

Tartu University
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**DEVELOPMENT OF A MOBILE APPLICATION FOR ESTONIAN VOCABULARY LEARNING:
A CROSS-PLATFORM SOLUTION USING REACT NATIVE**

Bachelor thesis

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Narva 2025

Tartu Ülikooli Narva Kolledž

Sotsiaalteaduste valdkond

Õppekava “Infotehnoloogiliste süsteemide arendus”

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MOBIILIRAKENDUSE ARENDAMINE EESTI SÕNAVARA ÕPPIMISEKS

REACT NATIVE BAASIL

Bakalaureusetöö

Juhendaja: Andre Säask, M.Sc.

Narva 2025

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TABLE OF CONTENTS

<i>Licence</i>	3
<i>Table of Contents</i>	4
<i>Introduction</i>	7
The Problem	7
The Solution	7
The Goal	7
The Tasks	7
Thesis Structure	8
1 Research	9
1.1 Existing Solutions on the Market	9
1.1.1 Language Learning Platforms.....	9
1.1.2 Traditional Dictionary Applications.....	10
1.1.3 Web-Based Translation Tools	11
1.1.4 Summary	11
1.2 Technologies and Tools Used	12
1.2.1 React Native and Cross-Platform Development.....	12
1.2.2 Data Management with AsyncStorage	13
1.2.3 SONAPI Integration for Language Data	14
1.2.4 Advanced Gameplay Features	14
1.2.5 Enhanced Statistics Tracking.....	15
1.2.6 Comprehensive Design and User Experience.....	15
1.2.7 Summary	16
2 Practical Development	18

2.1	System Architecture	18
2.1.1	Overview of the TestiMind Application	18
2.1.2	Modular Design and Components.....	18
2.1.3	Game Screen	19
2.1.4	Search Screen	21
2.1.5	Dictionary Screen	22
2.2	User Interface and Experience Design.....	23
2.2.1	Usability Considerations.....	23
2.2.2	Visual and Functional Design.....	23
2.3	Game Development.....	24
2.3.1	Vocabulary Expansion	24
2.3.2	Randomization and Game Logic	24
2.3.3	Game Flow and Screens	25
2.4	Challenges and Solutions.....	29
2.4.1	Word Classification	30
2.4.2	Performance Optimization.....	30
2.4.3	Handling Homonyms.....	30
2.4.4	User Engagement.....	30
2.4.5	Summary	31
2.5	Future Development.....	32
2.5.1	Enhanced Game Modes	32
2.5.2	Daily Streaks and Engagement.....	32
2.5.3	Advanced Progress Tracking	32
2.5.4	Expanded Features.....	33

2.5.5	Summary	33
	Conclusion	34
	References	35

INTRODUCTION

The Problem

Learning the Estonian language, particularly at an advanced level, presents significant challenges due to its complex grammar and rich morphological structures. There are learning resources already available for the Estonian language learners, but the field is far from being satisfactory. This gap in resources slows learners' progress and reduces motivation.

The Solution

In this thesis the author will develop a mobile application TestiMind designed to enhance Estonian vocabulary acquisition for advanced learners through gamified features. TestiMind will combine a dictionary module for word searches with a game-based learning environment that improve vocabulary knowledge. Additionally, the app will provide performance-tracking tools, personalized feedback, and offline capabilities to ensure consistent and effective learning.

The Goal

The goal of this thesis is to design and implement a user-friendly mobile application that leverages gamification to improve Estonian vocabulary learning. The application will aim to:

1. Deliver an interactive and engaging vocabulary learning experience.
2. Integrate advanced linguistic resources, such as SONAPI, for accurate word data.
3. Provide tools to track user progress.

The Tasks

To achieve this goal, the author will conduct the following steps:

1. Analyze existing language learning tools to identify resource gaps and opportunities for innovative approaches.
2. Design the application architecture and its key components.
3. Develop the core features including a vocabulary game, a search module, and a statistics dashboard.
4. Integrate third-party APIs and implement local data storage for offline use.

Thesis Structure

The thesis will begin with a review of existing solutions and related literature in Chapter 1.1, exploring language learning platforms, traditional dictionary applications, and web-based translation tools, as well as the technologies and tools used for developing the TestiMind application. Chapter 2 will detail the system architecture, modular design, and practical implementation, including game development, user interface design, and the challenges encountered during development. Chapter 2.5 will provide recommendations for future improvements, focusing on enhanced game modes, advanced progress tracking, and additional features.

1 RESEARCH

1.1 Existing Solutions on the Market

1.1.1 Language Learning Platforms

In the current language-learning landscape, several well-known platforms offer general or introductory courses that touch on Estonian, but they seldom delve deeply into specialized or advanced-level vocabulary. For example, **Lingvist** is a popular app that utilizes an AI-driven approach to personalized learning. While it supports Estonian and emphasizes high-frequency vocabulary and efficient progress tracking, its primary focus remains on providing a solid foundation rather than catering to advanced learners or exploring niche lexical areas.

Another noteworthy application is **Drops**, which excels at delivering visual and gamified vocabulary learning experiences. Drops includes Estonian among its supported languages and employs visually appealing word association techniques to engage learners. However, similar to other platforms, it focuses on basic and intermediate vocabulary rather than the specialized or advanced lexical content that some users may require.

Speakly, on the other hand, stands out from many competitors because it does include Estonian as one of its supported languages. It focuses on high-frequency words and phrases, using a combination of spaced repetition and real-life contexts to help users build practical communicative skills. Nevertheless, Speakly's main objective is to help learners attain basic conversational proficiency rather than exploring the specialized vocabulary that more advanced users might seek.

Another example is **Keeleklikk**, an online learning environment specifically designed for Estonian, which combines interactive videos, exercises, and quizzes. While Keeleklikk provides a structured approach to foundational grammar and vocabulary, it is primarily aimed at beginners and intermediate learners. Consequently, it does not generally cater to those needing more advanced lexical development or in-depth cultural context.

