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**КВАЛІФІКАЦІЙНА РОБОТА**

**(ПОЯСНЮВАЛЬНА ЗАПИСКА)**

**ВИПУСНИКА ОСВІТНЬОГО СТУПЕНЯ**

**“БАКАЛАВР”**

**Тема:** “Вебзастосунок для мовно-

культурного обміну студентів

англомовної групи”

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# Introduction

## Background and Motivation

In the era of globalization, English has firmly established its importance as a universal language for communication and learning. With over 1.5 billion speakers worldwide, it has become the linguistic thread connecting different cultures, industries, and academic disciplines. Therefore, a competent knowledge of English language can be a significant advantage, opening doors to numerous opportunities and fostering international understanding.

However, for non-native English speakers, mastering English can be a challenging process. It necessitates not only a clear grasp of vocabulary and grammar but also a deep understanding of the cultural nuances and conversational contexts. In a diverse group of learners, such as an English group where individuals from different linguistic backgrounds come together, effective communication becomes even more critical. The challenges associated with learning and communication in English can be manifold, including difficulty understanding complex grammatical structures, problems with pronunciation, and struggles with cultural references and idioms.

These challenges were exacerbated by the onset of the global pandemic that forced educational institutions worldwide to adopt remote learning methodologies. The shift to virtual education resulted in reduced interpersonal communication and collaborative learning opportunities for students. This lack of face-to-face interaction led to an environment that was not conducive to breaking language barriers and understanding the cultural subtleties of English. The interaction, which plays a key role in language acquisition and practice, was significantly hampered, leading to further obstacles in effective communication and collaboration amongst groupmates.

These circumstances led to the motivation for developing a solution to aid in these challenges – a web application aimed at facilitating language learning and cultural exchange amongst English group students. This application endeavors to offer a comprehensive platform, combining elements of communication and gamified learning features. The goal is to create an immersive, engaging, and collaborative environment where learners can practice and improve their English language skills while also experiencing cultural nuances and subtleties. Through this initiative, we aim to bridge the communication gap and promote effective collaboration and learning amongst students, regardless of their geographic location or their proficiency level in English.

## Statement of the problem

Learning a new language, particularly English, with its idiosyncrasies and cultural nuances, can be a daunting task for non-native speakers. Despite a plethora of language learning resources available, there still exists a considerable gap in the provision of platforms that effectively cater to the need for real-time communication, collaborative learning, and cultural understanding. This gap becomes even more glaring in a remote learning scenario which has been a primary mode of education due to the ongoing global pandemic.

The problems that non-native English speakers face are multifaceted. Primarily, traditional language learning resources often focus on individual learning, neglecting the benefits of group-based learning and real-time communication. Language learning is not just about mastering grammar rules and expanding vocabulary; it also involves practical application and cultural understanding. Consequently, learners often struggle to communicate effectively in English-speaking groups due to a lack of conversational practice and exposure to cultural nuances.

The transition to remote learning has further complicated the situation. Despite its many benefits, such as flexibility and accessibility, remote learning has introduced new challenges. Students often face difficulties maintaining the same level of engagement they would have in physical classrooms. The lack of face-to-face interaction makes it harder for learners to practice spoken English and understand the language's cultural aspects. Additionally, traditional language learning tools are not ideally equipped to foster collaboration and community building, crucial aspects of learning, particularly in a remote setup.

These issues underline the need for a comprehensive solution that goes beyond conventional language learning resources. An application that fosters real-time communication, facilitates collaborative learning, and provides a platform for cultural exchange could significantly enhance the English learning process for non-native speakers, especially in a remote learning context. Furthermore, it is critical that this solution is engaging, user-friendly, and tailored to the diverse needs and proficiency levels of the learners.

## Purpose of the study

The primary objective of this study is to design and implement a web-based application that addresses the previously identified challenges faced by non-native English speakers in learning and communication, particularly in the context of remote education. This application aims to create an interactive and collaborative learning environment where users can not only learn the English language but also understand and appreciate its associated cultural nuances.

The application will provide an array of features to facilitate effective communication and collaborative learning. These features include chat rooms for real-time communication, forums for discussion on various topics, and dedicated sections for sharing and understanding cultural aspects of the English language. Furthermore, to make the learning process more engaging and enjoyable, the application will incorporate gamified learning modules. These might include mini-games that help improve language skills, daily challenges on vocabulary and grammar, and quizzes based on cultural understanding.

To facilitate continuous learning and improvement, the application will also incorporate a feature for providing feedback on users' language skills and progress. This feedback system will be based on peer-review and automated language evaluation algorithms.

By providing an all-in-one platform for communication, collaborative learning, cultural exchange, and gamified language learning, this application aims to enrich the English learning journey for non-native speakers. By ensuring real-time interaction and collaborative learning, it also seeks to make remote education more engaging and effective. Ultimately, this study aims to contribute to the broader goal of breaking down language barriers, promoting international understanding, and fostering a global community of learners.

## Significance of the study

This study holds significant importance in multiple facets of language learning and education. It strives to bridge the gap in the current landscape of language learning tools, particularly for non-native English speakers navigating the challenges of remote education.

Firstly, the proposed application takes a holistic approach to language learning, merging traditional techniques with the social, collaborative aspects of language acquisition. By incorporating real-time communication and collaborative learning features, the application aims to mimic the natural language learning environment, often lacking in current digital learning platforms.

Secondly, the study recognizes the critical role of cultural understanding in language learning. By integrating cultural exchange into the application, it encourages learners to engage with the cultural aspects of the English language, fostering a more profound and comprehensive understanding of the language.

Furthermore, the gamified aspects of the application introduce an innovative approach to language learning, making it more engaging and motivating. Such a method can potentially enhance learners' retention and understanding of language elements, leading to improved communication skills.

The development of this application could also contribute to the broader field of educational technology. By demonstrating the potential of digital platforms in fostering interactive and collaborative learning, this study could inspire further innovations and advancements in this field.

Lastly, by addressing the challenges posed by the pandemic and the shift to remote education, this study provides a timely contribution to current educational needs. It provides a possible solution that enhances the remote learning experience, not just for language learning but potentially for other subjects and fields as well. Thus, this research can influence future strategies and methodologies in remote education.

