks, Memrise and Duolingo. He noticed that most apps for language learning were designed and made for new language learners or to people that already were proficient with the language. (Little, 2019.)

This section of the study will investigate different types of language learning games found in the literature, then will look into the game mechanics that the games have and how they affect the players' experience and learning.

2.1 Different types of language learning games

Gamlo (2019) investigated the existing mobile-game based language learning applications (MGBLLA) and found three different types of games that were used to learn English. First app was called Game Books: Great Reader and its purpose was to get users to read a piece of text and then their reading comprehension was tested, points were used to reward the players. The next app was called EnglishTracker which was designed to teach the player grammatical rules of the English language and as they succeeded, they were given stars as a motivational instrument. The last game was called Learn English Vocabulary Pop Quiz and it showed pictures and words linked to them in order to familiarize the player with such type of vocabulary. (Gamlo, 2019.)

Instead of using existing apps or games, some research papers try to make their own games in order to try out different types of methods. This was the case with Berns, Isla-Montes, Palomo and Dodero (2016) when they made a new type of hybrid game called VocabTrainerA1. The game was designed for a group of people and it first had a story for the players to read and then they were given roles in the story. The story that they used was a murder mystery. Communication and working as a team with the new language they were trying to learn was essential. First there was a learning session where essential words that would be used in the game, like body parts, were taught to the players.

Yen, Chen and Huang (2016) looked into a game called the PHONE words that had various types of mini games built in for users to play. What was interesting about this game was that most of the games were built and meant for two players. Games such as tic-tac-toe, hangman and tug of war were some of the mini games were turned into a small competition between the two players. In the tug of war players were asked vocabulary questions and each time they answered correctly their avatar in tug of war pulled the rope a little more, eventually winning when getting more answers correct than the opponent. (Yen et al., 2016)

Acquah and Katz (2020) investigated many papers on the subject of language learning and found out different types of games used by the researchers. The most intensive and biggest was a game called Second World, a simulation game where players could create

their own avatar and interact with other people in a virtual world. This required a third party, a teacher, to create a learning situation in the virtual world for the players to act a part in. A few different sites where there were mini games were presented. On the website eslgamesworld.com they brought up crossword puzzle, matching game, word search, spelling game, a few different types of board games and a sea battling game. Other murder mystery narrative game Whodunit was also used. (Acquah & Katz, 2020.)

Peterson (2009) presents some other games that were built for computer with the abbreviation CALL or Computer-Assisted Language Learning. MOO Domains or multiuser object-oriented domains use rooms and text-based communications were recognized with the game Moossinggang used as an example from these types of games. 3D web-based simulation game that was brought up by Peterson was called Active Worlds and it had big virtual worlds were players could interact with their avatars. Few simulation games they brought up were those that people could found from stores; The Sims and Simcopter. These games had realistic looking objects and environments so players could get immersed. Massively multiplayer online role-playing games (MMORPGs) were next looked into and more specifically World of Warcraft. Last genre and game to be looked at was called The Tactical Iraqi. It was most advanced out of all of these games and had even individualized AI-based training for users. (Peterson, 2009.)

2.2 Benefits from gamification and educational games in language learning

Yen et al. (2016) tell how advances in mobile technology and especially Mobile-Assisted Language Learning (MALL) applications are beneficial in vocabulary enhancement and reading comprehension. The same beneficial effects can be seen in all the Digital Game-Based Learning (DGBL) areas. Sundqvist (2019) tells how especially vocabulary can be studied using games for L2 (second language) learning. She found out that especially difficult words were handled well by people that had background in playing commercial-off-the-shelf games.

When going into the realm of games, it can be difficult for some people to understand the difference between educational games and games for entertainment purposes. Acquah & Katz (2020) make this distinction easier by using abbreviations GL (Game for Learning) and EG (Entertainment Game). In their study they investigated how the educational games were used and if they were used in a classroom or at home. Out of the selected 26 papers, 46% of the games were used in a classroom by a teacher, 23% in a classroom scenario but without teacher's interference and the rest were mostly at home, some hybrid forms between the three were found though. 78% of these papers reported positive effects from using their educational games and the rest were either mixed or not statistically significant, but straight up negative studies were not found. (Acquah & Katz, 2020). Martí-Parreño, Seguí-Mas and Seguí-Mas (2016) studied teachers' opinions about gamification in educational context and found out that approximately 62% used gamification in their classroom environments and only around 11% regularly.

Sailer, Hense, Mayr and Mandl (2017) use self-determination theory, SDT to measure and explain the motivational aspect of gamification. By using this model, they tried to recognize and associate different kinds of game mechanics into different motivational factors. (Sailer et al., 2017) Barata, Gama, Jorge and Donçalves (2013) made gamified course with the same idea and noticed that when using this theory, the activity levels in the class were higher compared to the previous years. SDT uses three main motivational

aspects; (1) Competence, (2) Relatedness and (3) Autonomy. (Sailer et al., 2017; Barata et al., 2013)

2.3 Aspects to consider when making a language learning game

Acquah and Katz (2020) found out that when learning vocabulary, the game should be easy, but in different aspects the games need to be more challenging. Having different degrees of difficulty depending on what the game seems beneficial. Social aspect also is something that motivated the players well, having someone to talk to about the game or the learning process helps. Instant feedback was also something that the players liked in the games as long as the feedback was well constructed. One of the most controversial aspects was competitiveness as it was found out to be beneficial in some cases and in some cases, it made the players feel bad if they scored worse than the others on a game. (Acquah & Katz, 2020.)

Yelahina and Fedchushyn (2020) found out that the players need to understand the rules of the game in their own native language before the games begun, otherwise they will just be lost trying to understand the mechanics and rules of the game without actually learning, also the game needs to be interesting for the players. They studied the effects in a roleplaying simulation done in person with patients and doctors as roles given to medical students. This way the educational game they used was as interesting as possible to the target audience through usefulness in medical studies and the communication and collaboration was active during the whole play. (Yelahina & Fedchushyn, 2020.)

Tahir and Wang (2020) found out that the existing literature papers did not go through the singular aspects when designing educational games, also the evaluating processes of the existing games did not go into enough detail so they made a new framework called LEAGUÊ (Learning, Environment, Affective-cognitive reactions, Game factors, Usability and UsÊr). (Tahir & Wang, 2020.) Alhammad and Moreno (2018) made literature research and found out that in the context of software engineering there were no good guidelines for gamification of such task and half of the used research papers tried to combine different elements, hoping they would stumble upon something good, but added advantages were not found with this method.

Rosell-Aguilar (2018) constructed an interview for users of an application called Busuu. Busuu is used for language learning and she tried to find out how users felt about the application, how they used it and what else the users did to learn a language. Users liked vocabulary, hearing comprehension and some grammar sections of the application the most and the least liked ones were writing, grammar and correcting people's writing. She also found out that getting feedback was something that the users like a lot, although over 6% did not feel like they received any kind of feedback from the application. (Rosell-Aguilar, 2018.) Pattermore, Gilabert and Sierra (2019) found out that children aged 10-11 years mostly instantly skipped the long feedback that the iRead application built for their research tried to offer them. Instead the kids just tried to do the task again after failing the first time. Hartshorne, Tenenbaum and Pinker (2018) tell about critical period, which is a time period where children should start learning language to master it like a native.

Kolb (2015) goes into detail about different types of game mechanics and how they should best be implemented in a gamified application. He makes a list of 11 rules and explains each well. Four of the eleven rules are about the quests or the missions that the gamified application offers for the users. The quests should be short, users should be able

to create their own quests and decide which quests they want to do, so that the system is not forcing something upon them. Experience points should be given a lot to the users, instead of giving players one to three crystals for every task, they should be given one to hundred. Anonymity is one thing that should be possible on the leaderboard. Other things he mentions are surprises for users, rewarding excellent performance and showing failure as a new way to learn. (Kolb, 2015.)

Hanus and Fox (2015) also studied the effect of having a leaderboard and how it would affect the users. They found out that having an anonymous option in the ranking system would make users feel better about themselves as they would not be as heavily judged by their peers. Also, the effects of gamification in their gamified group made people that were previously less motivated more motivated, but the people who were more motivated earlier had a decrease in their motivation levels due to the fact of having gamified application present in the educational environment. Alsawaier (2018) discussed the how game-based learning and educational games can have decreasing motivational aspects when the game ends and the learning process comes to a stop, but gamified language learning processes usually are more broad and that is why they can be there to help the language learner throughout the process.

Alavesa and Arhippainen (2020) introduce a game palette for game development in the context of minority languages. In the palette there are three levels of difficulty that are following the language learners' skills. Easy is for starters, medium difficulty for moderate independent language learners and hard requires native or home language knowledge. In the first level the vocabulary increases with the help of listening, in the next level speaking and some forms reading come into the mix, the third level has grammar tasks and writing. Different kind of games for different levels are visualized inside the palette, where first level should have easily accessible games for basic vocabulary using different kind of audio-visual cues and the games should have wide scope of audience. Second level brings in cultural aspects with different kind of themes and levels, the games should be testing the players' skill level. Communication is one of the aspects on this level and entertainment value of the games should be more apparent compared to the first level. The entertainment continues to third level, but on the third level the teaching and preserving the culture come along, where having dialect differences of the minority language in the game is important (Alavesa & Arhippainen, 2020.)

Smiderle, Rigo, Marques, Coelho and Jaques (2020) decided to study how different kind of personalities view gamified elements in educational context. They found out that introverts had more achievements and progress made in the gamified context compared to the other groups and low self-esteem students had better accuracy in the gamified group compared to the non-gamified one. Lopez and Tucker (2019) did not find similar answers with player profiles. Mora, Tondello, Nacke and Arnedo-Moreno (2018) had similar results when users were divided into groups based on a Hexad framework questionnaire, the users who were allocated and used gamified application, had 22% greater activity. Hexad framework 24 questionnaire set give better understanding of the user (Mora et al., 2018; Lopez & Tucker, 2019) to give the user better experience with gamified elements.

2.4 Gamified elements

Xu (2012) has a list of game mechanics that can be used in gamification with three different types; progression, feedback and behavioral game mechanics. Benefits and what type of player type does the game mechanic benefit the most are listed in the Figure 1. As can be seen some game mechanics have all of the added benefits for the user, but some

only have a few. Game mechanics included in progression, only four mechanics are found but they all have greatly added benefits compared to some of the game mechanics inside feedback. (Xu, 2012.)

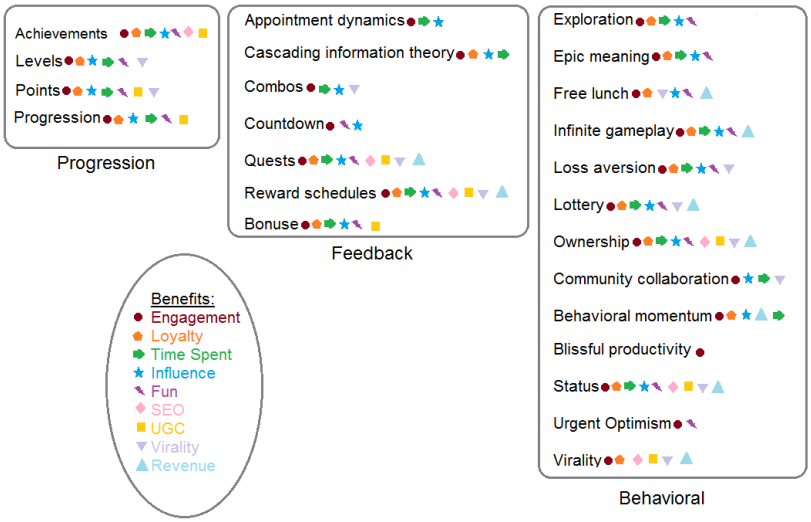

Figure 1. The illustration of game mechanics and their benefits (formed based on Xu, 2012)

Hamari, Koivisto and Sorsa (2014) conducted a literature research and found out that gamified applications have positive impacts on the motivation, but when taking away the gamified system after some usage, the users were unhappy as they did lose the achievements they had unlocked, but they also found out that gamification in some cases only had short term motivational effects, so using short term had advantages, but the loss of gained achievements makes it so that it might not be advantageous. (Hamari et al., 2014.)

Sailer et al. (2017) studied this more and tried to match a gamified element with a psychological need. Avatars were made to have users immerse, the need for success was brought with scoreboards and badges, the feedback was instant with performance graphs. As they suspected each aspect had an impact on the specific psychological aspect that they were trying to impact. Some blanks could also be found with the individual game elements and how exactly they affected the user. (Sailer et al., 2017.)

Hamari (2015) made a study into badges on a Sharetribe -website where people could sell things. The badges were implemented into the website with clear purposes and clear intentions in mind, for example leaving X amount of posts on the website would give user a badge. The badges were visible for all the users so looking at someone's profile could give an indication how reliable or active they were based on a quick look on the badges. The study went positive and badges seemed to increase the user activity on the website, proving that gamification even in a small way like this can add motivation. (Hamari, 2015.)

2.5 Minority language learning

Rodina, Kupisch, Meir, Mitrofanova, Urek and Westergaard (2020) studied language learning of heritage language in Israel, Germany, Norway, Latvia and England. The study had Russian as the language that was used by the families living in these countries, they

did not find any correlation between the language structure of the five countries that the participants were living in and Russian, but only the effect of hearing and using the heritage language outside and inside the residence was deemed to be profitable. (Rodina et al., 2020.)

Ward (2018) found out that heritage and endangered language teaching has many challenges, the biggest of them being limited resources. Out of these limited resources the biggest factors are limited monetary capital and not enough technological capabilities to make the tools to teach these languages into a digital form. The people learning endangered languages often are different in nature to the normal L2 learners as their age and level of motivation are not the same. Smaller language groups can also be difficult in the nature because the dialects of the language make things difficult. (Ward, 2018.) Polinsky and Scontras (2019) also talk about how difficult the smaller dialects can prove to be when the original language of the country has mixed up with the new country that the people live in and that is how some of the people living there can talk way different dialect compared to the original one their parents talked in the country they were living in. In these cases, it can be hard to determine how correct their grammatical rules and vocabulary are.

Little (2019) studied how heritage language families let their kids use language learning games and on which platform most of these games were. The studies suggested that the primary source of studying for the kids still was books, and the mobile and web applications were used equally as much. Kids were more excited about the smart device applications compared to the web ones. (Little, 2019)

Chiaráin and Chasaide (2016) studied AI-based bot that was used to teach three different dialects of Irish to 16-year old students. The voice recognition capabilities, the speech capabilities were said to be good by the participants and the bot also formed a personalized profile for each of the students so the replies more fitting. (Chiaráin & Chasaide, 2016.)

Ward, Mozgovoy and Purgina (2019) studied a mobile application called Word Bricks and more specifically the transformation process of the application into Irish from English. The application was a gamified application or so-called game-informed application. The differences between English and Irish were not recognized as hinderance when making the transformation and kids aged 8-11 were enjoying the usage. The teachers were also giving positive comments about how well it is suitable for teaching Irish. (Ward et al., 2019.)

2.6 Karelian serious games

Damiri Burlian, Sharmila, Alavesa and Arhippainen (2019) made a study where a mobile game was developed in attempt to teach Viena Karelian for people on the age range of 20 to 35 years as the main focus. The first prototype called Let's Learn Karelian had learning mode and playing mode, in the learning mode alphabets are taught and in playing mode vocabulary is taught through Karelian culture. It never left the prototype phase, but a new game called Learn Viena Karelian was designed based on the learnings from the first prototype made. (Damiri Burlian et al., 2019).

Koski and Arhippainen (2019) conducted a study on making a serious game as a language teaching tool for Finnish people. Šanakoški is an application where the players need to make as many words from one main word as possible and the words are in Viena Karelian

dialect. Another game that was made in this study was Hirsipuu or hangman in English. The dictionary used can be found online is tailored to fit the purpose of use in the game and was divided into XML files. In hangman players can choose different game modes and if the basic game mode is used, the level of the game will get harder with each word, the longest word being 14 letters in length. It also has themed mode where words are based on a set theme that user can change. A leaderboard for rankings was also implemented in both games. One more game called Learn Viena Karelian (Triando & Arhippainen, 2019) was also brought up in the study. All of the games received positive feedback from the participants (Koski & Arhippainen, 2019).