Duolingo, one of the most widely recognized language-learning applications, unfortunately does not currently offer Estonian. Despite its fun, gamified approach and large user base, Duolingo's focus remains on more commonly studied languages such as Spanish, French, and

German. This leaves a clear gap for learners seeking a tool explicitly tailored to advanced Estonian vocabulary with deeper linguistic features and contextual usage.

In summary, while these platforms excel at introducing commonly studied languages through a structured and engaging learning experience, they generally fail to address the needs of advanced Estonian language learners. The lack of specialized content, in-depth coverage, and targeted vocabulary practice means that users interested in taking their Estonian skills beyond the basics often find themselves under-served.

1.1.2 Traditional Dictionary Applications

Traditional dictionary applications play a foundational role in language acquisition by providing quick and reliable access to word meanings, synonyms, antonyms, and basic usage examples. Many online and offline dictionary tools exist for Estonian, offering a straightforward way to look up unfamiliar words. However, these platforms often limit themselves to a lookup-only approach, which places the burden on learners to figure out how best to retain and use this information in a real-life context.

For instance, the typical process of consulting a dictionary involves typing a word, reading its definition, and possibly seeing an example sentence. While this is invaluable for quick reference, it lacks interactive or engaging features—such as gamified content—that can help solidify vocabulary in long-term memory. Additionally, traditional dictionaries often do not track user progress or integrate spaced repetition systems (SRS), both of which are highly effective for vocabulary retention.

Moreover, the format of these applications can be somewhat passive. Learners rely on their own discipline to return to the dictionary repeatedly, compile the words they have learned, and devise personal review strategies. This approach can be effective for highly self-motivated learners but poses a challenge for those who thrive on structured guidance, consistent reminders, and gamified motivation. Consequently, dictionary applications, while vital as reference tools, seldom foster the kind of sustained engagement needed for advanced vocabulary building.

1.1.3 Web-Based Translation Tools

Web-based translation services like Sõnaveeb, **Google Translate**, **Microsoft Bing Translator**, or **DeepL** offer an invaluable quick-reference function. They provide almost instant translations of words and phrases across multiple languages, including Estonian. Such convenience makes them indispensable for travelers or individuals who need rapid assistance with a text. However, these tools tend to focus on providing single-use translations rather than cultivating a learner's ability to recall and use the language independently.

A common challenge with relying on translation tools is that they don't typically guide the user through structured language practice or offer features such as personalized learning pathways, progress tracking, or adaptive quizzes. Additionally, while machine translation has significantly improved, it may still struggle with nuanced, context-dependent translations or specialized vocabulary areas (e.g., technical, literary, or academic language). This can lead to gaps in learners' understanding of how a word or phrase should be correctly and idiomatically applied.

Furthermore, translation tools generally lack mechanisms for retention and review. Users who rely solely on these tools for vocabulary development must manually compile and revisit lists of new words. Without an integrated system for spaced repetition or active practice, newly encountered vocabulary is more likely to be forgotten. As a result, while translation tools are incredibly useful for quick checks or clarifying a particular phrase, they are not optimized for a systematic or gamified learning experience that encourages consistent engagement and in-depth mastery of advanced Estonian vocabulary.

1.1.4 Summary

Overall, there are several types of digital resources available for language learners: established language learning platforms, dictionary applications, and web-based translation tools. Each category provides unique benefits—such as structured course content, reliable reference material, or instant translation—but they also present significant limitations when it comes to advanced Estonian language acquisition. These gaps highlight the need for a

tailored solution that combines robust vocabulary-building strategies with engaging, interactive features.

A specialized Estonian language application, particularly one aiming to serve advanced learners, must address the shortcomings of existing solutions. It should offer deeper vocabulary coverage, adopt gamified elements for consistent user engagement, and implement proven pedagogical techniques—such as spaced repetition—to foster long-term retention. By focusing on these areas, such an application could fill the current void in the market and provide a comprehensive, engaging way to master advanced Estonian.

1.2 Technologies and Tools Used

1.2.1 React Native and Cross-Platform Development

At the core of the application is React Native, a powerful framework that allows developers to build cross-platform applications using a single codebase. This approach significantly reduces development time and ensures consistency between Android and iOS versions of the app. React Native's architecture leverages JavaScript and React's component-based design, enabling developers to build modular, reusable, and maintainable UI components.

One of React Native's standout features is its ability to achieve near-native performance. Despite being written in JavaScript, the framework bridges the gap with native UI components, ensuring smooth animations and responsiveness that are often indistinguishable from fully native applications. This native-level performance is particularly critical for an educational app where fluid user interactions play a key role in maintaining user engagement.

Furthermore, React Native incorporates a Virtual DOM mechanism to manage and update the UI efficiently. When a change occurs, the Virtual DOM calculates the minimal set of updates needed to reflect that change on the screen. This process minimizes unnecessary rendering, reducing resource consumption and ensuring the app runs smoothly even on lower-end devices.

The integration of third-party libraries also expands the app's capabilities. For instance, the app utilizes `react-native-vector-icons` to provide visually appealing and

customizable icons, while `react-native-animatable` adds dynamic animations that enhance user experience. The navigation system, powered by `react-navigation`, allows seamless transitions between screens, contributing to an intuitive and user-friendly interface.

React Native's robust ecosystem and active community further bolster its utility. With access to numerous plugins and tools, the framework simplifies the integration of platform-specific features like camera access, notifications, or GPS functionalities. This adaptability ensures the application can evolve alongside user needs and technological advancements.

1.2.2 Data Management with AsyncStorage

For client-side data management, the application employs `AsyncStorage`, a lightweight solution built into React Native. This mechanism facilitates persistent key-value storage directly on the user's device, enabling the app to retain critical information such as user preferences, game statistics, and saved vocabulary entries.