## Research questions

This study aims to answer the following research questions:

* How does the language barrier impact collaboration and communication among students in English language groups, particularly in a remote learning environment?
* How can technology be leveraged to help non-native English speakers improve their language skills while also fostering better communication and collaboration?
* What are the benefits and challenges of incorporating real-time communication and gamification into a web application aimed at language and cultural exchange among English language group students?
* How does ASP.NET Core, SQL Server, Angular, and SignalR contribute to the development of an effective and interactive language learning application?
* What are the user feedback and performance results of the developed application and how do they inform possible future improvements?

These questions will guide the research and development process, providing a clear direction for the design and implementation of the application.

# Literature review

## Current language learning techniques

Learning a language, especially one as globally prevalent as English, is a multifaceted process. Over the years, numerous techniques and tools have been developed to facilitate this process. In this section, we review the current methods utilized in English language learning.

Traditionally, language learning has relied heavily on classroom-based teaching. This approach employs a mixture of techniques such as grammar translation, the direct method, and the audio-lingual method, which emphasize the rules of the language, direct association without translation, and pattern drills, respectively (Richards & Rodgers, 2014). Despite the benefits, these traditional methods are often criticized for their lack of context and real-world application.

In contrast, communicative language teaching (CLT) focuses on meaningful communication and real-world tasks to teach language. CLT stresses the importance of interaction as both the means and the ultimate goal of learning a language (Nunan, 2014). This method facilitates the development of linguistic fluency rather than just accuracy, creating more well-rounded learners.

In recent years, the advent of technology has given rise to numerous digital language learning tools. Computer-Assisted Language Learning (CALL) uses computers and multimedia resources to enhance language teaching and learning. The benefits of CALL include interactivity, instant feedback, and a wealth of resources catering to diverse learning styles (Beatty, 2013).

Moreover, language learning apps such as Duolingo, Babbel, and Rosetta Stone have become increasingly popular. These apps use a mixture of methods such as spaced repetition, gamification, and immersion to make language learning more engaging and effective (Godwin-Jones, 2014).

Despite their popularity, these digital tools often focus on individual learning, neglecting the communicative and social aspects of language learning. Additionally, while they can help learners acquire vocabulary and understand grammar rules, they often fall short in teaching the cultural nuances of language.

In summary, while traditional and digital language learning techniques have their merits, there seems to be a gap in integrating these methods into a comprehensive, socially interactive, and culturally inclusive language learning tool. The next section will further explore the role of online platforms and tools in language learning and their limitations.

| **Technique** | **Description** | **Pros** | **Cons** |
| --- | --- | --- | --- |
| Grammar Translation | Focuses on the grammatical rules of the language, usually involving translation between the target language and the native language | Helps students understand the structural complexities of the language | Lacks context and real-world application; Not conducive for improving speaking and listening skills |
| Direct Method | Teaches the language directly without using the learner's native language; emphasis on everyday vocabulary and grammar | Provides a more immersive learning experience | Might be challenging for beginners as there's no translation involved |
| Audio-Lingual Method | Focuses on pattern drills and repeated practice of dialogues and phrases | Useful for improving pronunciation and fluency | Can become monotonous and boring; lacks focus on meaningful communication |
| Communicative Language Teaching (CLT) | Emphasizes interaction and real-world communication skills | Promotes fluency and understanding of language in context | Might neglect the importance of accurate grammar |
| Computer-Assisted Language Learning (CALL) | Uses computers and multimedia resources to assist language learning | Offers interactivity and instant feedback; caters to diverse learning styles | Often lacks the social aspect of language learning |
| Language Learning Apps (e.g., Duolingo, Babbel, Rosetta Stone) | Use gamification, spaced repetition, and other methods to teach language | Makes learning engaging and fun; allows learning at one's own pace | Often fails to cover the cultural aspects of language; lacks real-world communication practice |

## The role of technology in language learning

In the past few decades, technology has transformed the field of language learning. The advent of the Internet, mobile devices, and software applications has enabled learners to access language learning resources at any time, from anywhere in the world. This section of the study will explore the various roles that technology plays in language learning, emphasizing its advantages and potential drawbacks.

Access to Resources: Technology provides learners with a wealth of resources for language learning, including online dictionaries, grammar guides, and language learning websites and apps. There are also online language communities where learners can interact with native speakers and other learners.

* Interactivity and Engagement: Interactive software and applications can engage learners in a way that traditional textbooks cannot. This can include multimedia content, quizzes, games, and virtual reality experiences that make learning more interesting and fun.
* Personalization: Technology allows for personalized learning experiences. Learners can work at their own pace, focus on their areas of interest, and choose the learning methods that suit them best.
* Real-Time Feedback: Many language learning apps offer immediate feedback, allowing learners to correct their mistakes in real time. This can accelerate the learning process and increase learner confidence.
* Language Practice: Technology offers learners the opportunity to practice their language skills in realistic contexts. For example, they can participate in online discussions, listen to podcasts in the target language, or use language exchange apps to communicate with native speakers.

## Online learning platforms and tools

With the evolution of technology, various online platforms and tools have been developed to facilitate language learning. These platforms leverage digital technology to offer accessible, flexible, and diverse language learning experiences.

Popular language learning platforms like Duolingo, Babbel, and Rosetta Stone have revolutionized self-paced language learning. Duolingo, for instance, employs gamified lessons to engage learners and make the learning process fun. It offers immediate feedback, allowing learners to identify and rectify their mistakes promptly. Babbel focuses on conversational skills and provides lessons developed by language experts. Rosetta Stone uses an immersive approach, teaching languages through images, intuition, interactivity, and instruction in the target language (Chapelle, 2019).

Another category of online platforms are language exchange platforms such as Tandem and HelloTalk. These platforms connect learners from different parts of the world to facilitate language exchange. They allow learners to practice the target language with native speakers through text, voice, or video chat.

In the realm of formal education, Learning Management Systems (LMS) such as Canvas, Blackboard, and Moodle are used widely. They offer a range of features such as course management, assessment tools, forums for discussion, and resources for self-study.

While these online tools have brought significant advancements in language learning, they also have their limitations. Language learning apps often lack sufficient opportunities for real-world, spontaneous conversation. Language exchange platforms, while offering conversational practice, often lack structured learning. LMS, although comprehensive, may lack the interactive and engaging features of language-specific platforms.