Alavesa and Arhippainen (2020) noticed three digital language learning games called Riputandupačas, Uuši vuoši and Kielimestari. Riputandupačas is a hangman type of game for browser with different themes and a basic layout, it has image and text-based hints for the player (Figure 2). The game is in the Livvi Karelian dialect of the Karelian language. (Riputandupačas, n.d.). Uuši vuoši is a browser game for children mainly where vocabulary learning and pronunciation of vocabulary is the main purpose of the game. Kielimestari (Kielimestari, 2019) is a gamified application for learning minority languages on smart devices, it has also Swedish and Sami as the options for language learning. One of the games presented is a board game called Karjailini kylä – Karjalane kylä – Karjalaine hieru, that has the three dialects of Karelian language present, Livvi Karelian, Viena Karelian and South Karelian that uses dice to move on the board and all the possible spots have different kind of tasks for players, such as conversational task. (Turunen, Aleksejeva, Paalamo, Giloeava & Karjalainen, 2019)

Figure 2. Screen capture from Riputandupačas game (11.6.2020)

3. Research Methods

This section of the thesis goes through the selected research method and why it was selected. The selected research method for this type of study is design science research and when talking about it in the context of information systems, Hevner, March, Park and Ram (2004) have formed a paper on the subject that fits the purpose of this thesis. Evaluating all of the existing Karelian language learning games using heuristic set by Fitchat and Jordaan (2016) was done and a new artefact was made based on the findings of these.

3.1 Design Science Research

An artifact is being designed and constructed, it constantly goes through evaluation that is backed up by previous knowledge from empirical data and previous literature. There are seven guidelines that Hevner et al. (2004) introduce in their paper about Design Science Research (DSR).

1. Design as an Artifact
2. Problem Relevance
3. Design Evaluation
4. Research Contributions
5. Research Rigor
6. Design as a Search Process
7. Communication of research

The first guideline of design as an artifact brings the need of a construct, model or method to be brought forth in the process of design science as the representation of it helps to understand the underlying problems in the process of its creation. Understanding that the presented artifact is not complete package and often lacking in some technical aspect needs to be addressed in the design process. (Hevner et al., 2004.)

Second guideline on problem relevance brings forward the understanding of the problems that appear in the information system adaptation process. Having understanding of the technology-based artifacts, organizational-based artifacts and people-based artifacts is a must when discussing the problems. This helps the other researchers to evaluate and or validate the issues that are brought forward and gives information for further research. (Hevner et al., 2004.)

The third guideline of design evaluation is the step of rigor testing of the artifact by different methods. The iterative nature of the design science research is well presented by this guideline as the artifact cannot be constructed without having the different qualities of it tested first. Evaluation brings forward functionality, performance, usability, reliability issues that can affect the quality of the artifact in the concept phase. These can be then fixed in the designing phase later. Evaluation methods can be observational, analytical, experimental, testing or descriptive, where each of the five methods have different kind of solutions for evaluation. (Hevner et al., 2004.)

Fourth guideline is about the research contributions, where either the designed artifact, the foundations of the design phase or methodologies are the contribution to the field. All of these three can be found and discussed in the design science research paper, but even

one is enough of a contribution when it presents a solution to a problem found and studied. (Hevner et al., 2004.)

Fifth guideline of research rigor is about proving how does the artifact work and to present that in the study using different kind of analysis techniques with appropriate and correct data. Having mathematical constructs to validate the rigorousness is one option but putting too much effort on that can diminish the relevancy of the presentation. Balance in these two must be found and examined. (Hevner et al., 2004)

Sixth guideline of design as a search process brings forth the importance of dividing the problems of the design into smaller pieces that then can be used to start the iterative designing process. Finding these smaller pieces of the puzzle can then be tested and analysed with the evaluation methods used and as each of the piece is analysed a bigger picture can be formed from them. Design science research does not have to bring solution to all the problems as long as they are addressed and discussed in a manner that brings information about them. (Hevner et al., 2004)

The last seventh guideline identifies the communication of the research and how it is necessary to be able to read the findings presented in the design process by different audiences. They use the terms technology-oriented and management-oriented audiences to differentiate the practitioners of the field and people who are in the charge of the organizational structure and decision making in the business context. (Hevner et al., 2004)

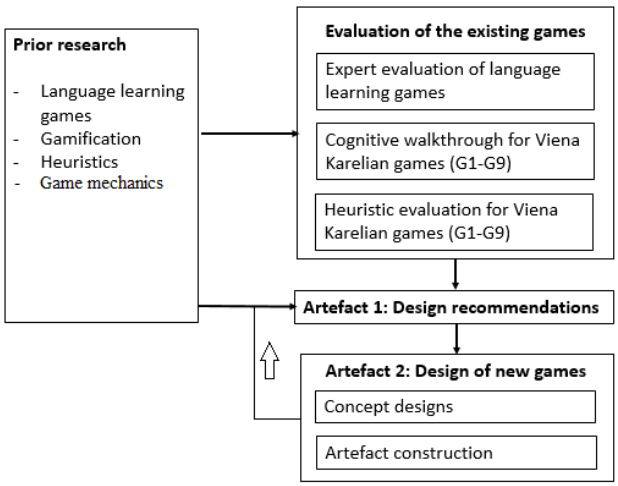

Figure 3. Research process of the thesis

3.2 Expert evaluation

Expert evaluation was conducted in this study and it differentiates from heuristic evaluation in a sense that no heuristic set was used. The evaluation criteria are solely determined by the researcher who acts as the expert in user experience and usability. Vermeeren, Law, Roto, Obrist, Hoonhout and Väänänen-Vainio-Mattila (2010) tell more about user experience evaluation methods and how UX and usability have same starting grounds for evaluation with the system, but users view of the system play larger part in UX evaluation. They also point out that the design methods should be separated from UX evaluation as the former is used as inspirational tool for design process and evaluation is used to ensure that the final result has the right UX elements.

3.3 Cognitive walkthrough and heuristic evaluation

Rieman, Franzke and Redmiles (1995) explain the cognitive walkthrough process in three steps where first one is to recognizing and documenting general user group and their description, second step is to recognize the steps that are going to be performed with the used system and third is to document how the tasks are being completed in the system focusing on the interface evaluation. Usually the cognitive walkthrough is done with the designer of the system, but it also can be done only by the researcher. (Rieman et al., 1995.)

Nielsen (1992) tells that the purpose of heuristic evaluation is to find usability problems in the various existing designs. Having different levels of skill when performing heuristic evaluations made it obvious that the expertise in usability gave better problem finding skills in the heuristic evaluation. Heuristics were used to address the major and minor usability issues find in the designs and generally two or three experts were enough to find most usability problems. (Nielsen, 1992.)

However, in this study the aim was not to focus on the usability aspects of the existing Karelian language learning games (opivienankarjalaa.fi) since all of the games developed there were in prototype phase, meaning that they might be lacking on the usability side. Therefore, the games have been evaluated using ten heuristics (Table 1) by Fitchat and Jordaan (2016) that were made for evaluating the user experience of serious games. All of the results are combined in Appendix A with answers and the analysis parts presented in section 6.3.

Table 1. Ten heuristics adapted from Fitchat & Jordaan (2016) with brief explanations

Heuristic	Explanation
1. Convenience	The users want convenience in a sense where the game should be easily accessible from any device and it should not be too heavy of a task to find and open.
2. Enchantment	The feeling of enchantment for the player comes from keeping their attention as much on the game as possible. Notifications from other applications should be low when playing, games should keep the attention in important parts and notifications for the players when not playing to return to the game.
3. Effortless learning	Effortless learning is about having as much incidental learning as possible where the players forget they are learning and just learn while having fun with the game.
4. Positive encouragement	If players are struggling, they need to be motivated to continue in a form of positive feedback and negative feedback should be kept to minimum.
5. Possibility to practise	Players should be able to go back and play the previously completed tasks and go ahead in the game to try out if their skills are good enough for the tasks that are further ahead.
6. Rewards for achievements	Players should be rewarded whenever they make progress in the game and perform well.
7. Use of all senses	Using all the senses is about having suitable visual and audio elements in the game and both of them are used to assist on the learning aspect.
8. Progress tracking	Players should be able to tell how well they are progressing with the new learning and they should be able to see it in some way.
9. Guidance	The game should tell the player how it is meant to be played and if the player needs additional guidance, they should get it.
10. Player centred design	Able to customise settings and to have different kind of playing styles in the game so that the game attracts wider audience that can feel that the games was made for them.

4. Analysis on the Popular Language Learning Games

The most popular language learning applications found on Google Play with the search term “language learning games” are listed in the Table 2. Only the first eleven were chosen for this study because after the eleventh one, the search result started showing language specific applications that were smaller parts of the bigger mainstream applications, thus the study only concludes the first eleven. These apps were only used as state-of-the-art game mechanics providers to show the way for the designing process.

Table 2. Game mechanics for language learning in the apps from Google Play store

Application	Game mechanics for language learning found
Duolingo	Short lessons, Progress tracking with achievements, speech recognition and audio files, word association, grammatical structures with translations, daily streaks, levels (Duolingo, 2020)
Mondly	Voice actors used in audio files, speech recognition, phrases, conversations, smart feedback system, scoreboard, adapts to user patterns (Mondly, 2017)
LingoDeer	Voice actors in audio files, exact grammatical rules, offline-mode, innovative exercises, speech recognition (LingoDeer, 2020)
Drops	Minimalistic illustrations, rapid tempo mini games, repetition with audio files (Drops, 2020)
Busuu	Conversations with native language speakers, plans can be created for learning, AI assisted learning, vocabulary training, official certificates, offline mode (Busuu, 2020)
Learn 50 Languages	Vocabulary learning with games, large variety of games such as crossword puzzles (Learn 50 Languages, 2020)
HelloTalk	Text chat and phone calls with native speaking people, speech recognition and comprehension, translations, status updates on user profile page, podcasts, commenting on profiles, badges (HelloTalk, 2020)
Memrise	Voice actors in audio files, speech recognition, offline-mode, short videos (Memrise, 2020)
Babbel	Contextual learning, speech recognition, audio files, short interactive lessons (Babbel, 2020)
Beelinguapp	Reading or listening to stories in different languages with the original language next to the new language being learned (Beelinguapp, 2020)
Rosetta Stone	Personalized learning plan, changing studying style, instant feedback, offline mode, voice actors in audio files (Rosetta Stone, 2020)

The selection of these games for more in-depth analysis came from variations in the games found on Google Play store. Duolingo, HelloTalk and Drops were some of the applications that were on the top 10 list when searching for “language learning games”, other top 10 applications were not included since these three had all more unique concepts and thus were better for comparison. Two other apps Flashcards Maker and Ekapeli Alku were also selected to represent some of the more smaller player base games. When looking at the applications the purpose, primary users, game mechanics and learning purpose were the focus of the evaluation. The purpose of evaluating these was to get a better look at the game mechanics and to identify aspects that should be taken into account when designing new game ideas.

4.1 Duolingo

In Duolingo (Duolingo, 2020) many interesting gamified elements were recognized and observed, such as weekly streak, daily goal, lives, levels and progress tracking with levels. Other game mechanics that could be found in the game were speech recognition tools and speech comprehension, notifications popping up and multiple form of visual elements for feedback. Duolingo did not have Karelian as an option for language, but interestingly few other languages like High Valyrian and Klingon that are languages from TV-shows were found. In Duolingo a 5, 10, 15- or 20-minute daily exercising periods could be chosen depending how quickly the user wanted to learn the new language. When starting at the basic level the possibility to skip ahead required a test on the on the previous stuff, in a way where the user's skill level was confirmed.

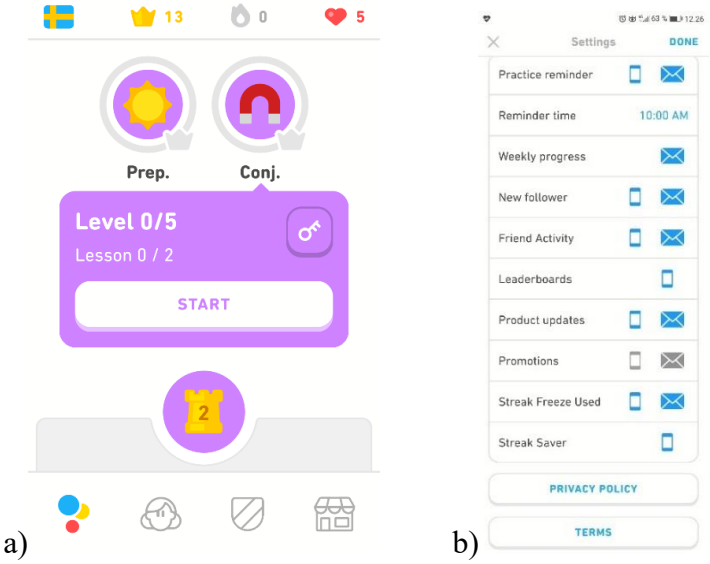

Figure 4. Screen captures from Duolingo (8.6.2020) where a) shows the level structure of the application, to proceed to the level 2 below in the image all the previous courses need to be finished or a test to prove skill must be done, b) shows all the notification and social aspects of the application.

4.2 HelloTalk

HelloTalk (HelloTalk, 2020) was not available in Karelian either despite the 150+ languages included in the application, interestingly High Valyrian and Klingon were found on the list once more. The main concept of HelloTalk differentiates from the usual bunch of serious games as this was more of a social application made for connecting different language learning people. The application has a user profile as the center of the design and users can either communicate with other people or update their own profile with status updates. These status updates then can be corrected by the native people of the language that the user is trying to learn. The point of correcting someone is that the user gets a point to their badge in their profile, which makes them more interesting to the others. The age group for this application would be up from teenager as it lacks any playful elements.

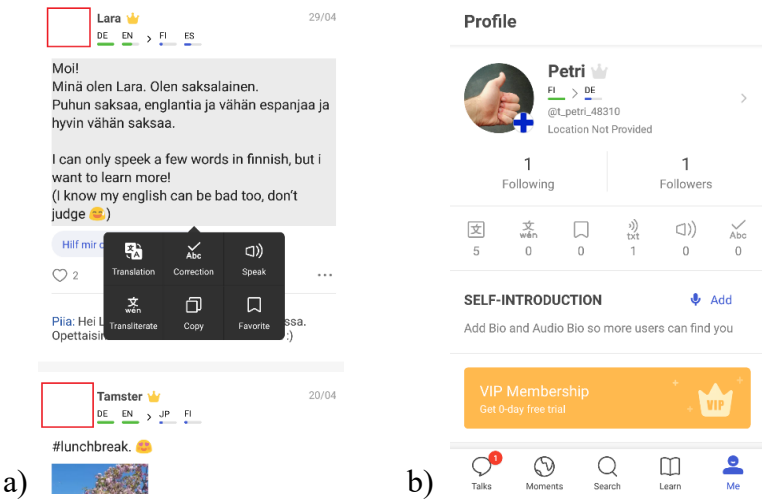

Figure 5. Screen captures from HelloTalk -application (8.6.2020) where a) shows how people can make posts on their walls to seek for a native speaker and application has translation, correction and other options, b) is the user profile where bio can be added, and badges of activity are shown.

4.3 Drops

Drops (Drops, 2020) was interesting vocabulary learning game, not only in the sense of its visually pleasing aspects, but also since it had minimalistic text elements in the mini games. The simplicity of the pictures and then combining them with words for meaning made it an application interesting for Viena Karelian and how easily it could be changed for new language. There were no scary grammatical rules, which makes this game good for kids. Time when playing was also something that was noticeable, users only had five minutes to complete the language level and there were 17 food related words in the first level in the Finnish language that the game was observed in. The words were all read by a female voice every time they appeared on the screen or user got a correct answer, making it repetitive and after a new word was presented, the application might have suddenly went back to already learned words which was a good feature. Words also had to be spelled at some points with innovative methods such as drawing on a lock-screen like structure of 3x3 grid of letters inside balls.

