Adaptive Language Learning with AI-assisted Conversational Agents

Software Requirements - MVP

Contents

Introduction

Purpose

This project will prototype a conversational English language practice application for mobile devices with a group learning scenario. The application will be developed by a student team under the guidance of Professor Tobias Thelen and will be tested in cooperation with groups of English students in public or private educational institutions.

Document Conventions

Abbreviation or Naming Convention	Meaning
SRS	Software Requirements Specification
AI	Artificial Intelligence
CEFR	Common European Framework of Reference

Project Scope

The application is supposed to only provide the framework for a group learning scenario. This means, that while the application might provide tasks that are solved by the user, the actual learning is happening in users' interaction. This interaction is moderated and guided by a conversational agent with NLP support.

References

https://www.w3.org/TR/WCAG21/

https://ec.europa.eu/info/law/law-topic/data-protection/reform/rules-business-and-organisations_en

Market Gap Analysis

Problem

As our study project we wanted to develop a language learning application with AI features, mainly for mobile devices. As there are numerous mobile language learning solutions already available, we needed to identify the possible market gap in order to deliver an application that would complement the existing learning scenarios rather than compete with them.
After discovering the market gap, we created a design proposal that does not overlap significantly with the designs available in the market.

Methodology

While developing the design proposal, we did the following:
First, we gathered information on the most popular AI-assisted language learning apps. To do that, we studied the market analysis paper written in Professor Thelen's "Artificial Intelligence in Education" course.
Then we brainstormed to find the unique learning feature that was not offered anywhere else. The resulting idea was a group learning application.
After that, we listed the AI functionality implemented in the analyzed learning scenarios to see what could be adapted for our purposes.
The final proposal was a language learning application with adaptive AI features that would facilitate cooperative/competitive learning.

Existing Solutions and Gap

These are the apps examined while identifying the market gap in regard to their group functionality and AI methods used:

App name	Group functionality	AI feature
Andy English	-	chatbot
Babbel	-	speech recognition with feedback, personalized learning

Busuu	peer review, community feedback	speech recognition, personalized learning
Duolingo	leaderboard	personalized learning
Flash Academy	leaderboard	speech recognition with feedback, personalized learning
HelloTalk	comments, feed and peer review for posts and messages	grammar checker
Lingvist	-	speech recognition, personalized learning
Mango Languages	-	personalized learning
Memrise	leaderboard	personalized learning
Mondly	leaderboard	augmented reality, chatbot, speech recognition with feedback
MosaLingua	-	personalized learning
Rocket Languages	leaderboard	speech recognition
Rosetta Stone	-	speech recognition with feedback
Speakly	-	personalized learning
SuperMemo	-	speech recognition with feedback, personalized learning
WordDive	-	speech recognition, personalized learning
Xeropan	leaderboard	chatbot, speech recognition
50+ Sprachen lernen mit Master Ling	-	chatbot
Tandem	language exchange	-
AnkiApp	sharing	-

	learning material	

Results

The results showed that language learning applications mostly integrate AI features in speech recognition, as chatbots, as personalization tool or for augmented reality. Most features are, however, not core functions, but rather add-ons to the apps.
Furthermore, we discovered that the same holds for all sorts of group functionality. Most of the group functionality is implemented either in the form of a leaderboard or only provides limited exchange opportunities for the learning community. Some apps offered a form of language exchange, where the learning happened through communication with others, for example, through correcting mistakes.
So, the research discovered a major gap in group language learning apps.

Conclusions

Finally, it was considered whether the identified gap could plausibly be filled with a new app and who were the new solution’s target audience.

While learning a language from scratch requires professional guidance and knowledge exchange with those at the same level brings very limited to no benefits, getting to use the target language and exchange experiences is quite promising for learners who have not yet mastered the language, but already have a certain experience.
Intermediate-level students also gain a lot from group work.
Some benefits of group learning are the following:

- Increased motivation (working together over a common task boosts productivity)
- Real communication practice
- Opportunities for competition/cooperation in the game format
- Learning from others’ mistakes
- Increased responsibility from feeling social pressure

In real-life language courses, once the students gather basic knowledge, many prefer to continue in a group. Therefore, a group learning scenario seems most attractive for continuing learners.
What concerns the learning approach, the analyzed apps offer gamified learning activities. This seems to be an established and effective concept for learning apps that should be adapted in the new scenario discussed here.
Out of the reviewed AI functionality, the chatbot could fit the best into the proposed concept. This would complement the group learning scenario by taking moderator role and walking the learners through the offered activities, offering hints, etc.