Below is a table providing an overview of the aforementioned platforms:

| **Platform** | **Description** | **Pros** | **Cons** |
| --- | --- | --- | --- |
| Duolingo | Gamified language learning app | Engaging and fun; Immediate feedback | May lack depth in grammar and culture aspects |
| Babbel | Language learning app focusing on conversation | Lessons developed by language experts; Focus on conversation | Subscription-based; Might be less engaging compared to gamified apps |
| Rosetta Stone | Immersive language learning platform | Provides comprehensive lessons; Focus on pronunciation | Relatively expensive; Some find the immersive method challenging |
| Tandem | Language exchange platform | Offers real-world conversation practice with native speakers | Lacks structured learning; Quality of learning depends on the partner |
| Canvas/Blackboard/Moodle | Learning Management Systems | Comprehensive tools for course management and self-study | Might lack the engaging and interactive features of language-specific platforms |

## Real-time communication in online learning

Real-time communication in online learning refers to live interaction between learners, instructors, or between learners themselves. These interactions can take place via video conferencing tools, instant messaging platforms, or collaborative online spaces, enhancing the educational experience by allowing immediate feedback and promoting active learning.

For language learning in particular, real-time communication is critical. Learning a language involves more than just acquiring vocabulary or understanding grammar. It also includes the ability to use the language spontaneously and appropriately in real-time conversations. Such skills are best developed through direct interaction with other speakers of the language.

Many studies have emphasized the value of real-time communication in language learning. Wang (2015) found that real-time communication can facilitate the development of speaking and listening skills, as it promotes natural language use and offers immediate feedback. Similarly, Sun (2016) highlighted that real-time communication can enhance learners’ confidence and motivation, making the learning process more engaging.

Despite its benefits, real-time communication is not always effectively incorporated in online language learning platforms. For instance, while apps like Duolingo and Rosetta Stone provide structured lessons, they often lack sufficient real-time interaction opportunities. On the other hand, language exchange platforms like Tandem, though offering real-time conversation practice, often lack the structure and support of formal learning environments.

Below is a table illustrating the presence of real-time communication features in various popular platforms:

| **Platform** | **Real-time Communication Feature** |
| --- | --- |
| Duolingo | Limited to forums, no direct real-time interaction |
| Babbel | No real-time interaction |
| Rosetta Stone | No real-time interaction |
| Tandem | Text, voice, and video chat |
| Canvas/Blackboard/Moodle | Depending on the course setup, may include video conferencing, instant messaging |

This review thus suggests a gap in the current landscape of online language learning tools: the need for a platform that combines structured learning, real-time communication, and cultural exchange. The proposed study aims to address this gap by designing and implementing a web-based application with these features.

## Advantages and disadvantages of current language learning applications

As technology becomes increasingly integrated into education, numerous language learning applications have emerged, each with its unique set of features and methodologies. This section will explore the advantages and disadvantages of these applications, highlighting the essential features that contribute to effective language learning and areas that require improvement.

## Advantages

Flexibility: Language learning applications allow students to learn at their own pace and time. This flexibility can be particularly beneficial for busy individuals who may not have the time to attend scheduled language classes. Moreover, it can accommodate different learning speeds, enabling faster learners to proceed without waiting and slower learners to take their time without feeling rushed.

Interactive Learning: Most language learning applications incorporate interactive exercises and activities, which can make learning more engaging and enjoyable. These interactive elements can range from simple multiple-choice quizzes to immersive virtual scenarios. By encouraging active participation, they can enhance learners' understanding and retention of the language.

Instant Feedback: One significant advantage of language learning applications is the provision of instant feedback. When learners make a mistake, they can immediately be made aware of it and learn the correct answer. This immediate feedback can contribute to more effective learning, as it allows learners to correct misconceptions and reinforce correct responses promptly.

Accessibility: With the advent of smartphones and tablets, language learning has become more accessible than ever before. Apps allow learners to study the language wherever they are, whether on the bus, during a lunch break, or at home. This portability can make it easier for learners to integrate language learning into their daily lives and take advantage of otherwise wasted time.

Range of Resources: Many language learning applications provide a wide variety of resources. These can include video lessons that explain grammatical concepts, interactive quizzes that test vocabulary and grammar, reading materials to enhance comprehension skills, and even listening exercises that use recordings of native speakers. Having access to such a broad range of resources can help learners develop a well-rounded understanding of the language.

## Disadvantages

Lack of Personal Interaction: Despite the many benefits of language learning applications, one significant drawback is the lack of personal interaction. Traditional classroom settings allow learners to interact with teachers and classmates, ask questions, get clarifications, and practice conversation in a natural setting. While some applications try to replicate this interaction through online communities or video chats, these features often cannot fully replicate the benefits of in-person interaction.

Over-reliance on Technology: While language learning applications can be a great tool, there's a risk that learners might become overly dependent on them. Other resources, such as textbooks, real-life conversations, or even immersion in a language-speaking community, can provide valuable learning opportunities that apps cannot offer. Therefore, language learning apps should ideally be used as a supplement rather than a replacement for these other resources.

Variable Quality: The quality of language learning apps can vary significantly. Some applications offer comprehensive and well-structured content, covering everything from basic vocabulary to complex grammatical structures. Others, however, might focus too heavily on one aspect of language learning, such as vocabulary building, and neglect other crucial components, such as grammar or pronunciation.

Limited Customization: While some apps allow learners to choose what they want to focus on or select their proficiency level, many do not offer the capacity for in-depth personalization. For example, an app might not adjust its content based on a learner's individual strengths and weaknesses, or it might not cater to different learning styles. This lack of personalization can limit the app's effectiveness for some learners.

Cost: While there are plenty of free language learning apps available, many of these applications hide advanced features and resources behind a paywall. For learners on a budget, this can be a significant drawback, as they might not be able to afford the premium versions of the app that offer more comprehensive learning material.

# Methodology

The Methodology chapter forms the foundation of this research project, laying out the strategies and techniques employed to investigate the outlined research questions, design the proposed application, and subsequently assess its effectiveness. The rigorous methodological framework utilized in this study ensures that the resulting findings are both reliable and valid.