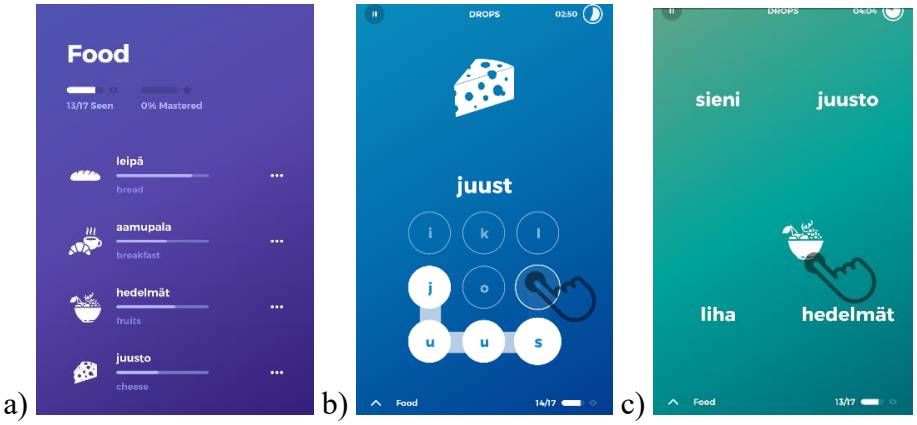

Figure 6. Screen captures from Drops (8.6.2020) where a) shows the different kind of themes and progress of the vocabulary, b) is one of the minigames where user spells the word from the letters and c) is another minigame where the picture of fruits needs to be connected to the correct translation

4.4 Flashcards maker

When searching for the language learning games on Google Play, a different kind of application was introduced with the name of Flashcards Maker (Flashcards maker, 2020). Since it was brand new application and possibly could provide some new techniques or elements for serious game developing, it was selected and tested. Karelian was not on the list of languages to learn, but Sami language was. The words in Sami were not included though and the user had to manually input the words that they wanted to learn. The saving factor was the words could be put in as larger excel tables, as typing each word individually would be a painful experience as was observed. Possibility to add a picture to the flashcard was in the application and it is highly recommended for new language learners as it helps them to associate the translated word with the subject. Using the application by teachers or for some specific vocabulary studying by individuals are the main purposes of this application.

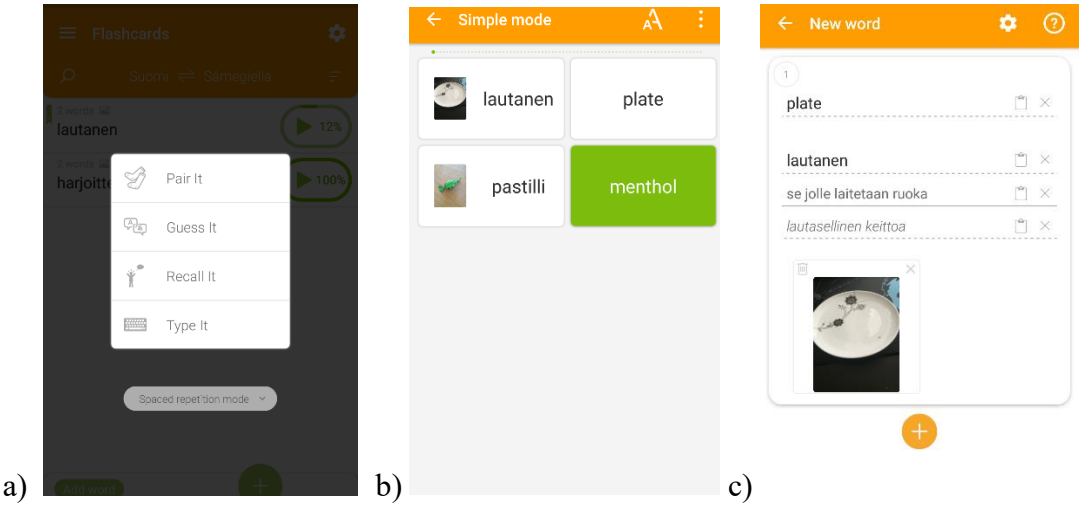

Figure 7. Screen captures from Flashcards Maker (8.6.2020) where a) shows all the different kind of minigames available for vocabulary learning, b) shows pair it where two words are added to the game, c) shows how the new words are added to the list

4.5 Ekapeli Alku

When searching for ”Karjalan kieli” or “Karelian language” as translation a game called Ekapeli Alku (Ekapeli Alku, 2020) was found. It is a language learning game for Finnish language and the main age group of the users was 6-8 years. The quality and variety of game mechanics was instantly observed as users had to create a profile with a character, even some basic added customizability like color of the clothes and skin color were implemented. Players start from edge of an island in a 3D world and they have a path laid out in front of them where stars and question marks represent the levels. Players have options to choose from when reaching the star, the games have reading or listening exercises where the learning goes from the most basic sounds of alphabet pronunciation to sentences that are read out loud by a native speaker. Players are rewarded with purple diamonds for their progress in the game. The way players need to click all kinds of things on the screen it can be a bit tedious for people that have not played many games on smart devices.

Figure 8. Screen captures from Ekapeli Alku (8.6.2020) where a) shows a conversation with a game character bird, b) shows the game options the user can choose from, c) is one of the selected games where a voice says the letter and user needs to click on the corresponding balloon to shoot it with cannon, d) is the feedback of the game showing how many were wrong and that was difficult in particular

5. Evaluating the Existing Language Learning Games for Karelian Language

An expert analysis was made on the existing games as a cognitive walkthrough. All of the games (opivienankarjalaa, n.d.) except Kielimestari (Kielimestari, 2019) and Hirsipuu (Vienankarjalan Hirsipuu-peli, 2020) being game prototypes for research purposes, their usability issues were not analysed thoroughly, instead gamified elements and learning aspects were looked at.

5.1 G1: Sanaristikot

Sanaristikko or the straight translation to English “crossword puzzle” has three different versions available of it. The first version of it has words in Viena Karelian presented at the top and the crossword puzzle has pictures in front of each line. The instructions tell the player in Finnish to choose a word from the top row and to place it in the crossword based on the correct image. The images used are clear pictures and leave no room for guessing as they all are from different themes as presented in Figure 9. The game lets users to try as many times as they want without any penalty until the crossword is filled.

The second (Figure 9) and third version of the game are different from the first one as in them the users are only presented the images and the boxes that the corresponding words from the images go to. These versions do not give user help if the word or even one letter is wrong as the whole word disappears from the box, giving user a chance to try again. The first version of the game is easiest to approach as a beginner to the language compared to the two others as both of them require either knowledge of the language or use of a translator application. The game is suitable for learners from all the age groups as players are not relying on things like reflexes, spotting small details or playing against a time.

Presenting the words, that were used in the crosswords, to the user could have been a good addition to the second and third version. This would of course in a sense defeat the purpose of the crossword game depending how many available words and picture combinations were made for the game. Another good way to fix the situation was to give users help when trying to solve the words, in a form of single letters or showing which letters were wrong when guessing, that way the user would not have to write the whole word each time with the new guess. This would be useful especially in the longer words that have more than 6 letters. On mobile version of the game (Figure 9c & 9d) the pictures could end up being really small and an older person might have harder time recognizing them.

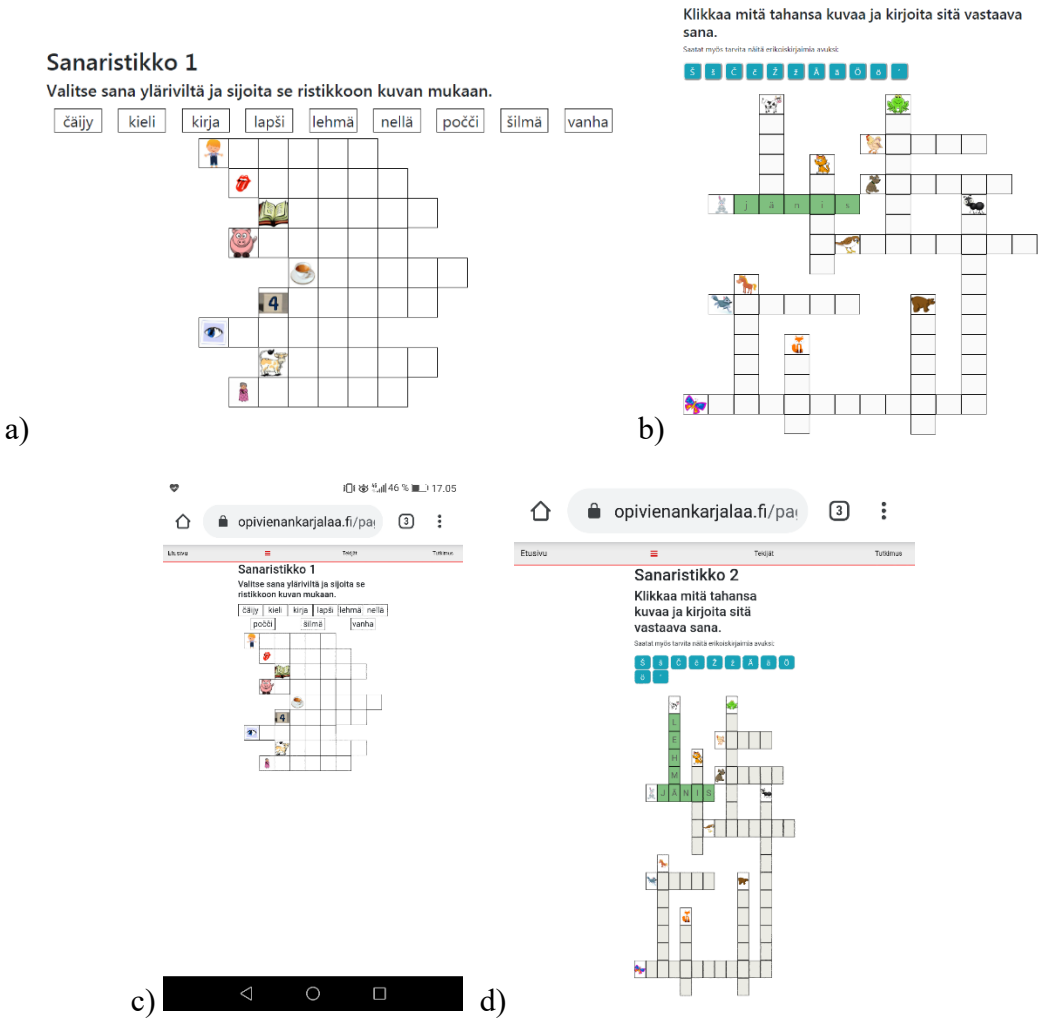

Figure 9. Screen captures from Sanaristikko (10.6.2020) where a) is the first version of the game with the words already given to the user to place in the crossword puzzle, b) is the second version where the user needs to know the words based on the picture and type the letters out, c) is the mobile view of the first picture and d) is the mobile version of the second picture

5.2 G2: Etsi sanat

Etsi sanat translates straight to “Find the words” in English and more familiar term for the game is word soup or letter soup. This game also had two versions which are different in terms of execution. The first version of the game (Figure 10a) has fruits as the theme and the instructions are to choose an image, then to find the word in the box of letters by clicking the first and then the last letter of the word. The images used are clear and big enough for users to click on them. This version does not teach the words to the user in advance, so they need to have language knowledge prior to playing. Guessing the words is one possibility, but that is much more time consuming in the scenario where the words are all scrambled. Using translator, a dictionary or having knowledge of Finnish language are helpful tools in this game, but these things are not something to rely on when designing a game for language learning. Using the web version of the game also seemed to have a feature where user had to drag the mouse on the letters of the word, otherwise the guess would be a failure. This could turn into a problem on a trackpad, on a mouse that has high sensitivity or if the person playing simply does not have the most accurate eye to hand coordination. The same issue was not existing on a smartphone.

In the second version of the game “Etsi sanat – viisi teemaa” where the latter translates to five themes, the users have the option to choose a theme, but also the idea of the game is different. The game (Figure 10b) shows the user all the words that they need to find from the combination of letters. This way the user does not need a dictionary or knowledge to play the game, they can just start searching the words. The only problem with this solution is that the translation or meaning of the words that the users are looking for are never explained. The theme is known, and the words can be deducted based on that in some cases, but in educational games this should not be the case. This version had option for difficulty which was nice addition and the order of the words was always randomized which gave the game the ability to be played again.

In both versions of the game the educational aspect of the game is lacking, in the first version the users do not have the explanation for the image and in the second version the users do not have the explanation for the word they have found. A combination of the two could be good where the word could be shown and when the user finds the word and image appears next to the word. In the second version the users could not tell when they are giving the game an input, some visual cue like highlighting the letter they clicked could be in order. This was done well in the first version. Something that could also be considered is a back -button so users could go to the menu as in now refreshing was the only option to go back.

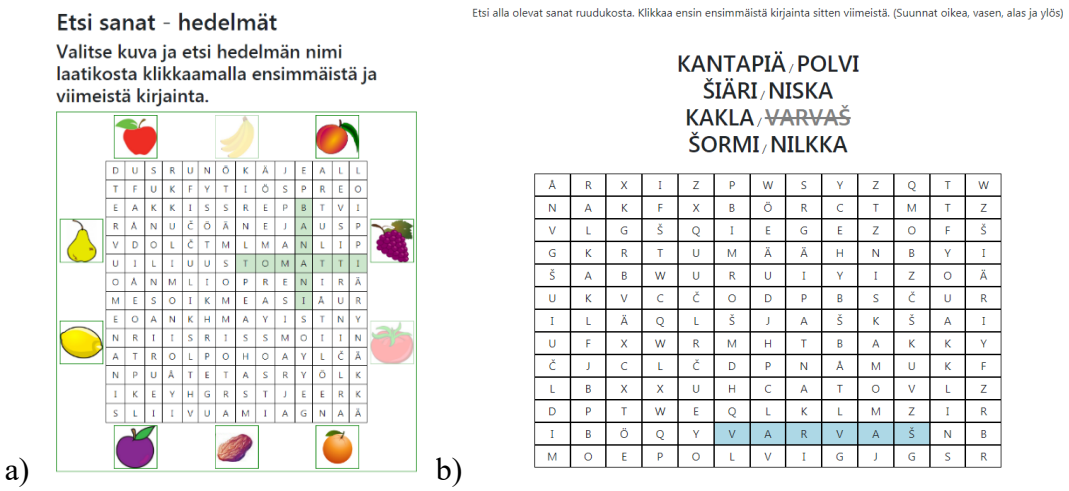

Figure 10. Screen captures from Etsi sanat (10.6.2020) where a) is the first version of the game with only the images given to the user and the correlating words need to be known and b) is the second version where the words are given to the user without images

5.3 G3: Muistipeli

Muistipeli or the straight translation ”memory game” is a game where two of the same kind of cards are searched and matched, turning around only two cards each turn. The idea of the game is simple, but three versions of the same game are presented. In the first game (Figure 11) the idea is in the simplest form and requires no existing knowledge of the language, making it perfect to be the one to begin with as the cards have pictures and text explaining them. There are four different categories to choose from, the categories being foods and drinks, body parts, numbers and animals and all categories have option to play with 8, 12, 16 or 20 cards on the screen The only problem with a game like this is that whenever user finds a pair, they probably will not take too much time trying to remember the foreign word as they will just keep playing and trying to find the next pair.

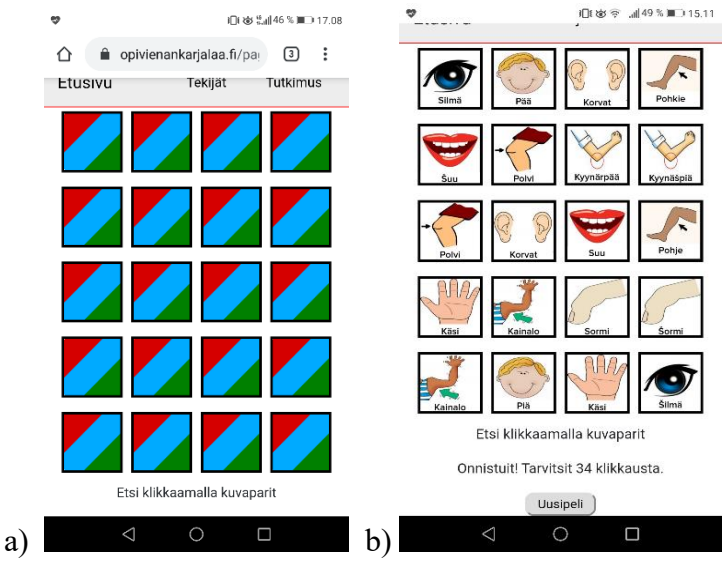

Figure 11. Screen captures from Muistipeli version 1 (13.5.2020) where a) shows how all the cards look before turning them and b) has all the pairs found, one of the pairs has text in Viena Karelian and other one in Finnish

In the second version of the game (Figure 12a) there is a static number of 36 cards on the screen. The instructions are also different as the users are prompted to now match a picture and a word. This version requires previous knowledge of the words used and all of the words used are from the theme body parts. Playing the first version of the game in body parts section is necessary for better experience and the versions are logical in order in that sense as the third version (Figure 12b) is almost the exact same game as the second version, the only difference visible after a pair is made. When a pair is made in the third game the users are asked to use that word in a sentence. The normal grammatical cases of the words are not used, and the users need to know how to bend the words to fit the sentence properly. This can prove to be very difficult but thankfully after few tries a button to skip is given to user. The order of the versions is fitting, and it is almost as if they are different levels of difficulty, the first version being easy to approach by users of all ages the last one actually requiring grammatical skills.

