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Developing TalkBuddy : An Inclusive Android Application for Deaf Students' English Learning and Statistical Support

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Abstract: This study aims to develop the Android-based application Talkbuddy as an inclusive communication medium for teaching English and Statistics to deaf students at Universitas Pamulang. The application is designed to address communication challenges in learning by incorporating features such as speech-to-text transcription, group discussion forums, access to learning modules, educational videos, the latest news in education, and a space for sharing experiences. This research adopts the Research and Development (R&D) method using the Luther-Sutopo model, which includes the stages of concept, design, material collecting, assembly, testing, and distribution. The trial was conducted with two deaf students who participated in a series of application usage tests to evaluate the effectiveness and practicality of the developed features. Data collection techniques included interviews, observations, and questionnaires throughout the trial process. Data analysis was conducted through expert validation (content and media), alpha testing, and beta testing. The results indicate that the Talkbuddy application enhances communication accessibility and supports inclusive learning processes in English and Statistics courses, with average scores in alpha and beta testing exceeding 80, indicating a high level of feasibility. This application offers an innovative solution to the academic communication barriers faced by deaf students and is expected to contribute to the advancement of inclusive learning technology in higher education.

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Introduction

Inclusive higher education is a fundamental right for every individual, including deaf students. However, in practice, deaf students often face various obstacles, especially in the aspects of communication and learning. Communication is a key element in the learning process; For deaf students, limitations in verbal communication can reduce their participation and academic achievement. According to the World Federation of the Deaf (2020), more than 5% of the world's population has hearing loss that affects their ability to access education.

In Indonesia, although inclusive education policies have been implemented, their implementation still faces significant obstacles, such as the lack of deaf-friendly learning media and the lack of adequate technological support. The communication process between lecturers and deaf students still relies on sign language interpreters, which are not always available in every learning situation. As a result, the participation of deaf students in class discussions, material understanding, and interaction with lecturers and fellow learners is limited. In Indonesian context, several previous studies have highlighted the potential of mobile applications in enhancing learning outcomes for deaf students by offering tailored and accessible educational tools (Hendriarto et al., 2024).

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Courses such as English and Statistics have their own challenges for deaf students. English, as a foreign language, requires a complex phonetic and grammatical understanding, while Statistics requires data interpretation and an understanding of mathematical concepts that are often conveyed verbally. Limitations in communication can hinder the understanding and active participation of deaf students in these two courses.(Bond et al., 2021)

English language proficiency is a cornerstone of academic success and global communication. However, for deaf students, acquiring English skills presents unique challenges due to limited access to auditory information and the scarcity of tailored educational resources. Traditional language instruction methods often rely heavily on auditory and spoken components, which are not accessible to students with hearing impairments. This gap underscores the necessity for innovative educational tools that cater to the specific needs of deaf learners. As highlighted by (Apriyanti & Puspitasari, 2024), mobile applications have emerged as promising tools to address these challenges by providing accessible, non-auditory learning experiences to assist deaf and hard-of-hearing students in learning English pronunciation.

Mobile technology has emerged as a promising avenue to bridge this educational divide. For instance, the "Easy Grammar" Android application was developed to enhance English grammar skills among deaf students across various age groups. The application demonstrated significant potential in improving grammatical abilities and communication through interactive and engaging content (Putrawansyah et al., 2020). Similarly, the "Hausar Kurma" app was designed to facilitate the learning of the English-Hausa Sign Language alphabet, resulting in notable improvements in academic performance and engagement among deaf students in Nigeria (Lawal et al., 2024).

Learning English and Statistics in college demands a deep understanding of abstract concepts and effective communication skills. Deaf students often face difficulties in understanding the material delivered verbally, especially in courses that require complex oral explanations. Limited access to auditory information can hinder their learning process and academic achievement. According to research by (Venkatesh et al., 2016), the use of mobile applications in learning can increase the motivation and engagement of students with special needs, including the deaf. However, there is still a shortage in the availability of applications specifically designed to support English and Statistics learning for deaf students in Indonesia.

One of the efforts to overcome this problem is to develop an Android-based application that can support communication and learning for deaf students. This application is expected to be an inclusive and effective learning medium, considering that smartphones are now a very common device among students. Technologies such as speech-to-text have been shown to be effective in improving accessibility for individuals with hearing loss (Bala & Song, 2020). The "Talkbuddy" application was developed as an innovative solution to overcome these challenges by integrating features such as real-time voice-to-text transcription, sign language translator, and interactive learning modules tailored to the needs of deaf students. By utilizing speech-to-text technology, the app allows deaf students to attend lectures and class discussions more effectively. In addition, the sign language translator feature can be helpful in understanding technical terms that are often used in English and Statistics courses.

Previous research has shown that the use of information and communication technology (ICT) can make a major contribution to improving the quality of education for students with disabilities (Husnul, NRIH & Rusnaini, 2024). However, while some apps already exist, apps specifically designed to meet the communication and learning needs of deaf students are still limited. Therefore, the "Talkbuddy" application designed in this study

is expected to answer these needs by providing a user-friendly and accessible platform, and being able to optimize the interaction between deaf students and teachers.

Although various previous studies have demonstrated the effectiveness of text- or image-based applications in supporting communication for deaf students, most of these applications have remained focused separately on either communication aspects or the delivery of learning materials. There has been limited research that specifically integrates two-way communication features with interactive learning elements within a single platform designed for deaf students. Previous studies (Apriyanti & Puspitasari, 2024) (Hendriarto et al., 2024) have shown that the use of text- or image-based apps for deaf communication has been shown to be effective, but apps that combine elements of interactive learning and live communication in a single platform are still rare. Therefore, this research aims to develop an innovative solution through the "Talkbuddy" application that not only provides communication features, but is also equipped with interactive learning features that can improve the understanding of lecture materials.