The primary advantage of `AsyncStorage` lies in its offline accessibility. By storing data locally, the app ensures uninterrupted functionality even when the user is offline, a feature that is especially beneficial for learners in environments with inconsistent internet access. This offline capability allows users to review their progress, save words, and test results at any time, fostering a sense of continuity and reliability.

`AsyncStorage`'s API is straightforward yet efficient, enabling rapid read and write operations. For example, game statistics, including scores, attempts, and accuracy, are stored as JSON objects that can be easily retrieved and displayed on the statistics screen. Similarly, saved vocabulary words are organized with metadata, such as word class and morphological details, ensuring that the data remains both comprehensive and easy to access.

To enhance user experience, error handling is integrated into the `AsyncStorage` operations. If a data retrieval or storage operation fails, the app provides clear feedback through mechanisms like `ToastAndroid`, alerting the user while maintaining app stability. This proactive approach to error management enhances the overall reliability of the application.

1.2.3 SONAPI Integration for Language Data

A crucial element of the application's functionality is its integration with SONAPI, an API wrapper around the Estonian Language Institute's Sõnaveeb portal.

SONAPI provides access to a wide range of linguistic data, including definitions, translations, morphological forms, and usage examples, making it an indispensable resource for language learners.

Estonian's complex morphology poses unique challenges for learners, particularly those at an advanced level. SONAPI addresses this by offering detailed morphological information that demonstrates how words conjugate or decline in different grammatical contexts. This feature not only aids in understanding individual words but also provides insights into their proper usage in sentences.

The API also classifies words into categories such as nouns, verbs, adjectives, and adverbs, helping learners grasp the grammatical roles of words. Additionally, SONAPI includes related terms and synonyms, enabling users to expand their vocabulary organically. These linguistic features are seamlessly integrated into the app's search functionality, allowing users to explore a word's full range of meanings, forms, and relationships with other terms.

The connection between SONAPI and the app's gamification elements is particularly noteworthy. For instance, during quizzes, the app utilizes SONAPI data to generate challenging yet relevant questions. By doing so, the app transitions from a basic vocabulary tool to a dynamic learning platform, combining theoretical knowledge with practical application.

1.2.4 Advanced Gameplay Features

The gamification component of the app transforms vocabulary learning into an interactive experience. The word-guessing game relies on the user's saved vocabulary, presenting questions that challenge their understanding of meanings and word classes.

During gameplay, the app dynamically generates questions by selecting saved words and pairing them with distractors. These distractors are carefully filtered based on word classes to ensure they are plausible alternatives, adding a layer of cognitive challenge. React Native's

UI capabilities, combined with libraries like `react-native-animatable`, bring these questions to life with smooth animations that make the gameplay visually engaging.

Feedback mechanisms play a pivotal role in enhancing the learning process. Correct answers are highlighted in green, while incorrect choices are marked in red, providing immediate clarity. This real-time feedback, coupled with post-game statistics such as accuracy and time spent, encourages users to identify their strengths and areas for improvement.

1.2.5 Enhanced Statistics Tracking

To complement the gamification features, the app includes a statistics screen where users can review their performance. This screen aggregates data such as scores, attempts, accuracy, and time spent, presenting it in an organized and user-friendly layout.

The statistics feature is powered by `AsyncStorage`, which ensures that data is retained across sessions. Each game result is timestamped, allowing users to track their progress over time. For clarity, time data is formatted into human-readable strings, and performance metrics like accuracy are displayed as percentages.

The ability to delete specific statistics entries ensures that users can manage their data effectively, keeping the records relevant and up to date. By presenting this information in a clear and accessible manner, the app not only engages users but also motivates them to strive for improvement.

1.2.6 Comprehensive Design and User Experience

The TestiMind application prioritizes user-centered design to provide an engaging and intuitive learning experience. The interface employs a modern, minimalistic aesthetic with consistent typography and a balanced color palette that highlights key actions and feedback without overwhelming the user. Navigation is streamlined through a bottom tab bar, enabling effortless access to essential features like games, the dictionary, and search functions. This layout reduces cognitive load and allows users to focus on learning.

Accessibility is a cornerstone of the design, with features like scalable text sizes and high-contrast color schemes ensuring inclusivity for users with varied needs. Interactive

elements, such as buttons and touchable components, are designed to respond quickly and predictably, enhancing the overall sense of control and reliability.

Visual feedback and subtle animations enrich user interactions, creating a dynamic experience that keeps learners engaged. For example, immediate responses during quizzes, such as highlighting correct answers, reinforce learning while maintaining a sense of progress. Performance data is presented in an organized, readable format, allowing users to track their achievements and understand their learning patterns over time.

This thoughtful approach to design and user experience ensures that the application not only meets functional requirements but also provides an environment that motivates and supports users in mastering advanced Estonian vocabulary.

1.2.7 Summary

The application integrates a range of modern technologies to deliver a seamless and engaging experience for language learners. At its core, React Native enables efficient cross-platform development, combining JavaScript and component-based architecture to achieve near-native performance on Android and iOS devices. Leveraging tools like `react-native-animated` for animations and `react-navigation` for intuitive navigation, the app ensures smooth interactions and a polished user experience.

For data management, `AsyncStorage` provides offline persistence, storing critical information such as saved words, user preferences, and game statistics. This ensures uninterrupted functionality even without internet access, a crucial feature for maintaining engagement in diverse user environments. Error handling, integrated via `ToastAndroid`, further enhances reliability by offering immediate feedback during operations like saving or retrieving data.

The integration of SONAPI v2 is central to the app's linguistic features. This Estonian language database enriches the application with detailed word definitions, morphological forms, and usage examples, addressing the complexities of Estonian grammar and vocabulary. The API also supports gamification by supplying data for quizzes, making vocabulary learning both interactive and educational.

Additionally, the application incorporates a sophisticated gamification system that dynamically generates questions based on saved vocabulary, providing immediate feedback and post-game statistics. Combined with a well-designed statistics screen for progress tracking, the app motivates users to improve their language skills.