In the first version of the game the game is nicely presented compared to the second and the third that have the cards laid out way too close to each other, clicking the wrong card in these cases is possible and it just looks way too cluttered. Having light green text on a white background is also not as clear as having black text on a white background.

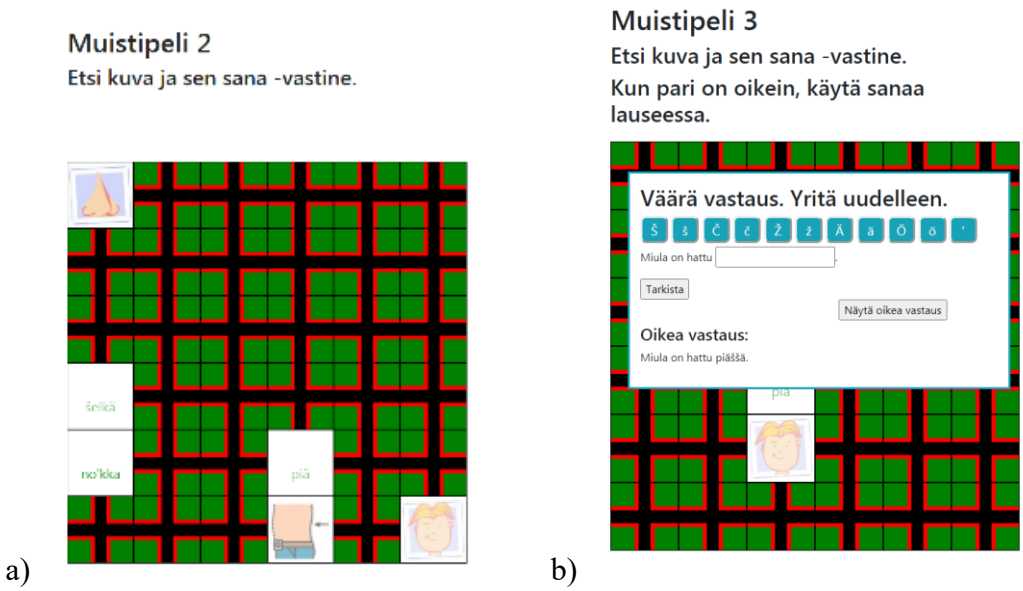

Figure 12. Screen captures from Muistipeli (10.6.2020) where a) is the second version of the game on PC where three image cards (nose, head, back) are found with the corresponding Viena Karelian word (n'okka, piä, šelkä) b) is the third version of the game where after matching a picture and the corresponding word the user has to use that word in a sentence, correct answer is shown after two wrong guesses.

5.4 G4: Kuvapeli

Kuvapeli or as it translates "picture game" is a perfect type of an example of a game that is fit to test vocabulary skill in form of a quiz. The users have an option to choose from four different themes that are numbers, body parts, food and animals. There is also difficulty option for easy or hard and the only difference between these is the words that are showed to the user. If there is a picture of an apple, in the easy mode the words could be translated versions of apple, ice cream and bread. Obviously, it is easier to find the correct word from this set, but in the harder difficulty the words had small differences between them (Figure 13a), so it was easier to recognize the correct answer, the number of options is always three.

The game did not show the correct answer to the user when answering wrong. How could users expect to learn anything if they will never be corrected and just keep answering wrong until they get it right once. The color of the "Correct" answer could have been green instead of blue (Figure 13b) as it is usually associated with correct answer, blue is the same color as the borders of the answer buttons and the picture.

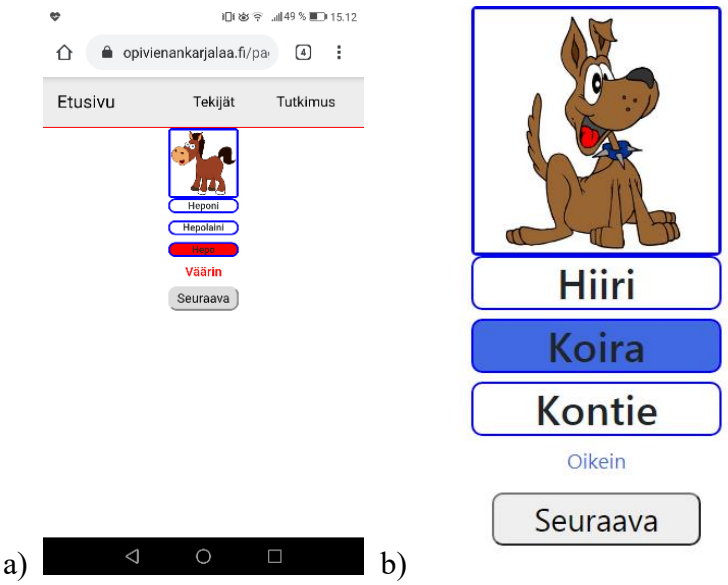

Figure 13. Screen captures from Kuvapeli (10.6.2020) where a) is a presentation of the game on a smartphone visualizing how small the items and how the correct answer is not shown to the user after wrong guess and b) is the same game on PC browser visualizing the correct answer.

5.5 G5: Viikonpäiväpeli

Viikonpäiväpeli or as it translates to English "weekday game" is a similar game to the picture game as it has the same quiz format, although this game has more game mechanics that make it more pleasurable experience to play. There are three difficulties and instead of changing the way the words are presented and having always only three options, the easy difficulty here has three options, the medium has four and the hard has five options to choose from (Figure 14a). The game has a live counter of the score underneath and the users are given feedback instantly after the answer is made in a form of a small emoji and a text presented (Figure 14b). Here the correct answer is not shown which makes the educational aspect of the game not be on the optimal level.

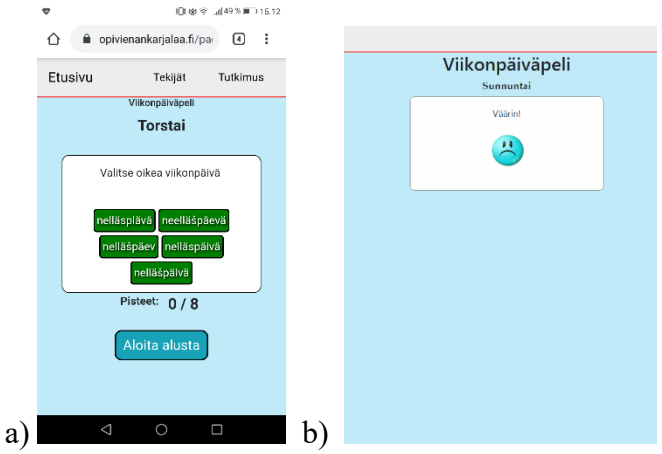

Figure 14. Screen captures from Viikonpäiväpeli (14.5.2020) where a) is taken on a smartphone showing the hardest difficulty level where five options presented and b) is taken from PC browser where after an incorrect answer a small sad emoji and text feedback are given to the user

5.6 G6: Kissa käskyttää

Compared to the earlier more known games this one is more unique. Kissa käskyttää translates to ”Cat commands” in English and the game does not have any instructions given to the user on how to play the game. The game is pretty self-explanatory in a way that the cat has a speech bubble coming out of their mouth and in the bubble, there is a text in Viena Karelian (Figure 15a). The cat asks for things and all the possible things that the cat can ask for are spread out on both sides of the cat. The users have to figure out themselves that the items are needed to drag-and-drop from the side on the cat icon. The cat then shows tongue if the answer is incorrect and the item gets a big red circle with a line crossing it so they cannot choose the same answer twice (Figure 15b). If the users do not understand what the cat wants it is not that bad as there are only eight options to choose from, the game can be brute forced quickly. Whenever a correct answer is guessed the cat whips their head back and smiles, which makes the item that was given disappear from the list. This game has more advanced learners or people who can connect the dots with Finnish in mind as a beginner would have a hard time understanding the words. The idea of having an animal as the center of the game is playful and makes the game fun educational tool for all age groups.

Some instructions on how to play the game would be in order. The cat could tell how to play the game to the user before starting the game. The subtle whip of head or showing tongue depending if the answer is correct or wrong is also something that the users might not see. This is why giving the user some other form of feedback in a form of text or sound is a thing to consider in terms of user experience.

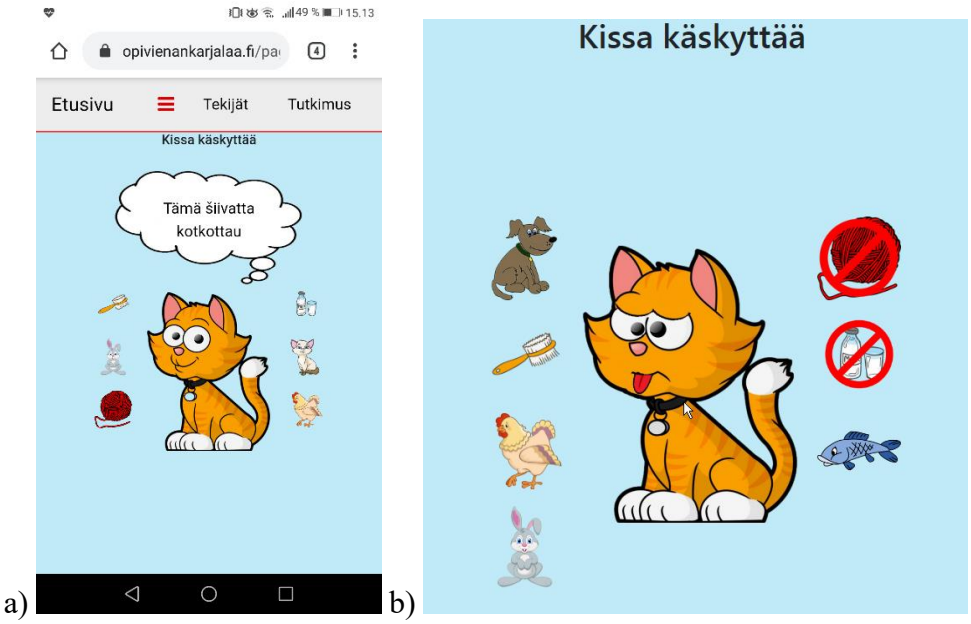

Figure 15. Screen captures from Kissa käskyttää (14.5.2020) where a) is on the smartphone and it shows the basic layout of the game and b) from PC browser where the cat gives instant feedback to the user after an incorrect answer by showing the tongue, also a red wrong signal appears on the attempted item.

When comparing G1 to G6 learning games to the popular Google Play language learning applications the differences are obvious. These games for learning Viena Karelian are lacking the more advanced game mechanics such as audio input or output for speech recognition or speech comprehension, they lack the more basic user experience elements such as “help” button to give the user guidance when they feel like they are stuck or do not know what to do, other more advanced gamifying elements such as badges or level

progress are also missing. The fact that all of these games represent different variations of the same concept in a form of multiple versions, such as three versions of memory game, tell that they could be combined into one better version.

One possibility when combining all of them into a bigger game could a solution where the cat is the guide or the character that the user can lead into the different games. First the cat would greet the user and ask their name, user profile with character image could be made, then the journey to the games could begin. All the different games go well together as they share the common themes of body parts, so making them into a streamlined journey where the player would gain experience after each game. At the end after finishing all the games, the user would be tested with the Viikonpäiväpeli and Kuvapeli, to see if they learned anything and if they pass them, they would have finished the game. Many of the games had random elements so playing the games each time would be different, which makes it perfect for going back and trying to get more score in the singular games, such as memory game. As most of the games had difficulty levels built in them, they can have added difficulty when replaying.

5.7 G7: Learn Viena Karelian

Learn Viena Karelian game is the only game on the website that has the option to choose the language as English (Triando & Arhippainen, 2019), and that already is a clear signal that it is more finished and advanced game than the previous ones. The game has lots of gamified elements such as user profile, achievements, scoreboard and points (Figure 16b). If the users want to, they can choose to be on the scoreboard anonymously, which is a great addition for users that want to stay private. The game is nicely streamlined for educational purposes in a way that the users are first given easy instruction into the word, then the same word needs to be listened to and chosen from four different pictures (Figure 16d). If the user chooses the wrong answer, they are given another try and an instant feedback comes in form of a popup box from the browser (Figure 16c). The listening part is done with a robotic voice and is clear to understand as all the options are not only few letters apart from each other, but they have all different meaning and words used (Figure 16a). The themes that the user can choose from are food and drinks, clothing, furniture, seasons of the year, body parts, numbers and dates.

There are some parts of the game that could be done better. When writing the translations for the sentences the users need to be absolutely exact in their wording and no room for error is left. The sentences and the words in them need to be word to word and in questions the question mark is also something that is needed, without it the user is left with a “wrong answer” popup, but in normal sentences the dot at the end also makes the game state that the answer is wrong. The lack of keyboard input on the web version when typing the sentences was annoying and a button to skip the sentence or go to the previous one could have been something that would have made it more enjoyable as now the users could get left stuck on a translation task and only possible way to go through it would be getting a translation help from outside or resetting the game completely. Resetting the game would make the user infuriated as their score would be wasted and the progress, they have made would be all for nothing, except of course from educational standpoint.

It is obvious from the lack of playfulness that this is just a gamified learning application and the similarities with the more popular applications on the market are apparent from the game mechanics. It is fit for all the age groups, but with the rather dull elements it is mostly suitable for older audiences. After finishing a task, the users are given a cultural info packet about things related to Viena Karelian which is exciting. After finishing one

of the themes the users cannot go and revisit those tasks without resetting the game fully. When looking at the application on a smart device, some of the aspects could be better designed for ease of use on mobile devices, such as the radio button selection (Figure 16a) could be turned into bordered boxes with wider gaps.

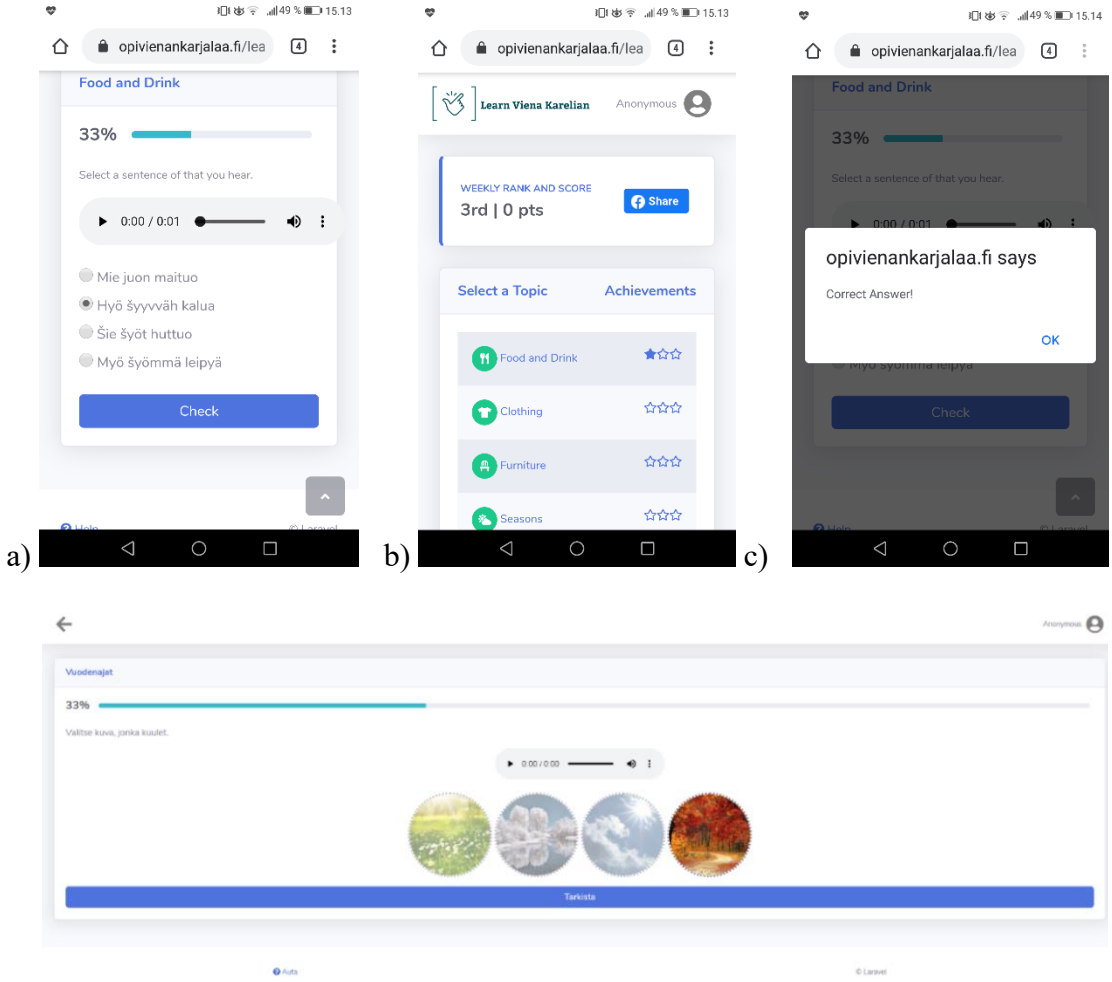

Figure 16. Screen captures from Learn Viena Karelian (13.5.2020) where the first three are from smart phone, a) visualizing a task where user needs to listen to the audio file and choose the correct answer, b) visualizes the main menu where weekly rank, score and share button are at the top and the themes under them with the progress level in form of stars, c) is the way the game shows user instant feedback and d) is the one of the tasks where audio file is given to the user and correct answer needs to be selected from the images.