In crafting the study design, meticulous consideration was given to choosing an approach that would facilitate comprehensive exploration of the complex interplay between language learning, technology use, and collaborative communication in English-speaking student groups.

Data collection and analysis methods were carefully selected to gather insightful, meaningful data, which was critically evaluated to generate nuanced understanding of the research problem. This empirical data then informed the design of the proposed application, ensuring that it was tailored to effectively address the identified issues.

With a deep understanding of the problem at hand and armed with substantial empirical data, the proposed application was conceptualized, developed, and polished. This process involved detailed planning and robust design strategies to ensure the application effectively harnessed real-time communication, facilitating language and cultural exchange among users.

## Study design

### Research approach

The research approach delineates the overall strategy and design of the study. In this research, a mixed-method approach was adopted, which incorporates elements of both quantitative and qualitative research. This decision was informed by the nature of the research questions, the nature of the study domain, and the practical considerations of the research.

Quantitative Approach: This research utilized a quantitative approach to gain a comprehensive understanding of the challenges students face when learning English in a remote setting, as well as the effectiveness of current language learning tools. The data collected using this approach is numerical and was analyzed using statistical methods. Quantitative methods are beneficial as they allow for the measurement of the extent of various phenomena, provide a broad view of the situation, and enable generalizations and predictions.

Qualitative Approach: This research also incorporated qualitative methods to gain nuanced insights into students' experiences, perceptions, and attitudes towards language learning, cultural exchange, and the use of technology in this context. Qualitative data was gathered through methods such as interviews, focus groups, and open-ended survey questions. This approach is advantageous as it provides a deep understanding of complex issues, allows for the exploration of contexts, processes, and meanings, and generates rich, detailed data that complements the quantitative findings.

By adopting a mixed-methods approach, the study aimed to capitalize on the strengths of both qualitative and quantitative research, thereby providing a more comprehensive, balanced, and robust understanding of the research problem.

### Rationale for chosen approach

The choice of the mixed-method approach for this study was motivated by the complex and multifaceted nature of the research problem. The challenges associated with English language learning in a remote setting involve various dimensions that can be best explored through different research methods.

The quantitative component of the study allowed for the gathering of objective data regarding the issues faced by students in the process of English language learning. Through surveys and questionnaires, we could collect broad, numerical data to measure the prevalence and magnitude of certain challenges. For instance, it could help determine the proportion of students struggling with specific aspects of language learning or the average rating of their satisfaction with existing learning tools.

Meanwhile, the qualitative aspect of the study facilitated a deeper exploration of students' experiences, attitudes, and perceptions. Through methods such as interviews or focus groups, we could delve into the personal narratives of the students, uncover the reasons behind the numbers, and understand the context and nuances of their learning journey. For example, it could elucidate why some students find certain aspects of language learning more difficult or what features they would like in an ideal language learning tool.

The combination of these two approaches thus provided a more comprehensive and balanced understanding of the problem. The quantitative data provided a broad overview and generalizable results, while the qualitative data offered depth and detail. Moreover, the two types of data could corroborate and validate each other, enhancing the reliability and validity of the findings.

Finally, this mixed-method approach informed the design and development of the proposed application. The quantitative data guided the choice and prioritization of features based on their perceived importance and prevalence of related challenges. Meanwhile, the qualitative data provided insights into how these features could be implemented in a way that is responsive to the students' needs, preferences, and context.

### Research procedures

The research procedures for this study were systematically organized into the following stages to ensure a smooth flow of activities and coherence in the research process.

Identification of the Problem: The initial step involved recognizing the challenges faced by non-native English-speaking students in language learning and cultural exchange, particularly in the context of remote learning. This stage relied heavily on literature review, preliminary surveys, and personal observations.

Definition of the Research Objectives and Questions: Based on the identified problems, clear research objectives and questions were defined to guide the research process.

Design of the Research Methodology: A mixed-method approach was adopted, incorporating both qualitative and quantitative research methods. The choice of methods was determined by the nature of the research questions, the context of the study, and the resources available.

Data Collection: Primary data were collected through surveys, interviews, and focus groups, while secondary data were gathered from existing literature and online resources. The data collection process was designed to be comprehensive, rigorous, and ethical.

Data Analysis: The collected data were thoroughly analyzed using appropriate statistical techniques for quantitative data and thematic analysis for qualitative data.

Application Development: Based on the insights gained from the data analysis, the proposed application was developed. This involved designing the application's structure and features, coding the backend and frontend, and implementing real-time communication features.

Testing and Evaluation: The developed application was rigorously tested for functionality, usability, and effectiveness. Feedback from users was collected and analyzed to evaluate the application's performance and impact.

Reporting of Findings: The findings from the data analysis and application evaluation were reported in a clear, comprehensive, and systematic manner. The report also includes recommendations for future research and development.

Below is a tabular representation of the research procedures and associated methods:

| **Stage** | **Associated Methods** |
| --- | --- |
| Identification of the Problem | Literature review, preliminary surveys, observations |
| Definition of the Research Objectives and Questions | Review of literature and preliminary data |
| Design of the Research Methodology | Methodological literature review, expert consultation |
| Data Collection | Surveys, interviews, focus groups, literature review |
| Data Analysis | Statistical analysis, thematic analysis |
| Application Development | Software development, user-centered design |
| Testing and Evaluation | Usability testing, user feedback collection, performance evaluation |
| Reporting of Findings | Academic writing, data visualization |

## Data collection and analysis methods

The robustness of the research findings and the subsequent development of the application hinge on the efficacy of the data collection and analysis methods. Given the mixed-method approach of this study, both quantitative and qualitative data were collected and analyzed. This section elucidates the methods employed for data collection and analysis and their relevance to the research objectives.

### Data collection

In the realm of this research, the data collection process served a vital role in capturing a holistic understanding of the issues non-native English-speaking students face, as well as gaining insights into their needs and preferences regarding language learning tools. To accomplish this, the study relied on both primary and secondary data collection methods.

Primary Data Collection: This study gathered first-hand, original data directly from students through the following methods:

Surveys: An online survey was distributed to students in English-speaking groups. The survey contained both closed-ended questions, which provided quantitative data, and open-ended questions, which yielded qualitative data. The questions covered various aspects related to their language learning experiences, challenges they encounter, their experiences with remote learning, and their opinions about existing language learning tools.