Functional Description

Product Perspective

The application is a new, self-contained product, which will implement a conversational chatbot learning scenario for English practice in a virtual group setting. The goal of the application is to improve reading and writing skills, while learning the fundamentals of efficient communication through short, task-oriented discussions in the target language.

Product Features

Users will practice English reading and writing fluency in gamified group tasks. Groups of four users will engage in a discussion to complete language-oriented tasks, such as error correction. The application will provide corrective feedback and adapt to user performance according to a task difficulty model. To provide additional motivation and a sense of progress, the tasks will be organized according to an 'Escape Room' narrative frame, which will pose each task as necessary to escape from an overarching captivity narrative.

User Classes and Characteristics

The main target user class are high school students who do English at school and wish to further improve in an informal setting.

We specifically target users within this demographic with intermediate-level knowledge or a B1-B2 CEFR competency in English. This decision was made to ensure the ability to communicate and understand basic instructions. It is also assumed that learners at this level already know basic communication patterns, but would benefit from additional practice.

A target user is comfortable using Telegram or other chat applications. They should have access to a mobile device or a computer and internet connection.

User Interfaces

The application will be implemented via the Telegram API and thus users will interface with the learning scenario via the Telegram messaging application front-end. All interactions will take place within the setting of a messaging application and must primarily utilize text with support of some additional media. Users will input responses and communicate with other users via an onscreen keyboard with potential for additional interactions such as contextual buttons.

Constraints

1. No optional fonts/font colors/ font sizes
2. Limited design options
3. Fixed button style
4. Fixed button position

Summary of Display Options

1. Text
2. Image
3. Buttons inside the chat
4. Pop-up menu
5. Polls/Quizzes
6. Audio
7. Video

Text Formatting

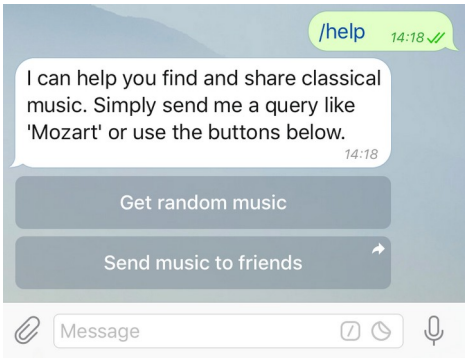
To separate the bot messages from the user messages and make them visually prominent and distinguishable, we will format the bot messages in a certain style using emoticons or non-alphanumeric characters.

Images

Images will be used to enhance the presence of the narrative and introduce the bot persona. We will include setting-appropriate imagery upon the introduction of a new task in order to establish the setting and punctuate the potentially monotonous stream of text. Emoji characters will be used to lighten the bot persona and generate target user appeal.

Buttons

Contextual buttons will be used to accelerate user response times when the interaction is irrelevant to language understanding, and also to limit user responses. Within the Telegram API it is possible to send contextual keyboards to different users, thereby limiting responses and affecting group dynamics.



Accessibility

In further steps we may consider adapting the app for people with visual/auditory impairments. Further information here: https://www.w3.org/TR/WCAG21/

Didactic Model and Theoretical Background

The general application learning scenario adapts the communicative approach, which is an approach to language teaching emphasizing authentic communication scenarios as the ultimate study goal. As groups of users are guided through various tasks, they are encouraged to organically negotiate and solve the challenges presented to them. This also makes the learning scenario input-oriented, i.e. the users are required to produce content rather than consume it. Closer interaction with material usually leads to better learning results.

AI Implementation

The application employs methods of artificial intelligence at multiple instances. First, the chatbot itself can be considered an AI feature, as it is able to react to messages the user send dynamically. The chatbot's primary task is to guide the user through the task by managing group creation and turn taking, giving instructions to the users and analyzing the user response correctness.