With a focus on thoughtful design, robust error handling, and engaging user experience, this application exemplifies the effective use of technology in education, providing a reliable and scalable platform for language learning.

2 PRACTICAL DEVELOPMENT

2.1 System Architecture

2.1.1 Overview of the TestiMind Application

TestiMind is designed with modular **architecture**, enabling separate yet interconnected modules to handle specific features. The primary modules are:

1. Interactive Game Module

- Offers gamified quizzes and exercises.
- Incorporates performance tracking and feedback mechanisms.

2. Search Functionality

- Allows users to look up Estonian words, view translations, and access related definitions.
- Relies on SONAPI integration to retrieve comprehensive linguistic data (definitions, morphological forms, etc.).

3. Personal Dictionary

- Enables saving or bookmarking words for easy reference.
- Provides a dedicated view of user-curated vocabulary, facilitating reviews and further study.

4. Statistics Module

- Tracks user progress (e.g., correct answers, total attempts, streaks).

This separation of concerns ensures that each module can evolve independently, promoting maintainability and scalability as new features are added.

2.1.2 Modular Design and Components

TestiMind adopts a **component-based approach** under React Native, structuring the application around discrete screens and shared UI elements. A primary example is the tab-based navigation, which manages the main screens—Game, Search and Dictionary—within a single navigator (**Figure 1**).

Each screen is developed as its own React component with dedicated logic, state management, and styling.

```
const MainTabs = () => {
  return (
    <Tab.Navigator
      screenOptions={({route}) => ({
        tabBarIcon: ({focused, color, size}) => {
          let iconName;
          if (route.name === 'Search') {
            iconName = focused ? 'search' : 'search-outline';
          } else if (route.name === 'Dictionary') {
            iconName = focused ? 'book' : 'book-outline';
          } else if (route.name === 'Game') {
            iconName = focused ? 'game-controller' : 'game-controller-outline';
          }
          return <Ionicons name={iconName} size={size} color={color}/>;
        },
        tabBarActiveTintColor: 'blue',
        tabBarInactiveTintColor: 'gray',
      })
    >
    <Tab.Screen name="Game" component={GameScreen} options={{title: t.gameTab}}/>
    <Tab.Screen name="Search" component={SearchScreen} options={{title: t.searchTab}}/>
    <Tab.Screen name="Dictionary" component={DictionaryScreen} options={{title: t.dictionaryTab}}/>
  </Tab.Navigator>
);
};
```

Figure 1. Navigation component

2.1.3 Game Screen

This screen (**Figure 2**) hosts quiz-related functionality.

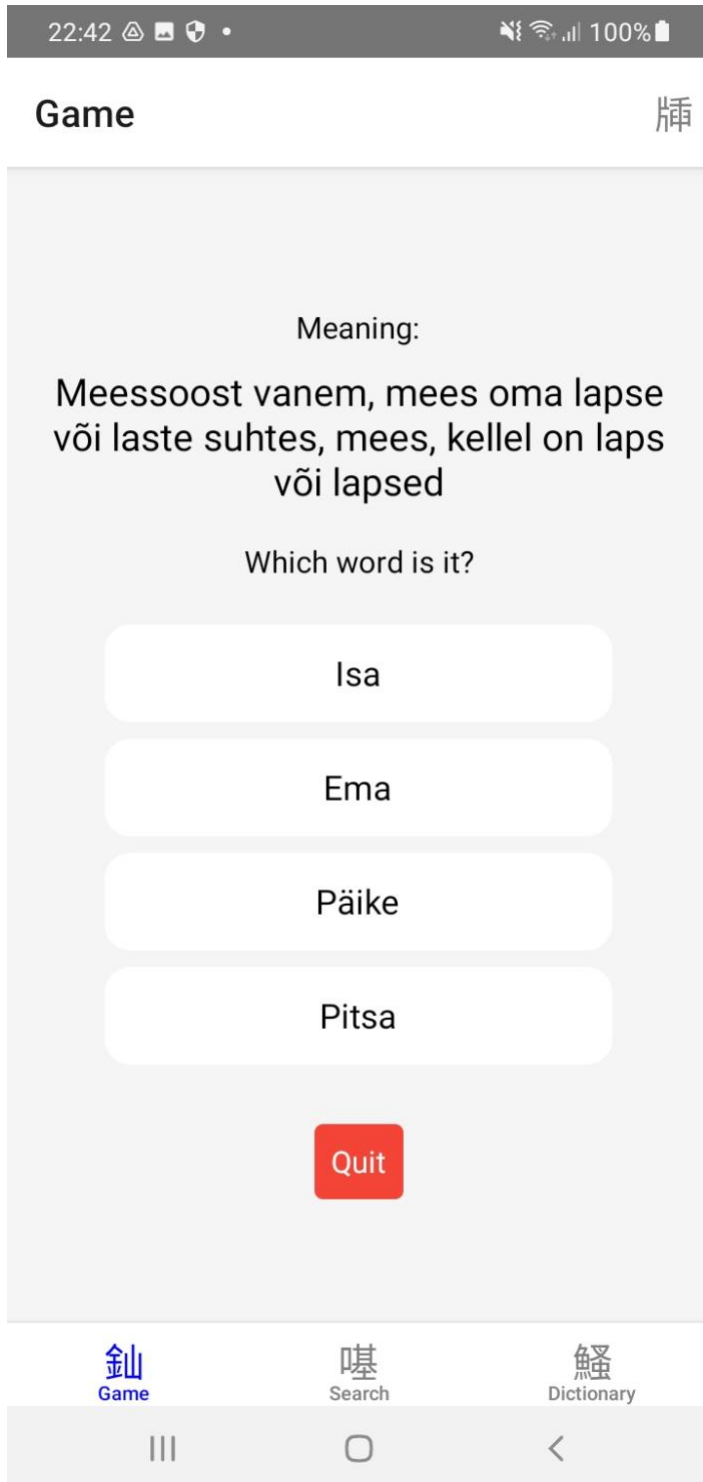


Figure 2. Game Screen

2.1.4 Search Screen

This screen (**Figure 3**) integrates SONAPI for advanced lookup features (e.g., morphological forms, synonyms).