Interviews: Personal interviews were conducted with a smaller, selected group of students. These in-depth interviews were semi-structured, with a set of predefined open-ended questions to guide the conversation while leaving room for follow-up questions based on the interviewees' responses. Interviews offered deeper insights into individual experiences and perspectives.

Focus Groups: A few focus group discussions were organized, each comprising a small number of students. These discussions revolved around their collective experiences with English language learning, the challenges faced in remote education settings, and suggestions for improving language learning tools.

Secondary Data Collection: Secondary data was obtained from preexisting resources. This data was instrumental in setting the research context, identifying the existing state of language learning tools, and understanding the gaps in the current solutions. The following sources were utilized for this purpose:

Academic Literature: Relevant academic articles, research papers, and theses were reviewed. These sources provided insights into the theoretical background of language learning, the effectiveness of various teaching strategies, and the impact of technology on language learning.

Online Reports: Reports published by educational institutions, language learning platforms, and other relevant organizations were examined. These reports provided statistical data on language learning trends and the efficacy of different learning tools.

Databases: Various databases were accessed for information related to language learning and teaching, the use of technology in education, and the challenges faced by language learners.

Through the combination of these primary and secondary data collection methods, a comprehensive and balanced understanding of the research problem was obtained. This data served as a solid foundation for the subsequent stages of the research and the development of the proposed application.

### Data analysis

Data analysis is a critical process that involves inspecting, cleaning, transforming, and modeling data to uncover useful information, draw conclusions, and support decision-making. The data collected for this study was analyzed in two ways to reflect the nature of the data collected - quantitative and qualitative data analysis.

Quantitative Data Analysis: This study utilized a range of statistical methods to examine the quantitative data collected through surveys.

Preliminary Analysis: This involved checking the data for any inaccuracies or inconsistecies, ensuring the completeness and quality of the data set.

Descriptive Analysis: Here, basic statistical measures like mean, median, standard deviation, and range were calculated to summarize the general features of the data, giving a clear overview of the data set's main characteristics.

Inferential Analysis: Inferential statistics were used to make assumptions about the population based on the collected sample data. Hypotheses were tested using various statistical tests, such as t-tests or ANOVA, depending on the nature of the data.

Correlational Analysis: This aimed to find any relationships between variables in the data. The strength and direction of the relationships were determined, which could hint at potential causes or influences on the issues being examined.

Data Visualization: Data visualization techniques like charts, graphs, and infographics were used to represent the data and statistical results visually, making complex data understandable and accessible.

Qualitative Data Analysis: The qualitative data obtained from the interviews and focus groups was analyzed using a thematic analysis approach.

Data Transcription: Initially, all the discussions from the interviews and focus groups were transcribed verbatim to ensure that no valuable information was lost.

Data Coding: The transcriptions were then read thoroughly, and initial codes were generated. These codes represent a feature of the data that seems pertinent to the research question.

Thematic Development: All the codes were reviewed, and similar codes were grouped together to form potential themes. These themes represent patterns or trends in the data that address the research question.

Theme Review and Definition: The potential themes were then reviewed and refined. This involved checking the themes against the dataset to ensure they accurately represent the data, and defining what each theme is and what it encompasses.

Data Interpretation: The final step was to interpret the findings. This involved analyzing the themes in relation to the research question and drawing conclusions based on this analysis.

Both these data analysis methods ensured that the study had a well-rounded understanding of the problem, taking into account both the breadth and depth of the issues. The findings from the data analysis directly informed the design and development of the proposed application.

## Description of the application

### Overview of the application

The application proposed in this study is designed to serve as an online platform that facilitates language learning and cultural exchange among students in English-speaking groups. Leveraging technology and real-time communication features, the application aims to enhance students' English language skills while promoting cross-cultural understanding and collaboration.

The application is intended to offer a rich, interactive, and engaging environment that makes language learning more accessible and enjoyable. Through its various features, the application seeks to address the challenges identified in the context of English language learning, particularly those accentuated by the remote education setting necessitated by the recent pandemic.

While the primary focus is on enhancing language skills, the application also seeks to cultivate a sense of community among students. Through real-time interactions, group activities, and cultural exchange, the application aims to foster a sense of belonging, making learning more collaborative and less isolating.

Designed as a web application, it can be accessed from various devices such as desktop computers, laptops, tablets, and smartphones, providing flexibility and convenience to users. The backend of the application is built using ASP.NET Core, with SQL Server serving as the database. The frontend is developed using Angular, and SignalR is employed for real-time interactive features.

In summary, the proposed application is a comprehensive, interactive, and user-friendly platform that combines language learning and cultural exchange, addressing the challenges faced by non-native English-speaking students.

### Application key features and functionality high-level overview

The proposed application, "SyncLink", incorporates a variety of features designed to stimulate effective and enjoyable language learning, cultural exchange, and real-time communication among students. These features are deliberately designed to address the unique needs and obstacles faced by non-native English-speaking students in English-speaking groups, particularly within the context of a remote learning environment.

Language Learning Mini-Games: These games provide an interactive and enjoyable method for students to challenge and improve their English language skills. Games could involve vocabulary quizzes, grammar exercises, listening tasks, or speaking challenges, among others. Points are awarded based on performance, promoting a friendly competition among students.

Word/Phrase of the Day Discussions: Each day, a new word or phrase is featured on the platform. Students can discuss its meaning, usage, synonyms, and contribute sentences using the word/phrase. This encourages daily active engagement with the language.

Forum for Q&A and Discussions: SyncLink provides a forum for students to ask questions, share insights, or engage in discussions related to language learning or course content. This is a moderated space that fosters respectful and constructive interaction among students.

Cultural Exchange Space: This feature allows students to share and learn about different cultures. Students can post about their own culture or inquire about others, fostering mutual respect and understanding among a diverse group of students.

Real-Time Chat: A real-time chat feature facilitates instantaneous communication among students. This can be utilized for informal conversations, rapid clarifications, or real-time discussions about the course material or the language learning games.

Collaborative Whiteboard: This feature facilitates group study sessions, brainstorming sessions, or problem-solving discussions. Users can write, draw, or annotate on the whiteboard in real-time, encouraging active participation and collaboration.