Other possible AI implementations for the future include:
- group matching algorithm to match groups with the same proficiency level together,
- automatic task content production, for example, sentence/mistake generation.

Example Task - Collaborative Error Correction

Narrative

The group is locked in a room and needs a password to move on to the next level. To prove that they are humans the group has to spot errors in sentences. They get a letter of the password if they complete several sentence tasks without mistakes.

Exercise

The first task will integrate a systematic repetition learning scenario in the communicative environment, encouraging users to collaborate while correcting grammar mistakes. In turns each user will be presented with a sentence which may contain an error, and the group's task is to discuss the sentence and if needed prove its correctness or incorrectness to the currently assigned user, and guide them to correcting the error. After several correct turns, the group completes the task.
Users will receive sentences via chat interface and nominated users will submit their responses via contextual keyboards. The group chat will be open for discussion on the current sentence. Sentences are gathered from a corpus of remedial English and selected according to an error set deemed appropriate to

the target user group. The bot will provide feedback to incorrect submissions, and adjust future trials according to group performance.
Difficulty is modeled at the sentence-level and associated with user proficiency values for the class of error for which a sentence is labeled. Each user's error-type proficiency value contributes to a group average which determines the baseline difficulty of presented sentences. Group performance on a task will update group proficiency values as a partial of a full update given to the nominated individual's update.

Task flow

We designed a task flow for the sentence correction task that provides an overview of the possible scenarios for the task.

1. Task initiated.
2. One randomly selected user is provided a sentence via his/her keyboard.
3. The selected user shares this sentence to the group, thereby revealing the 'correct' and 'incorrect' keyboard buttons on the selected user's keyboard.
4. The group discusses if the sentence is correct or not. Then the selected user chooses correct/incorrect based on the group consensus.
5. If chooses correct
    a) If succeed
        i. Advance to the next randomly selected user.
    b) If fail
        i. Bot informs the group of the error. They receive a (timed) opportunity to correct the mistake.
            1. If succeed
                a) Advance to the next randomly selected user
            2. If fail
                a) Group punished. Advance to the next user.
6. If chooses incorrect

a) If succeed

    i. Selected user provided with a means of identifying and correcting the error. Eg: select the false word and repair it.

        1. If succeed a. Advance to the next user.

        2. If fail

            a) Bot informs the group of the error. They receive a (timed) opportunity to correct the mistake.

                i. If succeed

                    1. Advance.

                ii. If fail

                    1. Group punished. Advance.

b) If fail

    i. Group punished. (The sentence is logically correct)

    ii. Advance to the next randomly selected user.

7. Repeat until all users have had a 'turn'.

8. Open questions

    a) Return to the beginning of a 'round' if a single trial fails? In other words, the group gets a piece of the clue after getting four correct trials in a row?

    b) Introduce a time constraint?

Nonfunctional Requirements

Performance Requirements

The application should not induce a request delay greater than 2-3 seconds as this will compound to hamper the conversation flow. The application should distinguish between orthographic mistakes and language understanding mistakes so that users are not demotivated by typos.

Security Requirements

Privacy

Data collection, processing, usage, and storage should comply with the General Data Protection Regulation (GDPR) of the EU. Among other aspects this means that users need to consent to the use of their data prior to using the product. Only data relevant for the correct functioning of the product should be collected and stored and the user should have the possibility to access the data stored about them and request its deletion if they wish to stop using the product. For more information see:

https://ec.europa.eu/info/law/law-topic/data-protection/reform/rules-business-and-organisations_en

Security

User authentication is in the context of a chatbot for a messenger platform already provided by the platform. User accounts are generally tied to a telephone number. No additional authentication will be necessary in this context.

Depending on how the groups in which users interact are constructed (i.e. friends vs. strangers) it could be beneficial to remind users of general security concerns and appropriate online behavior such as they should not share any sensitive information about themselves with other users etc.

Please provide feedback based on the following questions:

-What is your general opinion of the discussed learning scenario and its viability?

-What are the strong sides of the discussed learning scenario?

-What points of the discussed learning scenario may require further improvement?