5.8 G8: Hirsipuu

Hirsipuu (Vienankarjalan Hirsipuu-peli, 2020) translates straight to ”hangman” and it is the game in its most simplest form, just in Viena Karelian. To spice things up and make it more exciting the game has three different modes for the user to choose from (Figure 17a). The first mode is the basic game where words start as short as 4 letters and then go up one letter each time the user gets the word correct (Figure 17b), if they do not get too many answers wrong or lose by time limit before that. There is user profile and all the scores are logged and if score is high enough, they are placed on the scoreboard where top 10 best scores are shown. The second mode of the hangman has one letter given to the user as hint, but otherwise is the exact same mode as the first one where the user has

approximately 4 minutes to finish the word. The third more is different from the two as it has themes to choose from, where the themes are seasons and numbers, animals, human, nature, relatives or verbs. There is also no time limit in this mode and the number of letters in the word is completely random (Figure 17c).

This game is only available on mobile device and on a 5,2 inch screen the game had some usability issues (Figure 17c) where elements on the screen were stacked on top of each other, this was not something that made the game unplayable and it was still easy and fun to try to guess the words. Without prior knowledge of Finnish or Viena Karelian, the game is pretty much unplayable, but with Finnish it could be pretty easily played. Educational value of the game is not as great as the words are not explained in any way, but the entertainment value is great.

In these types of complete games, it is hard to say what aspects could be changed to make it better. Some type of hints for the users could be given with the cost of points, like giving letters or giving an opposite of the word, for example “is not a woman” and the word is man or something like that, that could be accessible in one of the games and one of the games would be left like it is to be played for more advanced language learners to compete on.

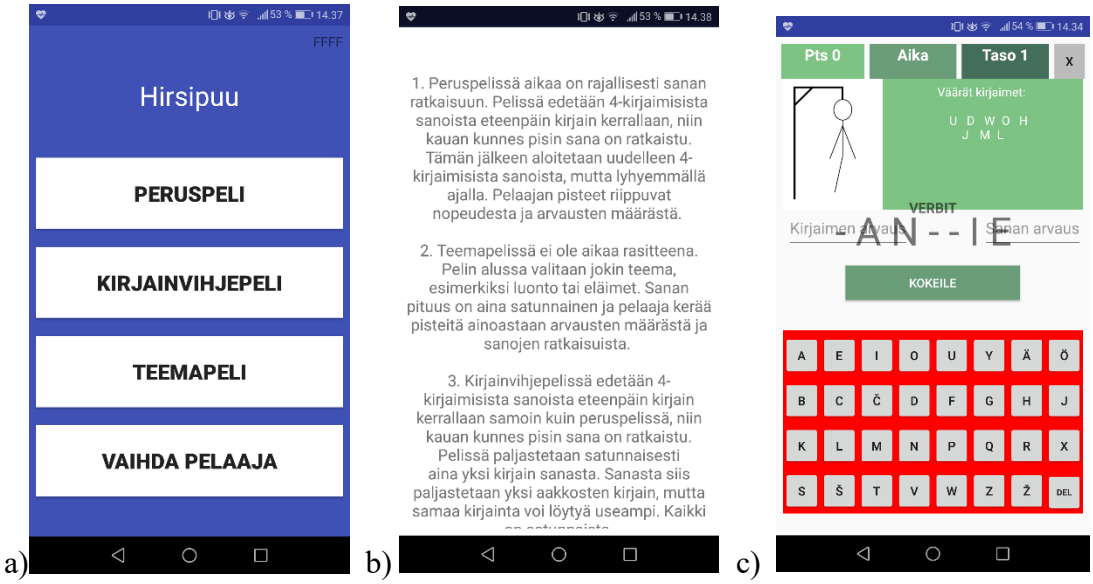

Figure 17. Screen captures from Hirsipuu (13.5.2020) where a) is the main menu of the game, b) is the game instructions screen explaining the three different themes “Basic game, Themed game and One letter as hint” roughly translated, and c) is the game in themed version.

5.9 G9: Kielimestari

Kielimestari (Kielimestari, 2019) translates to ”language master” and it is the most visually pleasing game out of all the evaluated games made for Viena Karelian. Even though the graphics are advanced and nice looking (Figure 18a), the educational aspect of the game is almost as simple as the Viikonpäiväpeli, where a word is given to the user and user needs to select the correct answer from four options, the fact that the word is used in the sentence does not give that much help if the language is not familiar. There are also Swedish and Sami languages available in the game. There is a player character and users need to move to a place with character, there are three different places to go to (Figure 18a), the character walks to the place and after that the user needs to select the

language depending where they are. After selecting the language, the themes are shown in form of pictures, there are medals, dancing, skateboarding, movies, games and sports to choose from in the Viena Karelian one. It is obvious that the game is still in the making as the same questions come up even with 10 questions only presented to the user per theme. What also differentiates this game from others is that there is audio feedback given to the user after each selection, the character in front of a laptop will also show thumbs up if the user makes the correct answer (Figure 18c) or look a bit sad if the answer is wrong (Figure 18b), the feedback after the round of sentences can be a bit hard for the user and not really motivating as (Figure 18d) the game states for the user: “Argh, did you even try?”

Game is suitable for all age groups, but the educational elements of it are mostly suitable for testing knowledge. At least the correct answer is shown to the user even for a brief moment before automatically skipping to the next sentence. A slow reader might miss the correct spelling of the correct answer in this case so making the time just a second or few longer would not hurt the user experience and would give much more to the educational aspect.

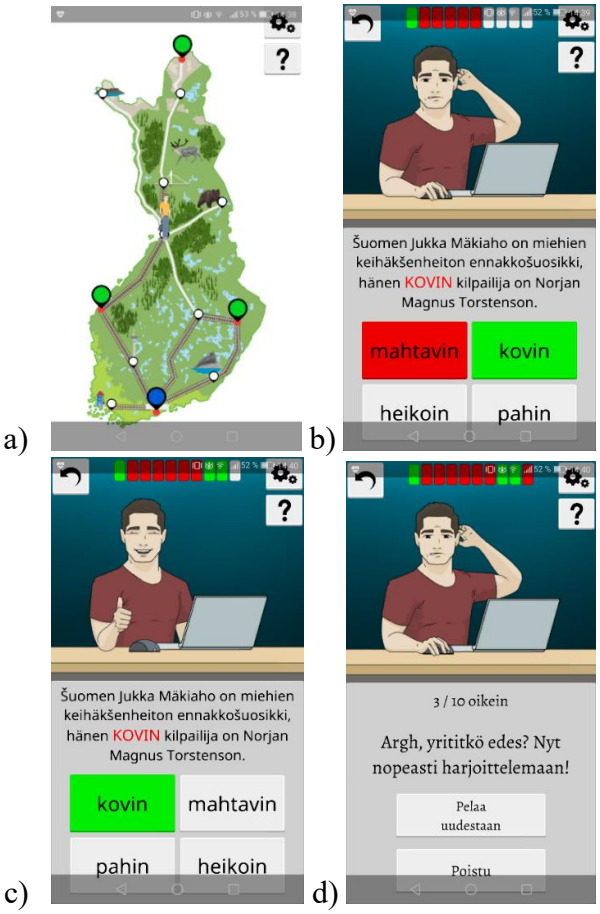

Figure 18. Screen captures from Kielimestari (13.5.2020) where a) is the map of Finland and user can move the character to the pinpointed locations, b) visualizes how the wrong answer makes the character respond and the correct answer is highlighted, c) shows how the character shows thumbs up when answered correctly and d) is the feedback given to the user.

6. Findings from Evaluations

Findings from the expert evaluation of the language learning games on Google Play, cognitive walkthrough of the existing games for Karelian language G1-G9 and the heuristic evaluation of the existing games for Karelian language G1-G9 are presented in this chapter. Finally design recommendations are presented based on these findings.

6.1 Analysis of the language learning games

Findings from the five selected applications from Google Play store are presented in a table format below.

Table 3. Analyzing gamified applications and educational games for language learning

Game	Purpose	Primary Users	Game mechanics	Learning purpose
Duolingo	Gamified structured language course with levels	Fit for all age groups, no prior knowledge required	Short minigames, progress tracking, speech recognition and comprehension, skipping and going back, notifications, feedback	Teaching the language and building the knowledge from ground up first with vocabulary, then with grammatical rules and sentence structure.
HelloTalk	Connecting people from all around the world in language pairs	Not easy to approach for children, mostly for adults, prior knowledge helps	Text chat and audio calls, user profile with status updates, speech recognition and comprehension, podcasts, AI chat bot.	The application had some also some normal type lectures for English learning, but mostly it was meant to connect matching language learning pairs, such as ENG-GER with GER-ENG and learning comes from communicating
Drops	Pictures and words and they need to be connected	Fit for all age groups, does not need prior knowledge	Minimalistic illustrations, quick tempo, visual cues without much text	Learning comes from picture and word association mostly and repetition until the words have been learned thoroughly
Flashcards Maker	Flashcards where word is shown for a few seconds then it is taken away and user tries to recall it	Fit for all age groups, does not require prior knowledge of the language	Small different types of minigames, adding words from own vocabulary for specific purposes, notifications	Learning comes from repetition, having the pictures for the words when assigning own words is optional
Ekapeli Alku	Adventure type 3D game with various little minigames	Mostly meant for children aged 6-8 but fits well for all age groups.	Character, 3D world, diamonds as progress tracking, speech comprehension, difficulty levels, feedback	Learning builds from the most basic things like sounds of letters and spelling the words with the help of easily spelled text and audio

As most of these applications are already at a point where they are perfect in their own sense, any new improvement ideas are not addressed in this study and instead these applications were just used as guidelines for the new design with all the state-of-the-art game mechanics such as AI chat bot in HelloTalk. Table 4 presents the new design ideas for the Viena Karelia language learning game based on each individual game.

Table 4. Design ideas for the new educational game

Game	Ideas for the new educational game from the analysis
Duolingo	- Having a starting test for users who have some knowledge in the language but do not know if they are good enough to start from higher difficulty than beginner
HelloTalk	- Communication and having collaborative learning experience with other people are something that could motivate
Drops	- Small rapid tempo mini games for vocabulary learning where the words are repeated for as long as necessary until they can be used in a sentence
Flashcards Maker	- More mini games, but also gives an example of a customizable application, where the learnable words can be changed, this was good grounds to the designing process
Ekapeli Alku	- Character, customizability and starting from the bottom where all the different kinds of quirks of the language like different letters are examined before jumping into the words

6.2 Cognitive walkthrough of the existing games G1-G9

All of the games above are summarized in Table 5. where the general purpose, user group, game mechanics and learning aspect of the games are looked at. It can be seen that most of the games are fit for all age groups, but some of them require existing knowledge of either Finnish or Karelian language.

Game mechanics are for the most part simple and lack any state-of-the-art elements, the only thing closest to those was the audio files in G7: Learn Viena Karelian, where players must listen to the audio clip and choose the corresponding text. Having a character somewhat representing the player in the G9: Kielimestari was good, but there could have been some customizability as the figure was only available as male.

Learning aspects of the games were in some cases very minimalistic, where the games acted only as tests for the language skills. Games where the learning was done through association, the learning comes over time slowly when playing the game and repetition is usually needed in those cases.

The improvement suggestions for each individual game can be seen in the summarization in the Table 6. and the new game ideas that came up when evaluating and analyzing these games. Most of the games that were born from these games were not made into concepts and few of the concepts that the study shows were not necessarily born from any of these games, the ideas for game elements and improvements just acted as guidelines when the concepts were formed into mockups. G7: Learn Viena Karelian is a perfect example of a game that did not generate any new game ideas, but the audio files, the structure of the reward system and the general gamified concept were heavy influencers in the design process.

Table 5. Game analysis of language learning games for Viena Karelian

Game	General purpose	User group	Game mechanics	Learning aspect
G1: Sanaristikko	Combining Viena Karelian word for corresponding picture	Fits all age groups and first version for beginners, second and third for more advanced	Drag-and-drop or just clicking depending on the platform, congratulates when completing	Learning mostly based on word and picture association, prior knowledge of the words necessary only in the second and third versions of the game
G2: Etsi sanat	Finding Viena Karelian words from randomized box of letters or so-called letter soup	Fits all age groups and the second version is good for beginners, first for more advanced	Has level of difficulty depending on the version, congratulates and shows progress, clicking and dragging	Learning is more of a confirmation of already learned things, but some form of associations can be made by the player due to nature of the game
G3: Muistipeli	Finding a pair from the upside-down cards on the screen	The first game fit for beginners, second and third for more advanced, fit for all age groups	Has level of difficulty, counts number of clicks required for completion, has skip button in the third version of the game, clicking	Learning in the first version is through picture and word association, the third version has sentences where player needs to input the word in correct grammatical case.
G4: Kuvapeli	Quiz game with picture and 3 choices	Fit for all ages	Instant feedback after clicking selection, points #/10 at the end and difficulty level	Learning is minimal in this game as wrong answers are not corrected by the game
G5: Viikonpäivä -peli	Quiz game for weekdays, 3-5 choices depending on difficulty	Fit for all ages	Difficulty level, instant feedback and running point counter, clicking	Learning is minimal in this game as wrong answers are not corrected by the game
G6: Kissa käskyttää	Cat tells what they want, user gives cat it	Fit for all ages but requires some knowledge of Karelian	Drag-and-drop, instant feedback	Learning requires knowledge of Viena Karelian although some form of association can be made with some of the words if player speaks Finnish
G7: Learn Viena Karelian	Themed words and pictures are combined, audio and picture/text combined	Fit for all ages but more towards adults, does not require existing knowledge of the language	Clicking, instant feedback, player profile, anonymous scoreboard, audio for speech comprehension	Learning is done by association and is validated after when the words are used in sentences, users are required to translate as well
G8: Hirsipuu	Hangman game, user tries to guess letters and word	Fit for all ages, requires, does require existing vocabulary knowledge	Clicking, player profile, counting points and scoreboard	Does require prior knowledge and new learning is very minimal and only possible if Finnish or some Viena Karelian is known
G9: Kielimestari	Quiz game but the words are placed in a sentence in different language, 4 choices	Fit for all ages, the visuals compliment younger and older audience	Clicking, instant audio and visual feedback, running point counter, character	Learning optimally requires some knowledge in Finnish or Viena Karelian but can also be played without any

Table 6. Ideas on how to improve the game and new ideas that were born from the game

Game	How to improve this game	New ideas based on this game
G1: Sanaristikko	- Teaching the words to the user first - Going through the words again after the game - Instant feedback	- Using crossword puzzle as a minigame inside a bigger game to test the words that are being learned in the game
G2: Etsi sanat	- Teaching the words prior to playing - Giving user hints if they are stuck when pressing a help -button	- Users are not given any words, but they have to search the longest word possible from a crossword puzzle within a time limit
G3: Muistipeli	- Reading the word out loud when a pair is made or somehow bringing the game to a small halt where player would focus on the pair	- Combining all of the games into one bigger concept for certain type of vocabulary learning
G4: Kuvapeli	- Showing the user correct answer if they answer wrong - Going through the mistakes after the game is over	- “Language bath” where bubbles come up from a soapy bathtub then an image, users need to burst the correct answer
G5: Viikonpäiväpeli	- Showing the user correct answer if they answer wrong - Going through the mistakes after the game is over	- Quiz type of game could be used as a way of testing the knowledge of the vocabulary after or before learning some new themed things
G6: Kissa käskyttää	- Using the cat as a guidance for the game rules - Having other form of feedback than just small gesture	- Having the cat as the guide into a series of different games and where the cat stays as an instructor and motivator in all of them
G7: Learn Viena Karelian	- Going backwards in the tasks inside themes - Skipping through hard tasks - Built in feedback system instead of browser popups	-
G8: Hirsipuu	- Optimization for different sized screens - ”Hint” -button	- “Snakes and ladders” type of game where two players go head to head, and they need to not only draw the dice but do some tasks in order to avoid snake or in order to get up a ladder
G9: Kielimestari	- Showing the parts that are finished - Going through the used words after the quiz is done	- ”Karjala uhan alla” is a game concept that came from this game

6.3 Heuristic evaluation of games G1-G9

Summarization of the findings from heuristic evaluations performed on the nine existing Karelian games (Table 7).