Progress Tracker: Each student has access to a personal progress tracker that monitors their activity on the platform, their performance in the language learning games, and their overall progress in language learning.

Collectively, these features of SyncLink create a comprehensive language learning environment that promotes active learning, real-time communication, cultural exchange, and community building among students.

### Technical specifications

SyncLink's architecture comprises of both a front-end and a back-end that communicate with each other to deliver the app's functionalities. In addition, the app makes use of real-time communication features to support instant interaction among users.

Backend Development: The backbone of the application is developed using ASP.NET Core, a robust, high-performance, open-source framework for building modern, cloud-based applications. The backend is responsible for the business logic of the application, such as managing user accounts, storing and retrieving data, and handling real-time communication among users. Data is stored in a SQL Server database, providing secure and efficient data management capabilities.

Frontend Development: The user interface of the application is built using Angular, a popular web application framework developed by Google. Angular provides a powerful platform for developing complex, single-page applications with a rich, responsive user interface. It facilitates clean and maintainable code, ensuring that the application is scalable and easy to update.

Real-Time Communication Features: Real-time communication among users is facilitated using SignalR, a library that simplifies the process of adding real-time web functionality to applications. SignalR handles connection management automatically and allows for broadcasting messages to all connected clients simultaneously, which is essential for the real-time chat and collaborative whiteboard features of the application.

Together, these technologies provide a secure, efficient, and responsive platform for SyncLink, ensuring that users have a smooth and engaging experience while using the application. The choice of these technologies was informed by their proven capabilities, extensive community support, and suitability for the specific requirements of the application.

### Development process

The development of SyncLink followed a structured process to ensure that the resulting application meets its intended goals and provides a smooth and engaging user experience. This process consisted of three main stages: Planning and Design, Implementation, and Testing and Debugging.

Planning and Design: The first phase involved clearly defining the application's goals and the specific functionalities required to achieve these goals. This was based on the needs and challenges identified through the literature review and data analysis. Once the functionalities were defined, the overall structure and architecture of the application were designed. This included designing the database schema, determining the main components and services of the application, and designing the user interface. Wireframes and prototypes were created to visualize the user interface and user flow through the application.

Implementation: The implementation phase involved coding the application based on the designs and specifications established in the planning phase. The backend was developed using ASP.NET Core, with the business logic and database interactions being implemented first. The frontend was developed using Angular, with each component and service being implemented and tested individually before being integrated into the application. The real-time communication features were implemented using SignalR, and integrated with both the backend and frontend.

Testing and Debugging: After the implementation, the application underwent extensive testing to ensure it functions as expected and provides a smooth user experience. This included unit testing, integration testing, and system testing. Any bugs or issues identified during testing were fixed, and the application was re-tested to ensure the fixes were successful. The application was also tested on different devices and browsers to ensure compatibility.

The development process was iterative, with regular feedback and testing at each stage to ensure that the application meets its objectives and provides a high-quality user experience. This approach allowed for any issues or changes to be addressed promptly, reducing the risk of major problems or delays in the later stages of development.

### Expected user experience

The SyncLink application is designed with a focus on user experience, ensuring that the platform is not only useful for language learning and cultural exchange but also enjoyable and easy to use. The following outlines the expected user experience of the application.

Intuitive Interface: The user interface of SyncLink is designed to be clean, intuitive, and easy to navigate, minimizing the learning curve for new users. Information and functions are organized logically and consistently throughout the application, ensuring that users can easily find what they are looking for.

Engaging and Interactive: SyncLink's functionalities aim to keep users engaged and involved in their learning process. The language learning mini-games, real-time chat, and collaborative whiteboard features provide opportunities for active participation, enhancing the learning experience.

Supportive and Collaborative Environment: The application aims to foster a supportive and collaborative community of learners. The discussion forums and real-time chat provide spaces for users to connect, share their experiences, and help each other in their learning journey. This sense of community can help users feel more motivated and less isolated in their language learning.

Personalized Learning Path: SyncLink offers a personalized learning experience. Each user's progress is tracked, allowing them to see their own improvements over time. The mini-games adapt to the user's skill level, ensuring that they are always challenged but not overwhelmed.

Cultural Exchange: Beyond language learning, SyncLink also promotes cultural exchange. Users have the opportunity to share about their own culture and learn about others, broadening their perspectives and fostering mutual understanding.

Immediate Feedback and Assistance: Through the real-time chat and collaborative whiteboard features, users can get instant help or feedback from their peers. This immediate response mimics the experience of a physical classroom, enhancing the effectiveness of remote learning.

Overall, the user experience of SyncLink is designed to be engaging, supportive, and personalized, facilitating effective language learning and cultural exchange in a remote learning environment.

# Web application: design and development

## Technologies used

### ASP.NET Core

ASP.NET Core, an open-source, cross-platform framework developed by Microsoft, was selected as the primary technology for the backend of the application. As a modern web development framework, ASP.NET Core offers several advantages that made it a compelling choice for the project.

ASP.NET Core was selected for its capabilities that extend beyond just serving web requests. It is equipped with a rich set of features that allow for implementing various architectural patterns like Command Query Responsibility Segregation (CQRS) and elements of Clean Architecture. The use of CQRS enables clear separation of read and write operations, enhancing the application's performance, scalability, and security. Clean Architecture elements were integrated to promote maintainability, flexibility, and independence from frameworks, thereby allowing the application's business rules and policies to drive the design.

Moreover, this framework is highly scalable and can handle large numbers of users simultaneously, an important factor considering the application's nature that encourages real-time interaction and collaboration. Its cross-platform compatibility, allowing the application to run on Windows, macOS, and Linux, also adds flexibility and broadens potential user demographics.

ASP.NET Core's built-in dependency injection and ability to integrate seamlessly with popular databases and other tools made it a fitting choice for developing a comprehensive and efficient backend for the application.

### SQL Server

SQL Server, a relational database management system developed by Microsoft, is used for managing and storing data for the web application. The selection of SQL Server as the database for this project was driven by its numerous advantageous features, ease of use with ASP.NET Core, and its comprehensive support for data management tasks.

SQL Server is renowned for its high performance, security, and scalability. It provides advanced features such as data compression, encryption, and a high level of compliance with standards, ensuring the safety and integrity of user data. Its transactional system allows the execution of complex queries, further facilitating robust data management.