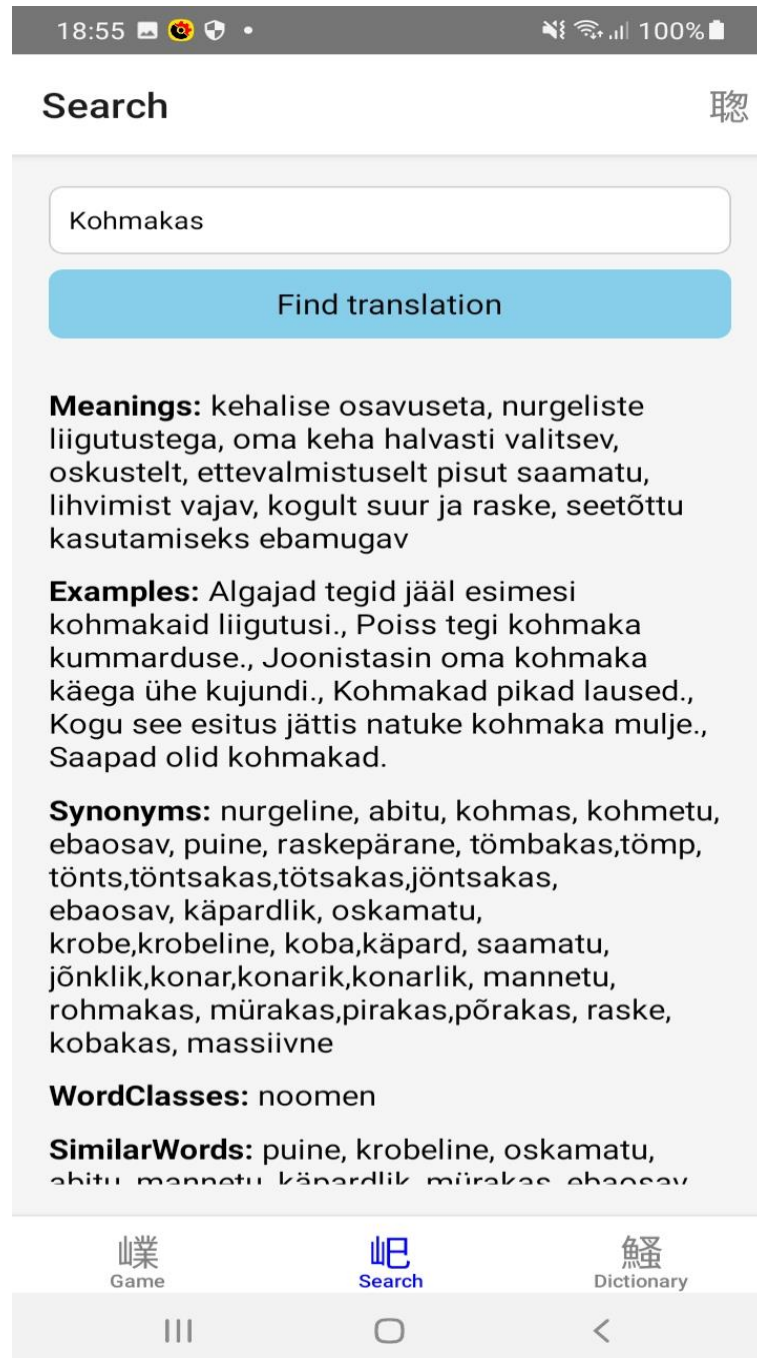


Figure 3. Search Screen

2.1.5 Dictionary Screen

This screen displays the user's saved words, with sorting options, and also allows user to view information about saved words and remove them from the dictionary (**Figure 4**).

This setup keeps concerns neatly separated: each screen focuses on its own functionality, while the tab navigator orchestrates how users move between different parts of the app.