Table 7. Evaluation findings according to each adapted heuristic

Heuristic	Evaluation findings (G1-G9)
1. Convenience	- Game is available in the internet for browser, playable on mobile and PC. (G1, G2, G3, G4, G5, G6, G7) - Game is only available on the Android platform on mobile (G8, G9)
2. Enchantment	- Game does not have any messages to try to make the player to return to the game, but the players should feel enchanted when playing (G1, G2, G3, G4, G5, G6, G7, G8, G9)
3. Effortless learning	- The learning is not effortless as vocabulary is the center of the game (G1) - Effortless learning possible as words are given for the user (G2) - Effortless learning is easily possible as the game is quick tempo and requires for users to look at the words (G3) - Learning can be effortless depending on the knowledge of the user (G4, G5, G6, G7, G8) - Effortless learning is possible through the association of the words and sentences (G9)
4. Positive encouragement	- Players are not motivated in case of failure (G1, G2, G3, G4, G5, G6, G7, G8, G9)
5. Possibility to practise	- Previous tasks are easily accessible making it easy to practice (G1, G2, G3, G4, G5, G6) - Previous tasks are not easily accessible as it requires a full reset (G7) - Practice of the game is possible, but it is hard due to nature of the game (G8) - Previous mini games are easily accessible (G9)
6. Rewards for achievements	- Players are rewarded with positive comments when completing the game (G1, G2, G3) - Instant positive feedback for successful answer (G4, G5, G6, G7, G8, G9)
7. Use of all senses	- Game has some visual elements but no audio to compliment it (G1, G2, G3, G4, G5, G6, G8) - Game has audio elements in some parts (G7) - Continuous audio-visual elements in the game (G9)
8. Progress tracking	- Progress can be tracked due to the open nature of the game (G1, G2, G3, G6, G8) - No continuous progress tracking in the game (G4) - Players are shown how many they have completed, but not told how many are left (G5) - Progress is well visualized in form of stars (G7) - Inside the mini game the progress is tracked but overall progress is not found (G9)
9. Guidance	- Game has guidance text, but *no additional help in problem situations (G1, G2, G5, G7, G8) - No guidance at all (G3, G4, G6, G9)
10. Player centred design	- No customizability and the players have a hard time feeling immersed or centered (G1, G2, G3, G4, G5, G7, G8) - No customizability but the character (cat) can lead to kind of immersion (G6) - With the character the players can feel some sort of immersion. (G9)

Table 8. Summary of the heuristic evaluation (Realization of the heuristic: **Y**es, Partially, **N**o). Summary of the heuristics (Summary) and result for each game (RR).

H	G1	G2	G3	G4	G5	G6	G7	G8	G9	Summary
H1	Y	Y	Y	Y	Y	Y	Y	P	P	**Y7, P2**
H2	P	P	P	P	P	P	P	P	P	**P9**
H3	N	Y	Y	P	P	Y	P	P	Y	**Y4, N1, P4**
H4	N	N	N	N	N	N	N	N	N	**N9**
H5	Y	Y	Y	Y	Y	Y	N	P	Y	**Y7, N1, P1**
H6	Y	Y	N	Y	Y	Y	Y	Y	Y	**Y8, N1**
H7	N	N	N	N	N	N	Y	N	Y	**Y2, N7**
H8	N	P	N	N	P	Y	Y	Y	N	**Y3, N4, P2**
H9	N*	N*	N	N	N*	N	N*	N*	N	**N9**
H10	N	N	N	N	N	Y	N	N	Y	**Y2, N7**
RR	**Y3 N6 P1**	**Y4 N4 P2**	**Y3 N6 P1**	**Y4 N5 P1**	**Y3 N4 P3**	**Y6 N3 P1**	**Y4 N4 P2**	**Y2 N4 P4**	**Y5 N3 P2**	

The answers were turned into numbers to get a better understanding and summary of each of the games and heuristics. Table 9. shows this data and the meanings of these are then thought about.

Table 9. Scoring of the heuristics (**Y**es=2, **P**artially=1 **N**o=0). Points summarized for each individual heuristic (Sum #/18) and points for each individual game (RR #/20)

Heuristic	G1	G2	G3	G4	G5	G6	G7	G8	G9	Sum #/18
H1	2	2	2	2	2	2	2	1	1	**16**
H2	1	1	1	1	1	1	1	1	1	**9**
H3	0	2	2	1	1	2	1	1	2	**12**
H4	0	0	0	0	0	0	0	0	0	**0**
H5	2	2	2	2	2	2	0	1	2	**15**
H6	2	2	0	2	2	2	2	2	2	**16**
H7	0	0	0	0	0	0	2	0	2	**4**
H8	0	1	0	0	1	2	2	2	0	**8**
H9	0	0	0	0	0	0	0	0	0	**0**
H10	0	0	0	0	0	2	0	0	2	**4**
RR #/20	**7**	**10**	**7**	**8**	**9**	**13**	**10**	**8**	**12**	

Heuristics 1, 3, 5 and 6 were actualized best in the games based on the summary of the points. If some of the heuristics were divided into smaller pieces like having instant feedback instead of just having feedback overall in a sense, then the values in the table would have shown different results. In the results all the ”Partially = 1” heuristic evaluations are lacking rigor because of the broadness of the heuristic (Table 9).

Heuristic 2 only actualized in the games Partially and the description for that heuristic indicates the reason for that (Table 9). The use of notifications to get the player is something that is more-so common in the games that are designed for the wider market

share and have lots of competition. As all these games were done in research purpose, the lack of phone or mobile alerts were lacking because of this.

Heuristics 4 and 9 were not present in any of the games (Table 8). None of the games had any positive feedback to the user when failure happened so this heuristic could not be said to be true in any of the games, possible partition of the heuristic into having minimal negative feedback and having positive motivational text when failing could be discussed. The heuristic 9 was a similar thing where users were told what to do in the beginning, but no additional help was provided to give a deeper explanation as to why things are happening the way they are.

The limitations of the heuristic set were identified. The heuristic set that was used in this study was designed to evaluate a single player game, which makes the social aspect and the game mechanics that compliment it not important, such as leaderboards where friendly competition can be seen. Another aspect was that the heuristics did not mention any difficulty level. In order to have the games designed for as wide of an audience as possible, the different levels of skill need to be catered to. Some games with zero knowledge of the language might find harder games unplayable due to that fact and the heuristics should recognize this.

6.4 Design recommendations for minority language learning games

The language learning game for minority learning should be made to be available for everyone easily. The easiest way for this, is to have the game available on the internet instead of having it as a board game sold offline. The game should not also be only found as an application for smartphones as it might limit some user groups from reaching it. The biggest audience can be reached when the game is on a webpage. After going through the existing Viena Karelian learning games found on (opivienankarjalaa.fi) it became apparent that the need to have the games evaluated on PC and mobile should be done as some usability issues can be found on smaller screens.

Designing the game for multiple languages can be hard depending on the level of the game and if cultural context is present, the difficulty increases plentiful. Cultural context is important when designing the game, because it gives players added motivation to learn the language. Using songs, folk lore or history when presenting the culture gives the players something to look at and listen and refer to when learning the vocabulary and pronunciation.

Feedback and achievements are very important in the light of motivation. Keeping the player's motivation up throughout the playing process is important and using badges, stars and positive feedback are one of the easiest implementations for this in game. There is no such thing as too much of these if they have clear intent and are correctly implemented. One example of a wrong implementation would be if the player needs to click and acknowledge each star after each answer. Correct way for this is to just flash the star for the user and then have it in the corner of the game area to remind them that they are doing well.

Based on the findings of this thesis the following design recommendations are proposed:

Player aspects

1. Pay attention to the age of the user group, if the game is for children, adults or everyone. (Alavesa & Arhippainen, 2020)

2. Aim to motivate the player as much as possible with achievements, badges and instant feedback. (Hamari, 2015)
3. Aim to have some form of social element in the game, either by increasing the player count, by adding a scoreboard or sharing results. (as a limit in Fitchat & Jordaan, 2016)
4. Aim to have some type of player character so the player can feel more immersed, preferably unisex model. (Fitchat & Jordaan, 2016)

Learning aspects

5. Pay attention to what is the learning purpose of the game, if it is meant to teach vocabulary, pronunciation, grammar or perhaps all of them. (Alavesa & Arhippainen, 2020)
6. Pay attention to adaptability for other minority languages or different dialects of the same minority language, like three different dialects of Karelian language. (Ward et al., 2019)
7. Aim to have repetition and reappearance of the words when learning simple things like vocabulary to test and assure that the words are fully learned.
8. Use themes to help the user perceive the vocabulary into one group to simplify learning. (Alavesa & Arhippainen, 2020)
9. Avoid scenarios where the game asks too much too quickly from the user, such as after learning a word they are required to use that in a sentence. (Alavesa & Arhippainen, 2020)
10. Aim to have the game in a linear manner (as it is in Duolingo).
11. Aim to let the user have access to already learned parts of the game, so that they can test their learned skills and to iterate words. (Fitchat & Jordaan, 2016)

Platform aspects

12. Pay attention to the platform for the game, if it is mobile application, on the web or possibly a board game, for example children were more excited about mobile applications. (Little, 2019)
13. Pay attention to the usability aspects on different platforms when designing multiplatform games on the web, for example the size of the pictures should scale well. (Was found as a problem in G1 & G4)

Design aspects (usability & user experience)

14. Use clear pictures where the user can easily distinguish one thing from another, for example separating sugar from salt. (Done well in G1, G2, G3, G4, G5, G6)
15. Use audio-visual elements to help the user learn vocabulary, for example audio clip associated to a word. (Chiaráin and Chasaide, 2016)
16. Avoid too quick elements in the game, for example feedback or answer should not just disappear after X amount of time. (Found as issues in G5, G6)
17. Make many variations of the same concept and evaluate their weaknesses and strengths.
18. Make clear instructions on how the game work and present them to user before playing and add extra guidance when the user is stuck. (Yelahina & Fedchushyn, 2020)
19. Avoid too complicated games that require excessive learning time of the game, the users should get accustomed to the game quickly and easily. (Fitchat & Jordaan, 2016)

7. Designing Game for Learning Karelian Language

Findings from the previous chapter were used for designing the new game concepts. When starting to conceptualize the artefact, the idea of user group, game mechanics, heuristic set were thought about. When trying to answer the main research question on the subject of "What kind of games should be made" then broad variety of ideas can be presented, possibilities were not only limited to mobile or web applications as concepts could have been something such as board game or card game.

7.1 Conceptualizing learning games

Six concepts were created in the beginning of designing process, some of them moved to the mock-up stage where a few images were made to visualize how the general idea of the game would be executed. The game concepts are presented in the subchapters. The process of visualizing the images was done with rapid sketching and all the designs are made by the author of the thesis

7.1.1 C1: Threat in Karelia

"Threat in Karelia" is a concept where a map of the Karelian area is used, and different types of threats were appearing. These threats would have been visualized in a more children friendly manner so that the possibility to use it as a children's learning game in the presence of an adult. Different kind of linguistic tasks then would follow, and correct answers would make the threat go away and keep the language alive in the area. The concept comes mainly from the idea of a language going extinct and saving it by using it would make it come back alive stronger. Learning would be effortless and fun with players all senses used, the concept was possible for either as a web game or mobile game.

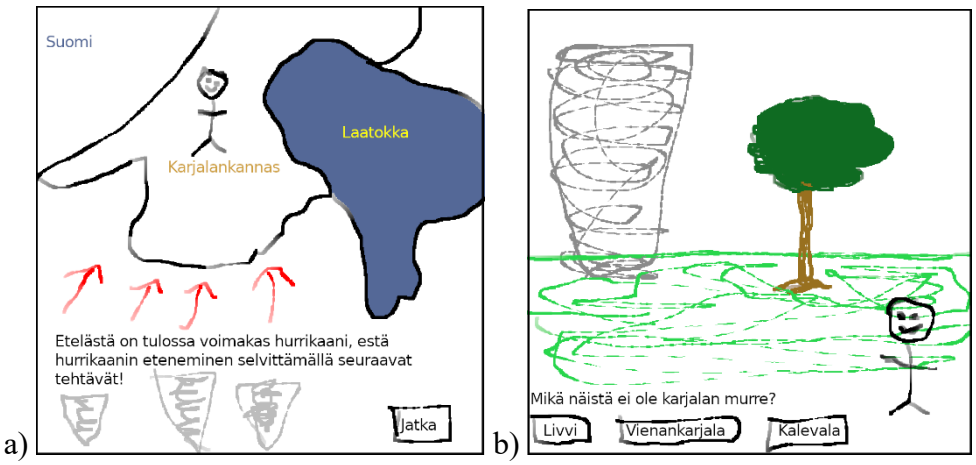

Figure 19. Threat in Karelia mock-up where a) shows the picture of the map with the threat of a hurricane approaching the character and b) is the way the screen where threat is diminished through questions and different kind of tasks

7.1.2 C2: Karelian or Finnish?

"Karelian or Finnish" is a concept where series of vocabulary words with pictures associated to them to make learning easier, appear on mobile device and player would just swipe left, right or up depending on the word. This concept could possibly just be one of those smaller types of minigames in one of the larger games, the idea would also work on its own.

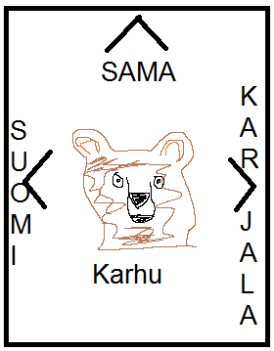

Figure 20. Mock-up of the Karelian or Finnish? made for mobile device

7.1.3 C3: Karelian pies

The most famous Finnish food associated with Karelia is a game where player creates their own character and then they need to go to town to buy ingredients for the recipe of Karelian pies. The main way of teaching things in the game would be through conversation in the shop with the seller and with different kinds of people while in the process of making the Karelian pies at home. The game is fit for all age groups and the process of making the actual food does not require any knowledge on how to make them.

a) 

b) 

Figure 21. Mock-up of the Karelian pies game where in a) the user goes to the store to buy ingredients and b) shows the process where the karelian pies are made

The possibility to form this game into a board game where all the story options are on cards and there can be two players, one acting as the shopkeeper and other one acting as the player. In the baking phase of the game the other player can guide the player with the instructions as they place the ingredient cards on the table in the correct order. When used in live version the conversational elements and pronunciation are more highlighted.

7.1.4 C4: Ladder to Viena Karelian

Ladder to Viena Karelian comes from the old snakes and ladders type of game where two players go head to head on a board, throwing dice until other one gets to the goal. Ladders on the way let players get up multiple rows or snakes can "eat" the player to make them

fall down several ranks. Whenever a player lands on a ladder or a snake they are given a task, a word, a sentence or something else to translate or change one word to make it correct. The fact that another player is needed makes it easier to be played on a browser as there it can be player from tablet, smartphone, laptop or PC.