The database structure in SQL Server is designed to efficiently store user details, game scores, discussion records, and more, all of which are crucial to the web application's functionality. Furthermore, SQL Server integrates seamlessly with ASP.NET Core, simplifying the process of data operations in the backend, such as CRUD (Create, Read, Update, Delete) operations, which are fundamental in the interactive nature of the web application.

Moreover, SQL Server's compatibility with Entity Framework Core, an Object-Relational Mapping (ORM) framework, facilitates the translation of object-oriented domain models into a database, further simplifying database management and enhancing developer productivity. The support of LINQ (Language Integrated Query) queries to directly interact with the database using C# also bolsters its efficiency and usability in the context of this project.

In conclusion, SQL Server provides a powerful, reliable, and secure platform for the application's data storage and management needs.

### SignalR

SignalR, a library developed by Microsoft, is incorporated into the application for real-time web functionality. This technology enables server-side code to push content updates to connected clients instantly as they become available, rather than having the server wait for a client to request new data. This bidirectional communication is pivotal for creating highly interactive applications.

The inclusion of SignalR is particularly relevant for the collaborative and interactive nature of the web application, where instantaneous updates and real-time communication are fundamental. SignalR caters to various real-time scenarios, such as live chatting, real-time gaming, and instant notifications, all of which are crucial in enhancing user engagement within the application.

One of the key advantages of SignalR is its automatic handling of connection management. It can create persistent connections between the client and the server, enabling them to call methods on each other directly. Also, SignalR elegantly handles connection interruptions and can automatically reestablish a disrupted connection, providing a seamless user experience.

SignalR supports different types of transport protocols (WebSockets, Server-Sent Events, Long Polling) and automatically chooses the best available transport based on the client's and server's capabilities. This ensures optimal performance regardless of the server and client environments.

In conjunction with ASP.NET Core, SignalR provides a straightforward and effective approach to real-time communication, enhancing the interactive and collaborative aspects of the web application and contributing to its overall user experience.

### Angular

The frontend of the web application is built using Angular, a popular open-source web application framework developed by Google. Angular was chosen for its robust set of features, scalability, and the capability to build interactive single-page applications (SPAs) that provide a superior user experience.

Angular employs TypeScript, a statically-typed superset of JavaScript, which adds a layer of security due to its compile-time error checking capabilities. This ensures better code quality, easier debugging, and overall improved maintainability, which are vital for the long-term sustainability of the application.

The framework's component-based architecture is another significant advantage. This architecture promotes reusability, modularity, and separation of concerns, thereby leading to a well-structured and easier-to-maintain codebase. Components can be reused across the application, improving the development speed and reducing the likelihood of code duplication.

Angular also offers two-way data binding, which automates the synchronization of data between the model and view components. This feature simplifies the programming model, reduces the amount of boilerplate code, and further improves performance.

Angular's comprehensive set of tools and libraries, such as Angular Material for UI components and RxJS for handling asynchronous operations, further enhance the application's development and functionality. Additionally, Angular's compatibility with third-party libraries allows for flexibility and customization, ensuring that the application can adapt to future needs and changes.

Angular Material, a UI component library, was utilized to craft visually appealing, consistent, and functional interfaces. The library provides a set of reusable, well-tested, and accessible UI components based on Google's Material Design specification. The use of Angular Material helps in ensuring a unified user experience across the application, decreasing development time and promoting user interaction.

With its robust capabilities, Angular together with Angular Material UI components library facilitates the creation of an interactive and engaging user interface, which is crucial for the gamified learning environment that the web application aims to provide.

### NgRx

NgRx is a group of Angular libraries for reactive extensions. It's used in the application for efficient state management. The need for a state management tool like NgRx arises when an application grows complex, with many components sharing and affecting the state.

Based on Redux, a popular state management library in the JavaScript ecosystem, NgRx employs a unidirectional data flow where the state is immutable. This means that when a change in the state is required, a new state is created instead of modifying the existing one. This practice greatly enhances the predictability and traceability of state changes.

In NgRx, the application's state is managed through three core concepts: Actions, Reducers, and Store.

Actions are dispatched in response to user events or operations like clicking a button or API responses. Each action represents a unique event with a type and optional data payload.

Reducers, pure functions, handle these actions and return a new state based on the action type and the previous state.

The Store, an observable of the state and an observer of dispatched actions, brings actions and reducers together. Components can select slices of state from the store, and the state can be updated by dispatching actions to reducers through the store.

By employing NgRx, the application maintains a single source of truth, making the state predictable and consistent. This is especially crucial in a real-time, interactive application where the state can be affected by multiple users simultaneously.

NgRx also integrates seamlessly with Angular's component architecture, RxJS, and the Redux DevTools extension for debugging and performance tracking. This makes it an excellent choice for state management in Angular applications.

### Database management

Database management is a key aspect of the application development process. As the heart of most applications, the database stores, organizes, and retrieves the data that drives functionality. In the context of this application, we use SQL Server as the main database technology due to its performance, scalability, and security features.

The design of the database schema is crucial for the application's operation and performance. It involves the careful planning of how data is structured and related to ensure efficient storage and quick retrieval. For this application, a relational database design is adopted, employing tables to store data related to users, minigames, and word/phrase of the day discussions. Relationships are defined among these tables to enable efficient data access and maintain data integrity.

Data manipulation operations, including data insertion, deletion, updating, and retrieval, are performed using SQL (Structured Query Language). These CRUD operations are implemented in the application's backend using ASP.NET Core, which communicates with SQL Server through Entity Framework Core, a powerful ORM tool that simplifies data access by enabling us to interact with the database using C# objects.

Additionally, data consistency and integrity are ensured through the use of constraints and transactions. Constraints restrict the data that can be stored in tables, while transactions ensure that database operations are carried out completely or not at all, preventing data inconsistency in case of errors or system failures.

Data security is another critical concern in database management. It is addressed by implementing measures such as data encryption, user authentication, and authorization to protect sensitive data and prevent unauthorized access.

In summary, efficient database management is vital for the application's smooth operation, performance, and security. The use of SQL Server, in conjunction with ASP.NET Core and Entity Framework Core, ensures that these requirements are met while providing a scalable and flexible data management solution.