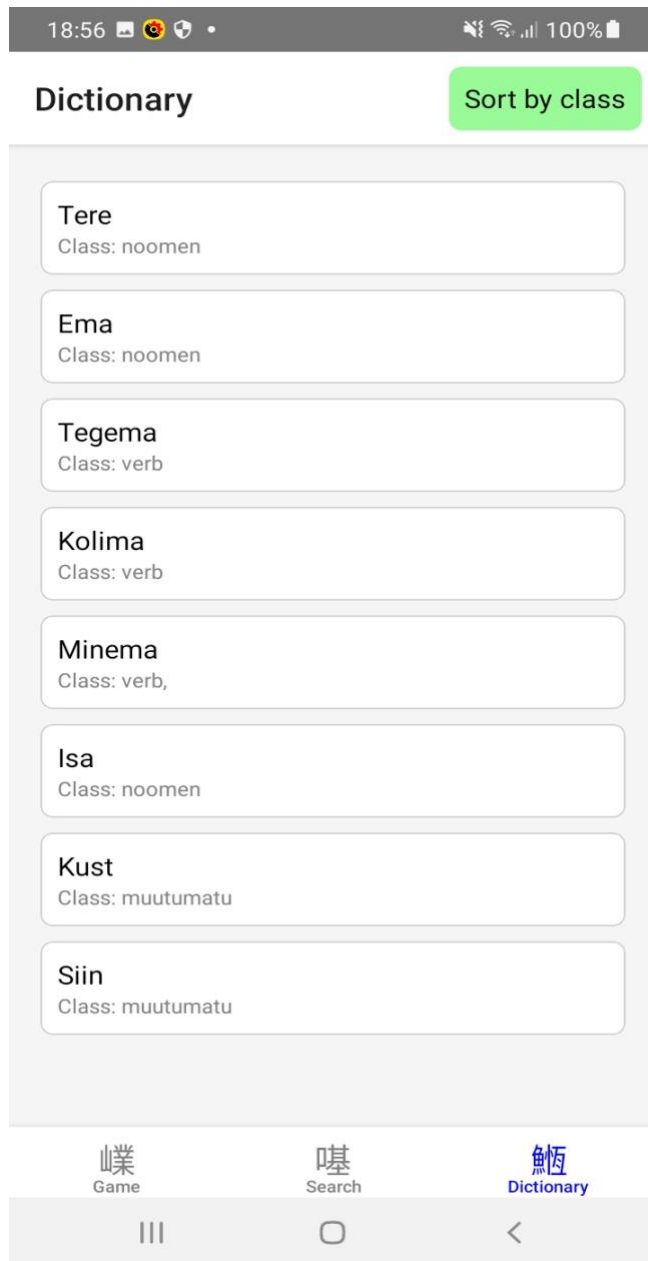


Figure 4. Dictionary Screen

2.2 User Interface and Experience Design

2.2.1 Usability Considerations

The design of TestiMind places a strong emphasis on **intuitive navigation** and **accessibility**.

Major usability points include:

1. Bottom Tab Navigation

- Offers straightforward access to primary screens, reducing the learning curve.
- Icons and labels clarify each tab's purpose at a glance.

2. Information Display

- Presents word details, morphological variants, and translations in a clear, organized manner.
- Consistent formatting across the app ensures familiarity.

3. Game Interaction

- Immediate feedback on correct or incorrect answers fosters a sense of progress.
- Dynamic question types maintain user engagement.

4. Accessibility

- High-contrast color schemes and chosen text sizes help accommodate various visual needs.
- Buttons and interactive elements use ample spacing for easy touch interaction on mobile devices.

2.2.2 Visual and Functional Design

Visually, TestiMind adopts a **clean, modern aesthetic** aligned with current mobile app design standards:

1. Consistent Styling

- A neutral palette coupled with accent colors for highlights (e.g., correct/incorrect answers, notifications).

- Typography that balances readability with aesthetics (e.g., sans-serif fonts, clear headings).

2. Feedback & Animations

- Smooth transitions between tabs and subtle animations when answering quiz questions.

3. Interactive Elements

- Tappable cards for dictionary entries, revealing detailed word information on selection.

2.3 Game Development

2.3.1 Vocabulary Expansion

The **GameScreen** module is designed to turn words by user into engaging and educational practice sessions. The primary goal is to enhance vocabulary retention through repetitive exposure to words in a gamified context. The game leverages saved words stored locally via `AsyncStorage`, alongside predefined distractor words, to create randomized quizzes.

The gameplay loop follows these steps:

1. The game begins by selecting a random word from the user's saved list as the correct answer.
2. Distractors (incorrect options) are chosen from predefined or saved words with matching word classes (e.g., nouns or verbs). This ensures that options appear plausible and challenge the user.
3. The player selects the correct word based on the displayed definition. Immediate feedback is provided, highlighting correct and incorrect answers.

2.3.2 Randomization and Game Logic

The game logic is designed to provide variety and maintain engagement throughout each session. Key features include:

1. **Class-Based Grouping.** Words are grouped by their grammatical classes (e.g., noun, verb) using SONAPI metadata. Only distractors of the same class as the correct answer are included, enhancing plausibility and difficulty.
2. **Balanced Distractors.** Distractors are randomly selected from a predefined pool of words, ensuring enough variation without overwhelming the player. Randomization algorithms also shuffle the answer options for every question.
3. **Session-Based Progress.** After every session, user performance is recorded, including metrics such as:
 - Total score
 - Number of attempts
 - Accuracy percentage
 - Total time spent

This data is saved using AsyncStorage and is later displayed on the **Statistics Screen** (Figure 9).

2.3.3 Game Flow and Screens

The game progresses through three main stages:

1. Start Screen (**Figure 5**)
 - Users are welcomed with the option to begin a new game. If no saved words are available, an error message prompts users to add words before starting.
2. Question Screen
 - A definition is displayed at the top, and users select one of four options. Words are highlighted in green (correct)(**Figure 6**) or red (incorrect)(**Figure 7**) after submission, providing immediate feedback.
3. End Screen (**Figure 8**)
 - After all words are attempted, the end screen displays user performance statistics, including accuracy and total time spent.