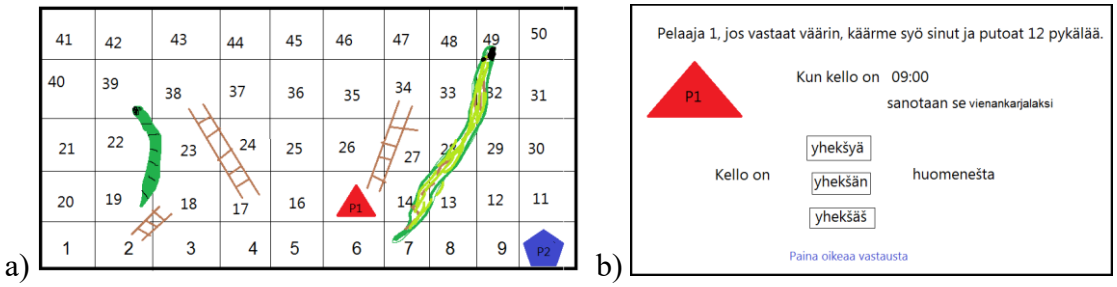

Figure 22. Mock-up of the Ladder game where a) shows the board where the players compete and b) shows one of the example questions for the user

7.1.5 C5: Language bath

Language bath is a concept where different kinds of language related questions pop up from the bathtub. The game starts from the most basic form of letters and is in a form of quiz, trying to teach the difference between Finnish language and Viena Karelian. The users are first prompted to select their skill level and depending on the level the questions will be harder. The progression is done with levels and the possibility to advance to a harder level requires completing the easier ones first with the option to skip straight to the harder ones in case harder ones are wanted to try.

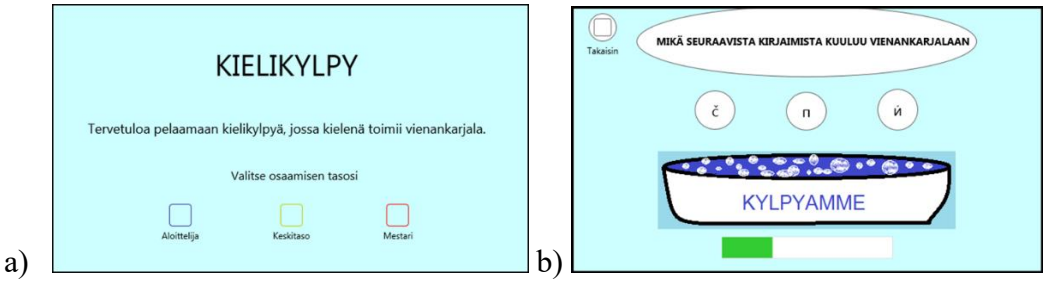

Figure 23. Mock-ups of the Language bath game where a) shows the welcoming message and user selects the difficulty level, b) is one of the more basic questions that come out of the bathtub that asks the questions

7.1.6 C6: T&P Viena Karelian

T&P or Test and Practise Viena Karelian is a concept where users skills could be tested at the beginning and then serious of vocabulary quizzes would be presented to the player. The game would have audio files that complement the learning. Gamified elements such as live progress tracking and instant feedback.

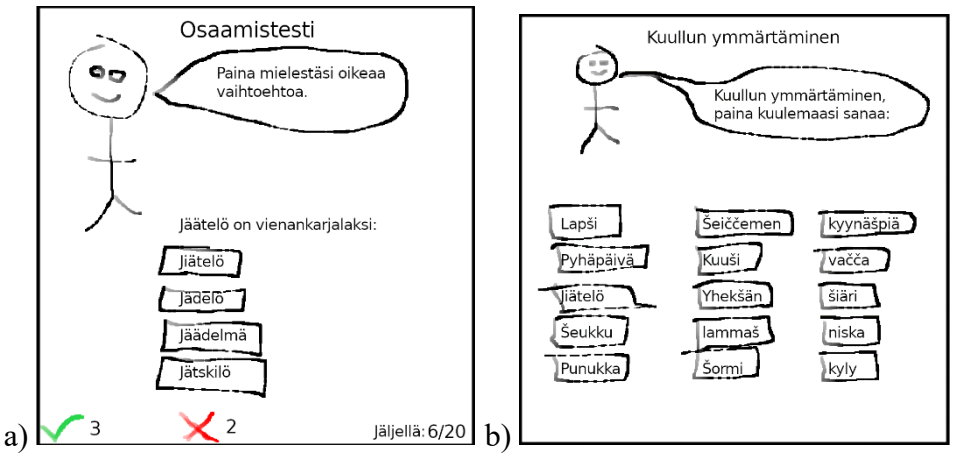

Figure 24. Mock-ups of Test and Practise Viena Karelian, where a) is a quiz to test the knowledge of the user with four answers to choose from, counters of correct and wrong answers at the bottom, b) is a listening game where users click the answers that are read out loud

7.1.7 Summary of the concept phase

The concepts are summarized (Table 10) where the platform, idea of the game, characters, starting position, goal, context, number of players, user groups and game mechanics are presented.

Table 10. Summarization of the game concepts

Concept #	C1	C2	C3	C4	C5	C6
Platform	PC, smart device	Mobile	PC, smart device, card, board	PC, smart device, board	PC, smart device	PC, smart device
Idea	Defending Karelian region by completing language learning tasks	Various words with pictures shown to player, swipe direction of the language	Story game with different kind of real-life situations, Karelian language used	Throwing dice to run to the end of the game, language tasks to prevent going back or moving forward	Teaching language via gamified elements and visual effects where the bathtub is the "teacher"	Gamified elements with some cultural aspects like game guide to help and support the player
Characters	Player	Player	Player, Shopkeeper, bus driver	Players as buttons	Player	Player
Starting	Karelian cultured presented then suddenly threat appears	Different themes for, word and picture appear on the screen	Player character is home and has guests arriving, wants to offer pies	Square 1, player rolls dice and moves	Choosing level and then starting to learn via tasks	Starting quiz to test the knowledge of the player
Goal	Teaching Karelian culture and language in a fun way by protecting earth	Teaching vocabulary by theme in a simple manner, to complete all themes fully	Go to town and buy materials to make Karelian pies all in Viena Karelian	Reaching square 50 before another player does	Going through all the language learning tasks available	Progressing through the game to learn broadly about Karelian language
Context	Modern day Karelian region with unnatural elements	Themes of food, dates, animals, basic sayings	Karelian region in a time without smartphones			
Players #	1	1	1 / 2+	2 / 2+	1	1
User group	All	All	12+ years solo, for multi all.	All	All	All
Game mechanics	Levels, stars, badges, 3D map, character	Themes, progress tracking	Character, levels, virtual scenarios	Minigames, task success tracking	Levels, progress tracking, feedback, help	Audio recordings, progress tracking, levels, feedback, help

7.2 Designing the artefact

Where the designed artefact would be placed was first under revision as mobile application have their advantages with their ease of use. Web based browser game was selected because of the availability and ease of implementation to different platforms.

Playing a browser game on mobile is much simpler than playing mobile application on PC, where simulators need to be used. With the selection of web game, the implementation language of the artefact came to be JavaScript, HTML and CSS, the basic elements of a web page. The Viena Karelian dialect parts are formed from a book teaching Viena Karelian (Karlova, 2013).

Designing the artefact started with understanding the user group and making the game elements according to that. With the help of a character in form of a game guide the user is first brought into the game with welcoming messages. The idea is to keep the game guide throughout the whole game with the player. Without game guide, the instructions might seem boring, but the person also acts as a motivator in the games. The game would also work without the guide but using audio-visual cues makes the game more enjoyable for all audiences.

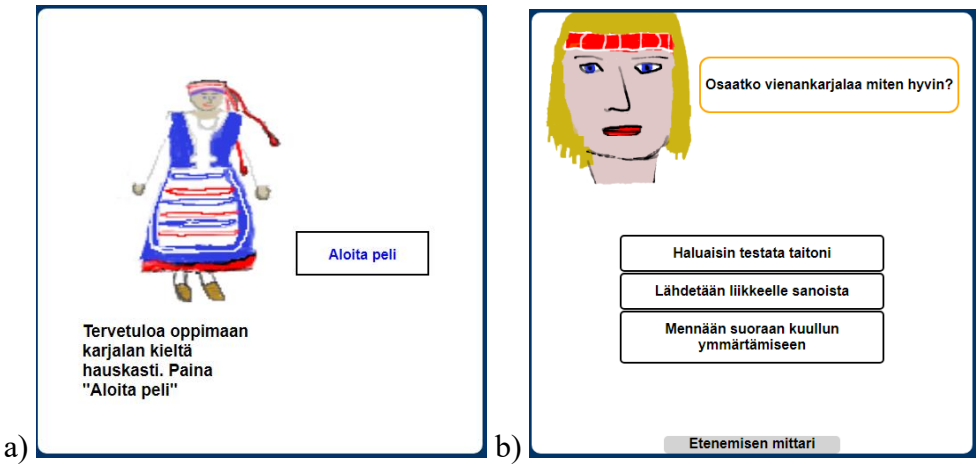

Figure 25. Screen captures from the artefact where a) is the welcoming guide and b) is the main menu where three options are presented for the user, first being game to test skill level, next is vocabulary learning through a small vocabulary game and the third is an audio-based game with vocabulary learning.

The more basic types of quiz games were used in the vocabulary learning section where a word would be shown, and the player needs to select whether the word is in Viena Karelian, Finnish or if the word is the same in both versions. Game where players' skills are tested has four options to choose from and all of them are alike in their formatting so the answer would not be too obvious, the games have progress bar present all the time and also there is a voice feedback of a person saying "Correct" or "Wrong". Having every word that read out loud for the game would have proved to be too big of a task for one person to implement and thus was rejected in the construction phase. When the game would be tested with the mock-up the words could be read out loud to see if the users like it or not.

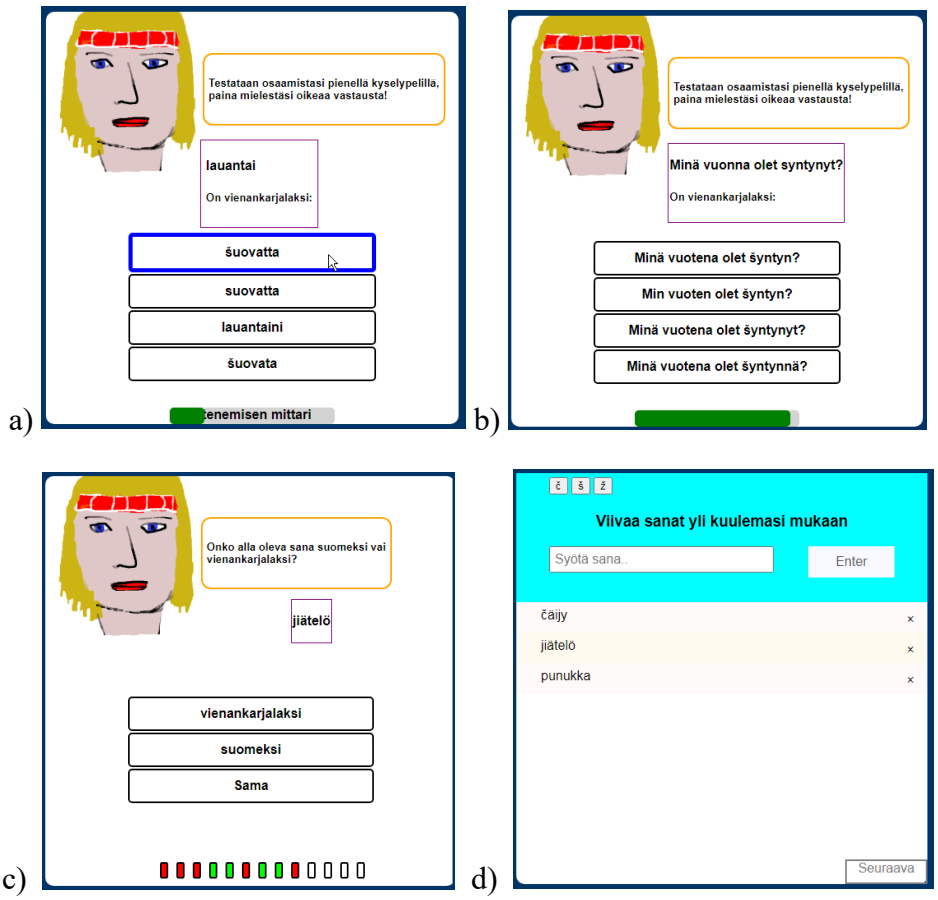

Figure 26. Screen captures from the artefact where a) is the game of testing skills of the player, first by one letter words, then to get a better understanding of the skill in b) longer sentences are presented, c) shows the small game of differences between Finnish and Viena Karelian and d) is the audio game

In the audio game where words would be read out loud in Viena Karelian the screen would have many options to choose from and clicking the correct word is the key to completing the game. After some time of just listening and clicking the words, the players are prompted to write the word into the field based on what they hear. It is important to note that the three common letters for Viena Karelian are presented somewhere on the screen where they are easily accessible. The use of the button letters can be awkward when switching from writing on the keyboard to pressing the button, so alternative methods can be discussed. When writing the words that are heard it is important to notice two things, the pronunciation of the speaker in the audio file should be clear and that the user must have option to replay the audio file as many times as they want. After guessing the word several times incorrect the player should be either given hint in form of a picture, text or just given the word completely. Having a picture of the corresponding word immediately on the screen is one option, but it could undermine the audio clip as the player already then knows what the word is without listening. The first part is based on the C6 Test and Practice Viena Karelian.

After the completion of these vocabulary learning games the player can proceed to the actual story-based game. This section of the game should have cultural context. The story is based on the C3 Karelian pies where the player is a character that needs to go to the town and buy ingredients for making the Karelian pies. First the player should get to the town and the way of transportation is a bus, in the town the player goes to buy ingredients from the shop and last the last phase is to make the pies. The conversational parts of the game with the different characters are done in a way where the story is streamlined, but

the player needs to know what the people are saying. As most of the text is only in Viena Karelian the player might not yet have enough knowledge of the language making it necessary to use a button that shows the player translations if wanted. Having the option to play the game as solo player or duo brings the added social element, where friends can try to make the game as easy as possible or to have fun with added challenge.

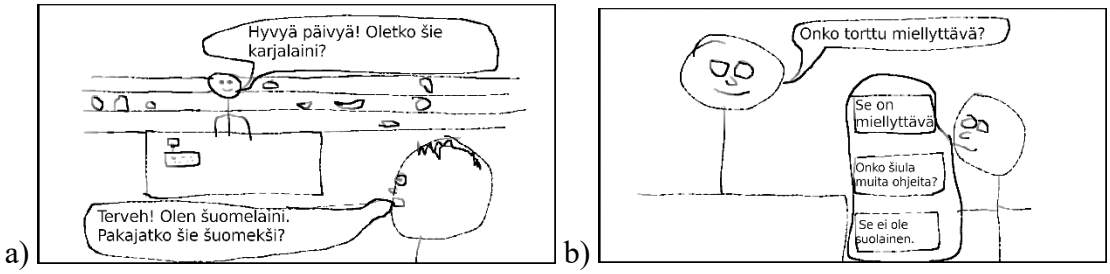

Figure 27. Visualizing the shop construct where a) is the meeting conversation and b) is one of the options that the player can choose from c)

Figure 27b illustrates the way players have different options to choose from. Due to the technical limitations of the study the story-based game was only constructed via illustrations to bring the design implications. When the game is played with another player the role of shopkeeper is given to one of them and they have the option to give the player easy time with offering pies instantly or offering something else like cake here and the player needs to understand that it is not the right option and choose the correct answer. When choosing the wrong answer there is a text steering the player into the right direction of the game story.