## System design and architecture

The web application adheres to a three-tier architecture, consisting of the Presentation Layer (Frontend), Application Layer (Backend), and Data Layer (Database). This architecture ensures the separation of concerns, modularity, and scalability, which align perfectly with the collaborative and interactive nature of the application.

The Presentation Layer is crafted using Angular and Angular Material, facilitating the creation of dynamic, interactive, and visually appealing user interfaces. Angular Material, a UI component library, is employed to design consistent and functional user interfaces based on Google's Material Design guidelines. Furthermore, NgRx, a robust state management library, is integrated into this layer. By managing both local and global states, NgRx promotes performance, predictability, and consistency across the application.

The Application Layer, created with ASP.NET Core, serves as the application's core, handling business logic and controlling the functionality of the application. This layer employs the Command Query Responsibility Segregation (CQRS) pattern for efficient handling of data manipulation operations, enhancing performance and scalability. Elements of Clean Architecture are incorporated to achieve a flexible, maintainable design that focuses on the application's business rules and policies.

The Data Layer, driven by SQL Server, is entrusted with the task of data storage, retrieval, and manipulation. This layer ensures the organized and ready availability of data, preserving data consistency and integrity through transactions and other measures.

SignalR, a real-time library, bridges the gap between the server and client, enabling them to maintain a persistent connection and exchange information in real time. This adds a dimension of live updates and instant communication to the application, which is particularly beneficial in a collaborative environment.

Considering the interaction among these components, suppose a user participates in a minigame. When the user submits an answer, this event is captured by the Presentation Layer, which then communicates it to the Application Layer. The Application Layer processes the request, updates the game state, and stores the relevant data using the Data Layer. Meanwhile, SignalR propagates these updates to all other participants in real time.

In conclusion, the system's design and architecture are instrumental in ensuring a scalable, maintainable, and efficient application, providing a seamless, engaging experience for the users.

## Frontend development

The frontend of the web application plays a critical role in providing users with an engaging, interactive, and intuitive platform for language and cultural exchange. It is developed using Angular, an advanced JavaScript framework for building single-page applications, supplemented with NgRx for efficient state management and Angular Material for a consistent, appealing UI design.

### User interface design

The user interface (UI) design is primarily concerned with ensuring a visually appealing, intuitive, and user-friendly experience. It combines aesthetics with functionality, enabling users to interact with the application effectively.

The UI is crafted using Angular Material, a component library implementing Google's Material Design principles. The application UI consists of numerous components like dialogues, forms, navigation bars, buttons, and game interfaces. These components follow a coherent visual language, providing consistency across the application.

Furthermore, the UI is designed to promote user engagement through gamified learning features. It includes interfaces for minigames, word/phrase of the day discussions, and other interactive elements that make learning and communication fun and enjoyable.

### Responsiveness and accessibility

Given the diverse range of devices that users might use to access the application, responsiveness is a key aspect of the frontend development. The application's UI is designed to be responsive, ensuring that it adapts to different screen sizes and orientations, providing an optimal viewing and interaction experience across a variety of devices.

Accessibility is another critical concern, ensuring that the application is usable by people with different abilities. Best practices for web accessibility are followed, including providing alternative text for images, ensuring proper color contrast, and allowing keyboard navigation, among others.

Through an intuitive UI design, responsive layout, and accessibility features, the frontend development ensures that the application provides a user-centric experience that caters to diverse user needs and preferences.

## Backend development

The backend development of the application forms the core of the system, providing all the necessary logic and operations to support and drive the application's functionalities. In order to facilitate the communication and learning processes, the system relies on an ASP.NET Core web API, a SQL Server database and the use of Entity Framework Core for data access. This chapter outlines the key features and functions that were developed in the backend.



### Database management

The heart of our web application lies in its database, which is responsible for the storage, retrieval, and manipulation of data. We have chosen Microsoft's SQL Server for this project due to its efficient handling of complex data relationships, robustness, scalability, and broad support for complex queries.

The database schema is a comprehensive representation of the various entities in our system, including User, Group, Room, Message, Whiteboard, WhiteboardElement, TextPlotEntry, TextPlotGame, TextPlotVote, UserGroup, and UserRoom. These entities encapsulate the various functionalities and relationships in the system.

* User: Represents a user in the system. Users can belong to multiple groups and rooms, and they can send multiple messages.
* Group: Represents a group in the system. Groups have multiple users and rooms associated with them, and they can host games.
* Room: Represents a room in the system. Rooms can be associated with multiple users and have multiple messages.
* Message: Represents a message sent by a user in a room.
* Whiteboard: Represents a collaborative space where users can create and manipulate WhiteboardElements. Each Whiteboard is associated with a user (Owner) and a Group.
* WhiteboardElement: Represents an element on the Whiteboard. Each element is associated with a user (Author).
* TextPlotEntry: Represents an entry in a TextPlotGame. Each entry is associated with a user and can receive multiple votes.
* TextPlotGame: Represents a game in the system. Each game is associated with a group and has multiple entries.
* TextPlotVote: Represents a vote cast on a TextPlotEntry. Each vote is associated with a user.
* UserGroup: Represents the membership of a user in a group.
* UserRoom: Represents the membership of a user in a room.

Entity Framework Core is used to interact with the SQL Server database. This ORM allows us to work with the database using .NET objects, which reduces the amount of data-access code that needs to be written and maintained. It also provides an abstraction layer over the underlying database system, improving the resilience of the application to potential changes in the database technology.

The database management involves creating, reading, updating, and deleting (CRUD) records in the database. These operations are performed by various API endpoints, and the data returned by these endpoints is formatted as JSON for easy use in the Angular frontend.

In the next section, we will outline the various APIs and functionalities provided by the backend.

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### API and functionality

In order to create a platform for English language and cultural exchange for students, several functionalities were developed on the backend of the application. The features provided by the application's backend, and exposed through APIs, are integral to ensure a collaborative and gamified learning environment.

In the backend, we've employed a layered architecture utilizing principles of CQRS and Clean Architecture. It facilitates separation of concerns and makes the codebase more maintainable and adaptable to changes. MediatR is used for dispatching commands and queries, which are processed by separate handlers, and AutoMapper is utilized for mapping between various DTOs and domain entities.