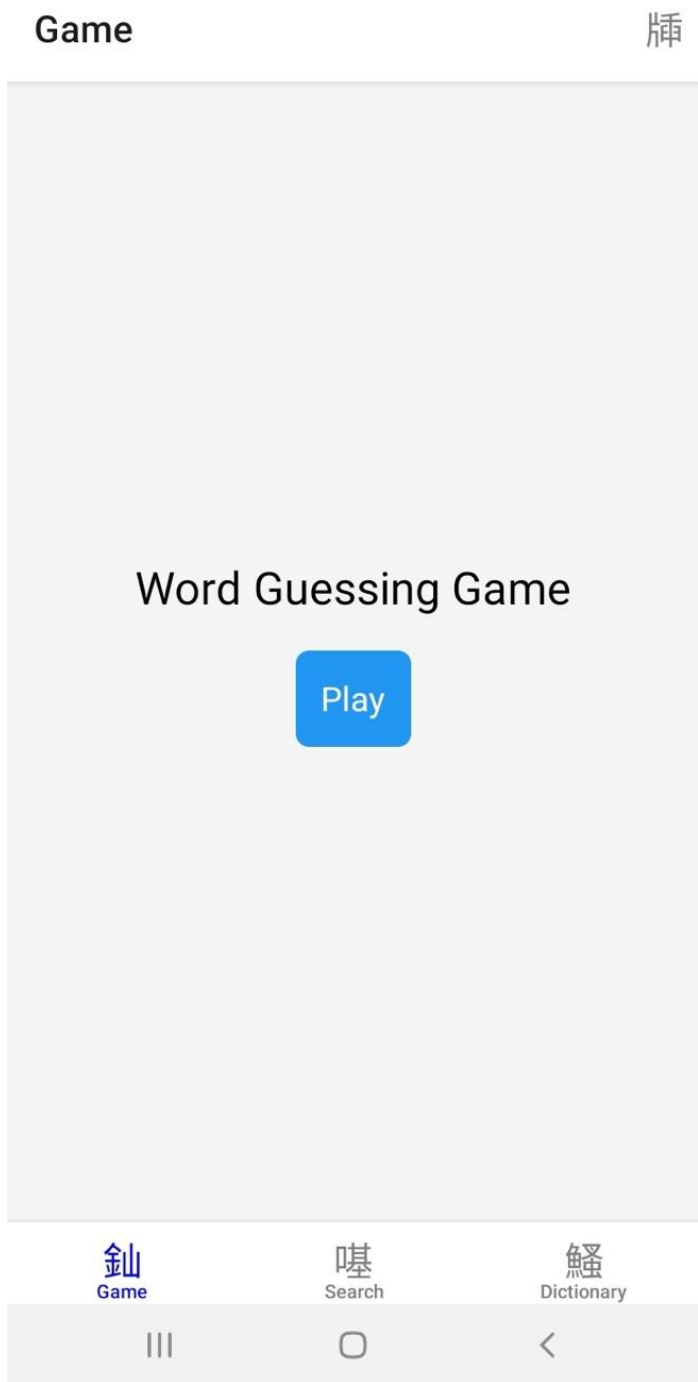


Figure 5. Game Start Screen



Figure 6. Game True Screen

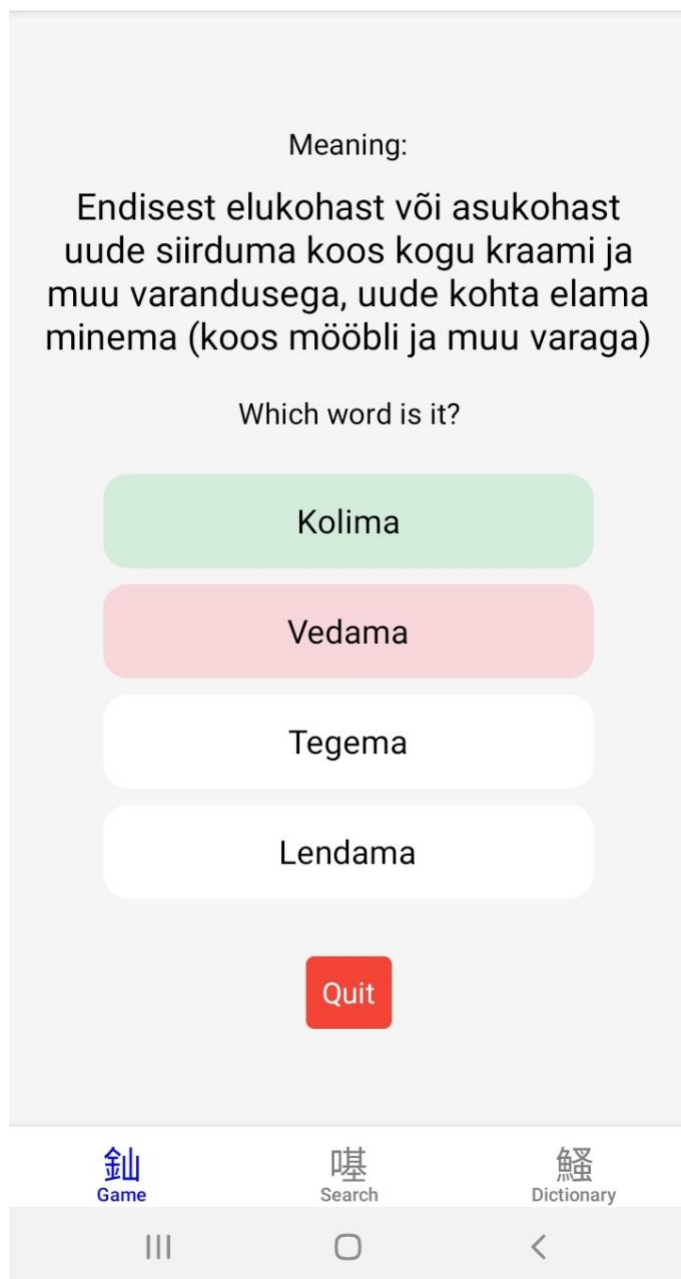


Figure 7. Game False Screen

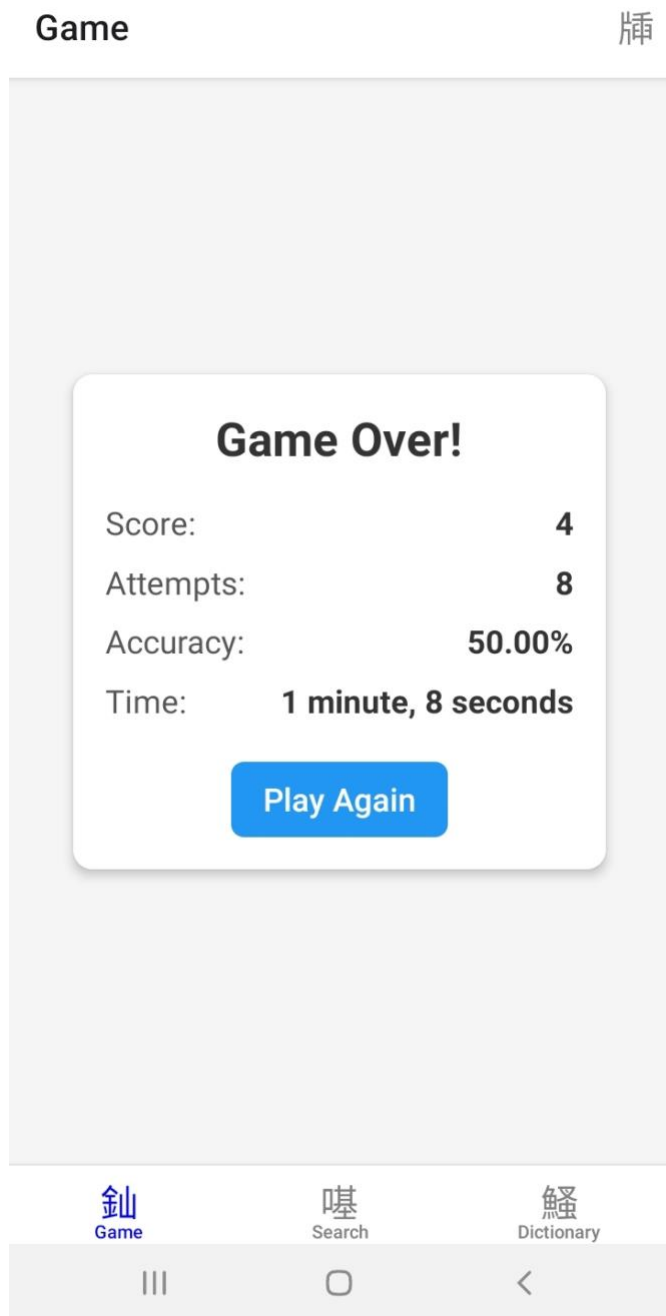


Figure 8. Game End Screen

2.4 Challenges and Solutions

The development of the game module presented several technical and design challenges, each of which was addressed with specific solutions.

2.4.1 Word Classification

Challenge: Ensuring accurate word groupings for distractor generation. Mismatched distractors could confuse players and diminish learning effectiveness.

Solution: By leveraging SONAPI's detailed morphological data, words are filtered by grammatical class (e.g., nouns, verbs) before being used as distractors. This guarantees logical and contextually appropriate options.

2.4.2 Performance Optimization

Challenge: Efficiently managing large datasets of saved and predefined words, especially with real-time filtering and shuffling.

Solution: Pre-cached saved words and reduced redundant computations through optimized data structures. Only the required subset of data is fetched and processed during each game session.

2.4.3 Handling Homonyms

Challenge: The Estonian language contains many words that are spelled identically but have different meanings based on context. This could confuse users during searches or vocabulary selection.

Solution: When searching for a word, the app presents possible variations of that word based on SONAPI data. Users can review the definitions and select the appropriate version to save in their personal dictionary. This approach ensures clarity and allows learners to focus on the most relevant meaning for their learning goals.

2.4.4 User Engagement

Challenge: Sustaining user interest and motivation over time while ensuring consistent interaction with the app.

Solution: Implemented real-time feedback during quizzes, such as color-coded responses for correct and incorrect answers. Designed the Statistics Screen (**Figure 9**) to present clear and engaging performance metrics, encouraging users to track progress and maintain regular engagement.

Game Statistics

Date: 1/1/2025, 5:30:40 PM
Score: 10
Attempts: 10
Accuracy: 100.00%
Time: 2 minutes, 13 seconds

Delete

Date: 1/1/2025, 5:21:05 PM
Score: 7
Attempts: 9
Accuracy: 77.78%
Time: 1 minute, 22 seconds

Delete

Date: 1/1/2025, 5:03:09 PM
Score: 7
Attempts: 9
Accuracy: 77.78%
Time: 1 minute, 46 seconds

Delete

Figure 9 Statistics Screen

2.4.5 Summary

The GameScreen successfully combines robust randomization, contextual distractor generation, and real-time feedback to create a challenging yet enjoyable vocabulary-building experience. The integration of accurate word grouping, handling of homonyms, and user performance tracking ensures that the module is both educational and engaging. By focusing

on these elements, the TestiMind application delivers a well-rounded approach to vocabulary practice for Estonian language learners.