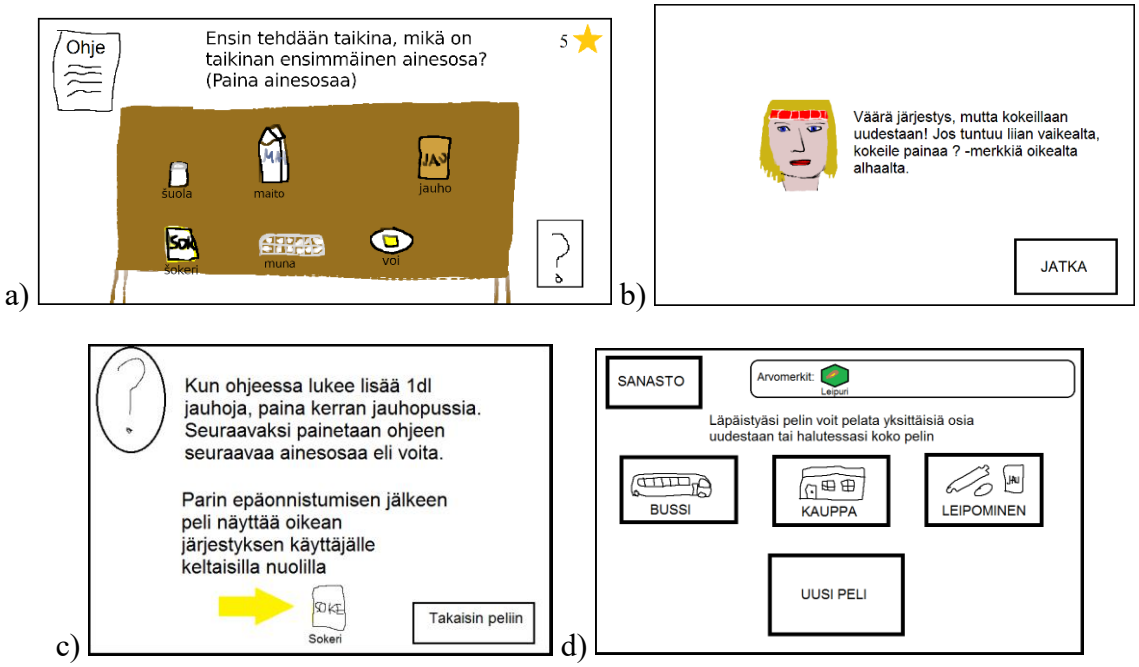

Figure 28. Visualizing the game parts where a) is the last baking phase in the game, player needs to make Karelian pies, in order to make it the instructions need to be looked at then the correct ingredients need to be clicked on the screen in the right order, b) tells the player they selected the wrong ingredients and guides to use the help button "?", c) is the help screen that guides the player on the game and shows how they are helped with yellow arrows if they keep answering wrong d) is the main menu screen after completing the game, the player has option to play separate scenes, start a new game or go back to the vocabulary learning, badges are at the top

The game should have appropriate feedback methods and assistance to the player when they get stuck, the game guide acts as the tutor and tells when something is wrong in a motivating way, not in a way of diminishing the players efforts. The helping of the player when pressing the question mark button is done with arrows that guide them towards the correct sequence of the story (Figure 28c). After completing the game, the option to go back to one scene in the game is pointed optional or the player can go back to the vocabulary learning part of the game, where new learned language learning skills can be tested to see if their knowledge improved.

8. Discussion

When designing games for minority language learning, the user group, educational aspect and game mechanics are the most important things to consider. These three elements all have various design aspects and challenges related to them especially in minority language game design.

The audience of the game is the first thing that needs to be examined when starting the design, whether the game is built for young people, elderly people or people from all age groups if possible. Targeting one of these age groups might have the possibility to make the game more enjoyable and easily approached but is it worth it? Making the game for all age groups, as most of the existing games for Viena Karelian learning and on Google Play store were, could reach wider audience. In these cases, the possibility to have the games for all user groups would mean added layers and complexity of the game in the form of explaining technicalities in a more detailed manner. Children who were raised with smart phones and computers available for them since birth have different kind of understanding of game mechanics than people who did not have them growing up. Same goes with the language aspect of the users, having wider knowledge of Finnish language is a clear advantage when learning Karelian because it is the closest dialect to Finnish language.

After the audience is recognized, the educational aspects and game mechanics (Xu, 2012) can be investigated as they are very similar and somewhat dependant on each other. Game mechanics and educational aspects are not dependant necessarily on the user group as Ekapeli Alku demonstrates, having very high quality and variety of game mechanics in the game does not mean that it cannot be for younger audience as they can be presented and altered to fit the purpose. Having different game mechanics like sound, speech recognition or leaderboards should not take anything away from the user. The option to let the user choose whether they should use them is something that should be taken into account depending on the type of game (Hanus & Fox, 2015). Minority language learning games should have stronger sense of social aspect in them as the user base of the language is in most cases smaller than other languages so having a button to share the results of the language learning process with friends or relatives is one of the important game mechanics that was not present in most of the existing Viena Karelian games except Learn Viena Karelian. Connecting native or proficient speaker of Karelian is something that would be great, but one of the challenges of small language base of minority languages, such as Viena Karelian dialect, is that connecting and finding these skilled speakers is difficult compared to the majority language groups. In these cases, using speech recognition and audio files can compensate.

For the subject of using gamified elements only, as can be seen in Learn Viena Karelian, versus having game that has blurred learning aspects like Kissa Käskyttää, is challenging. The heuristics have effortless learning listed as one of the items in the set and it is important factor in game design. Some users might view effortless learning differently and depending on the level of commitment to the language learning, when the learning is tried to be done to effortlessly, it might be completely diminished. In all of the concepts the effortless learning aspect can be said to be little, but still present. Mostly in the artefact and C3 Karelian pies concept the effortless learning comes from the conversational scenes.

One of the noticeable challenges for minority language learning that was apparent in this study is resource usage for these educational games (Ward, 2018). When designing a

game it can be hard to figure out where to use the time efficiently, should the focus of the game be in the game mechanics that complement the learning elements or the gamified elements that motivate the user to keep playing the learning game. One good example of this is that should there be audio recordings or AI-based bot (Chiaráin & Chasaide, 2016) to compliment the words when finding a pair in memory game or is it wiser to use the time for creating badges that are given to users when completing the level. The motivation for the heritage language learning comes from different sources depending on the age of the user, for children it usually comes from their parents (Little, 2019), so the motivation does not come from self-determination in those cases (Sailer et al., 2017). If the learner is an adult that starts to learn the language in their own time by their own volition, the motivation can be said to be more genuine and the use of motivation increasing element in game is not as useful, although still positive depending on the resources available.

All the linguistic parts of the game should be also evaluated by someone who can speak the correct dialect of the language as a native, so the players are not learning bad habits or wrong kind of use of the language. The small differences that have formed over time in minority languages that are mixed with the language of the country can be difficult to separate (Polinsky and Scontras, 2019) and the need for sources like verified vocabulary database are needed.

The games to be made for heritage language learning should not be too complex like Ekapeli Alku but should also have more complexity than crosswords. Having different kind of minigames for vocabulary learning is the key to learning any language (Alavesa & Arhippainen, 2020) and combining those with more advanced language settings like conversational skills are important when wanting to be able to learn the language. Minority language learning games are obviously the minority of the language learning games and that is why making as many games as possible is advised and recommended. Bigger games like MMORPG’s are not out of the question, but then again, they require a large player base which in most cases is not possible with minority language learning games, smaller games with fewer players instead are recommended.

9. Conclusions

This study conducted design science research on the topic of minority language learning games and the results are two artefacts; design recommendations and design of new games. The design recommendations are simplistic guidelines that can help new language learning game developers in the process of making a new game for minority language learning. Design of new games has concept designs that give examples of such games and how different kind of game mechanics are necessary in different types of games. Finally, a single artefact is formed and brought forward with more unified elements from the concept design section.

The study uses design science research model, but the user testing phase of the evaluation on the artefacts was not performed, because of the way the artefact is constructed it would have required face-to-face sessions for evaluation. Since covid-19 is present the proper places for this were not found as all the association that runs Karelian language cultural group has cancelled their meetings without further notice. Online evaluations could have been possible, but due to time constraints they were not found in this study.

Pedagogy and psychology are some of the aspects that are heavily present when discussing language learning games, but they are not in the scope of this study. Having deeper knowledge about how each of the pedagogical elements of language learning game works is important and seeking consult would be advised in the design process. Psychological aspects about motivation and deeper understanding about how feedback systems should work when making the most supportive learning game should be investigated.

Future research on the topic should go more into detail about the heuristics that are used to language learning games. The heuristic set used in this study (Fitchat & Jordaan, 2016) was made for serious games in particular and it proves to have limitations when evaluating language learning games. The possible heuristic set for language learning games could also include some aspects about pedagogical work in the game as to whether the words should be really similar or about the complexity of the sentences used.

Most of the literature on language learning games found was focusing on the younger audience or children in particular, but no mention of elderly people was found. The language learning games should be made with the consideration to all the user groups, not only the ones that are the most apparent ones to play the games.

The design recommendations presented in the section 6.4 should be evaluated to validate are they proper and do they take into account all relevant aspects when designing language learning games. Finding out how different it is to design for different platforms should be considered also.

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Appendix A. Heuristic analysis on language learning games for Karelian language

Table A. G1: Sanaristikko heuristic evaluation.

Heuristics	Y/N/P	Comment
1. Convenience	Y	Game is available in the internet for browser, playable on mobile and PC.
2. Enchantment	P	Game does not have any messages to try to make the player to return to the game, but the players should feel enchanted when playing
3. Effortless learning	N	The learning is not effortless as vocabulary is the center of the game
4. Positive encouragement	N	Players are not motivated if they fail
5. Possibility to practise	Y	Previous tasks are easily accessible making it easy to practice
6. Rewards for achievements	Y	Players are rewarded with positive comments when completing the game
7. Use of all senses	N	Game has some visual elements but no audio to compliment it
8. Progress tracking	N	The open nature of the game makes it possible for easy progress tracking
9. Guidance	N*	Game has guidance text, but *no additional help in problem situations
10. Player centred design	N	No customizability and the players have a hard time feeling immersed or centered

Table B. G2: Etsi sanat heuristic evaluation.

Heuristics	Y/N/P	Comment
1. Convenience	Y	Game is available in the internet for browser, playable on mobile and PC.
2. Enchantment	P	Game does not have any messages to try to make the player to return to the game, but the players should feel enchanted when playing
3. Effortless learning	Y	Effortless learning possible as words are given for the user
4. Positive encouragement	N	Players are not motivated in case of failure
5. Possibility to practise	Y	Previous tasks are easily accessible making it easy to practice.
6. Rewards for achievements	Y	Positive comment for the user when completing the game
7. Use of all senses	N	Game has some visual elements but no audio to compliment it
8. Progress tracking	P	Progress can be tracked due to the open nature of the game
9. Guidance	N*	Game has guidance text, but *no additional help in problem situations
10. Player centred design	N	No customizability and the players have a hard time feeling immersed or centered

Table C. G3: Muistipeli heuristic evaluation.

Heuristics	Y/N/P	Comment
1. Convenience	Y	Game is available in the internet for browser, playable on mobile and PC.
2. Enchantment	N	Game does not have any messages to try to make the player to return to the game, but the players should feel enchanted when playing
3. Effortless learning	Y	Effortless learning is easily possible as the game is quick tempo and requires for users to look at the words
4. Positive encouragement	N	Players are not motivated in case of failure
5. Possibility to practise	Y	Previous tasks are easily accessible making it easy to practice.
6. Rewards for achievements	N	Positive comment for the user when completing the game
7. Use of all senses	N	Game has some visual elements but no audio to compliment it
8. Progress tracking	N	Progress can be tracked due to the open nature of the game
9. Guidance	N	No guidance at all
10. Player centred design	N	No customizability and the players have a hard time feeling immersed or centered

Table D. G4: Kuvapeli heuristic evaluation.

Heuristics	Y/N/P	Comment
1. Convenience	Y	Game is available in the internet for browser, playable on mobile and PC.
2. Enchantment	P	Game does not have any messages to try to make the player to return to the game, but the players should feel enchanted when playing
3. Effortless learning	P	Learning can be effortless depending on the knowledge of the user
4. Positive encouragement	N	Players are not motivated in case of failure
5. Possibility to practise	Y	Previous tasks are easily accessible making it easy to practice
6. Rewards for achievements	Y	Instant positive feedback for successful answer
7. Use of all senses	N	Game has some visual elements but no audio to compliment it
8. Progress tracking	N	No continuous progress tracking in the game
9. Guidance	N	No guidance at all
10. Player centred design	N	No customizability and the players have a hard time feeling immersed or centered

Table E. G5: Viikonpäiväpeli heuristic evaluation.

Heuristics	Y/N/P	Comment
1. Convenience	Y	Game is available in the internet for browser, playable on mobile and PC.
2. Enchantment	P	Game does not have any messages to try to make the player to return to the game, but the players should feel enchanted when playing
3. Effortless learning	P	Learning can be effortless depending on the knowledge of the user
4. Positive encouragement	N	Players are not motivated in case of failure
5. Possibility to practise	Y	Previous tasks are easily accessible making it easy to practice
6. Rewards for achievements	Y	Instant positive feedback for successful answer
7. Use of all senses	N	Game has some visual elements but no audio to compliment it
8. Progress tracking	P	Players are shown how many they have completed, but not told how many are left
9. Guidance	N*	Game has guidance text, but *no additional help in problem situations
10. Player centred design	N	No customizability and the players have a hard time feeling immersed or centered

Table F. G6: Kissa käskyttää heuristic evaluation.

Heuristics	Y/N/P	Comment
1. Convenience	Y	Game is available in the internet for browser, playable on mobile and PC.
2. Enchantment	P	Game does not have any messages to try to make the player to return to the game, but the players should feel enchanted when playing
3. Effortless learning	Y	Learning can be effortless depending on the knowledge of the user
4. Positive encouragement	N	Players are not motivated in case of failure
5. Possibility to practise	Y	Previous tasks are easily accessible making it easy to practice
6. Rewards for achievements	Y	Instant positive feedback for successful answer
7. Use of all senses	N	Game has some visual elements but no audio to compliment it
8. Progress tracking	Y	Progress can be tracked due to the open nature of the game
9. Guidance	N	No guidance at all
10. Player centred design	Y	No customizability but the cat can lead to kind of immersion

Table G. G7: Learn Viena Karelian heuristic evaluation.

Heuristics	Y/N/P	Comment
1. Convenience	Y	Game is available in the internet for browser, playable on mobile and PC.
2. Enchantment	P	Game does not have any messages to try to make the player to return to the game, but the players should feel enchanted when playing
3. Effortless learning	P	Learning can be effortless depending on the user
4. Positive encouragement	N	Players are not motivated in case of failure
5. Possibility to practise	N	Previous tasks are not easily accessible as it requires a full reset
6. Rewards for achievements	Y	Instant positive feedback for successful answer
7. Use of all senses	Y	Game has audio elements in some parts
8. Progress tracking	Y	Progress is well visualized in form of stars
9. Guidance	N*	Game has guidance text, but *no additional help in problem situations
10. Player centred design	N	No customizability and the players have a hard time feeling immersed or centered

Table H. G8: Hirsipuu heuristic evaluation.

Heuristics	Y/N/P	Comment
1. Convenience	P	Game is only available on the Android platform on mobile
2. Enchantment	P	Game does not have any messages to try to make the player to return to the game, but the players should feel enchanted when playing
3. Effortless learning	P	Learning can be effortless depending on the user
4. Positive encouragement	N	Players are not motivated in case of failure
5. Possibility to practice	P	Practice of the game is possible, but it is it is hard due to nature of the game
6. Rewards for achievements	Y	Instant positive feedback for successful answer
7. Use of all senses	N	Game has some visual elements but no audio to compliment it
8. Progress tracking	Y	Progress can be tracked due to the open nature of the game
9. Guidance	N*	Game has guidance text, but *no additional help in problem situations
10. Player centred design	N	No customizability and the players have a hard time feeling immersed or centered

Table I. G9: Kielimestari heuristic evaluation.

Heuristics	Y/N/P	Comment
1. Convenience	P	Game is only available on the Android platform on mobile
2. Enchantment	P	Game does not have any messages to try to make the player to return to the game, but the players should feel enchanted when playing
3. Effortless learning	Y	Effortless learning is possible through the association of the words and sentences
4. Positive encouragement	N	Players are not motivated in case of failure
5. Possibility to practise	Y	Previous mini games are easily accessible
6. Rewards for achievements	Y	Instant positive feedback for successful answer
7. Use of all senses	Y	Continuous audio-visual elements in the game
8. Progress tracking	N	Inside the mini game the progress is tracked but overall progress is not found
9. Guidance	N	No guidance at all
10. Player centred design	Y	With the character the players can feel some sort of immersion.