2.5 Future Development

The **TestiMind application** has great potential for further enhancement to provide a richer and more engaging learning experience. Key areas for future development include:

2.5.1 Enhanced Game Modes

New Game Mode: Introduce a mode where users play with entirely **new words** rather than those saved in their dictionary, with an option to add the newly encountered words to their personal vocabulary.

Dynamic Difficulty: Expand gameplay with adjustable difficulty levels, catering to beginners and advanced learners alike.

Time-Based Challenges: Higher difficulty levels will include a timer, which can function either as a countdown for the entire game session (e.g., answering as many questions as possible within two minutes) or a per-question limit (e.g., 5–10 seconds to respond before moving to the next question). Failure to answer within the time frame will result in a penalty, adding an element of urgency and testing quick recall abilities.

2.5.2 Daily Streaks and Engagement

Daily Streak System: Track consecutive learning days and send **push notifications** to remind users to practice. Rewards like badges or score multipliers will encourage consistency.

2.5.3 Advanced Progress Tracking

Improved Statistics: Enhance the existing Statistics Screen with detailed user progress visualizations, including word mastery rates and learning activity trends, giving actionable insights into areas for improvement.

2.5.4 Expanded Features

Speech Recognition: Introduce pronunciation practice with real-time feedback, enabling learners to refine their speaking skills.

2.5.5 Summary

By adding these features, TestiMind will deliver a more personalized and interactive learning experience, ensuring long-term engagement and better language retention. With its modular architecture, the app is well-positioned to integrate these enhancements seamlessly.

CONCLUSION

The TestiMind application set out to create an advanced platform for learning Estonian vocabulary through gamified features, seamless data management, and cross-platform accessibility. Over the course of its development, the project achieved its primary goals by integrating SONAPI for linguistic data, implementing an engaging quiz system, and providing users with personalized features such as a searchable dictionary and performance-tracking statistics.

During the development process, unexpected challenges arose, such as ensuring accurate word classification for quiz distractors and optimizing performance for large datasets. These obstacles were addressed by leveraging robust APIs, caching strategies, and randomization algorithms.

The application delivers a polished, modern interface, efficient offline capabilities through AsyncStorage, and a rich feature set that appeals to both intermediate and advanced learners.

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