The rapid development of information technology should be used to overcome this obstacle. Studies by (Damyanov & Tsankov, 2018) show that mobile-based applications have great potential to support learning for students with special needs, including deaf students. Unfortunately, most of the applications available globally are not specifically designed for the context of higher education in Indonesia, so they are not fully relevant to the local needs of deaf students. Previous research has offered a variety of approaches to overcome communication barriers, such as the use of hearing aids and sign language interpreters. However, these solutions tend to be partial, not fully integrating communication and learning needs in a single medium (Rival Kurniawan et al., 2023). Therefore, an innovation that is more focused, inclusive, and relevant to the context of higher education is needed, which is able to improve accessibility, effectiveness, and learning efficiency for deaf students.

The novelty of this research is that the "Talkbuddy" application will integrate speech-to-text technology, sign language translators, and interactive features that support the learning of deaf students. Previous research has developed learning apps for people who are deaf, but there is no app that integrates all aspects of communication and learning in one intuitive and easy-to-use platform. Thus, this research has a significant differentiator, which is to create a multifunctional application to support both aspects simultaneously. The purpose of this study is to develop and test the "Talkbuddy" application as an Android-based communication and learning medium that can improve interaction and quality of learning for deaf students in college. With this application, it is hoped that deaf students can more easily communicate with teachers and classmates, and be more active in following the learning process carried out in the classroom.

Research Method

This research adopts a Research and Development (R&D) approach that focuses on the process of designing, manufacturing, and evaluating a product in the form of an Android application called "Talkbuddy", which is intended as an inclusive means of communication to support English and Statistics learning for deaf students in universities. The subjects in this study were the target users of the TalkBuddy application, consisting of three deaf students, one lecturer who teaches English, and one lecturer who teaches Statistics. In the data collection process, the researcher uses a combination of several techniques, such as interviews, observations, surveys, and questionnaire dissemination, aimed at exploring user needs as well as input from experts to improve the developed application. The data obtained

from these various sources will be the basis in the needs analysis and application design development stage.

The development of the "Talkbuddy" application follows the multimedia software engineering model developed by Luther and modified by Sutopo, as described by (Satwika et al., 2019). This model was chosen because it is considered to be able to provide systematic, flexible, and relevant stages to the context of interactive digital media development. The main stages in this model include: (1) conceptualization, (2) design, (3) material collecting, (4) product assembly, (5) testing, and (6) distribution. Although these steps are arranged sequentially, in practice, their implementation can be dynamic and not always linear.

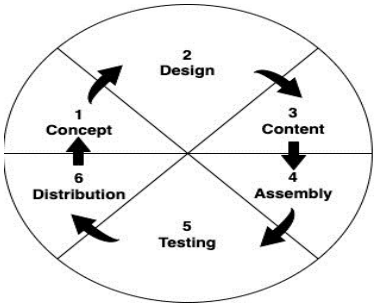

Figure 1. Luther Sutopo Model

The concept stage begins with the identification of user needs, including input-output information, the type of application being developed, as well as the specific purpose of the Talkbuddy application. Furthermore, at the design stage, the designer establishes the visual elements, the flow of user interaction, as well as the structure of the app's interface. This process is the foundation of the development that will be carried out. Then, the material collection stage includes searching and selecting supporting content, such as text, images, sounds, videos, and other interactive elements relevant to learning English and Statistics. This material will be assembled in the assembly stage, where all the elements that have been collected are integrated into the application platform as a whole.

After the application was developed, a testing phase was conducted. The initial evaluation was carried out by the development team to ensure that the basic functionalities operated as intended. Subsequently, validation and product testing were conducted in stages, including content expert validation, validation by instructional designers and media experts, individual small-scale testing, small group testing, and large group testing. These stages aimed to assess the feasibility, effectiveness, and user appeal of the Talkbuddy application prior to its broader implementation. The final phase was distribution, which involved storing and disseminating the application through selected storage media or digital platforms. If the application file size was too large, a compression process was performed to facilitate easier access for end-users. This stage marked the conclusion of the development cycle before the application was implemented in an actual learning environment.

The research instruments included interviews during the initial needs analysis stage, followed by questionnaires for content and media experts, user response questionnaires (administered to deaf students and lecturers), and learning outcome tests (pre-test and post-test). Data analysis techniques included validity testing, reliability testing, and feasibility analysis through alpha and beta testing.

Results and Discussion

This research resulted in an innovation in the form of an Android-based application called "Talkbuddy", which is designed as a communication and learning medium for deaf students at Universitas Pamulang (UNPAM). This application integrates various learning and

interaction support features, such as voice-to-text conversion that makes it easier for students to record lecturer explanations in written form, conversation and group features like WhatsApp to support academic collaboration, as well as learning modules and videos that can be accessed flexibly according to students' learning needs. The materials in the Talkbuddy application are also focused on learning English and Statistics, two fields of study that often cause difficulties for deaf students due to their reliance on verbal communication. In addition, the app features thematically curated educational news, as well as inspirational stories, aimed at building motivation to learn and reducing the sense of social isolation that students with hearing disabilities may experience. The features are designed to create an inclusive, self-reliant, and sustainable learning environment.

The results of the initial trial were carried out on two deaf students at UNPAM. Their response shows that this application is very helpful in understanding English and Statistics learning materials that were previously difficult to understand through oral explanations. Voice-to-text allows students to absorb information visually, while learning videos bridge the limitations of access to verbal instruction. The group discussion feature also helps them in discussing with lecturers and classmates without communication barriers. Application feasibility testing is carried out in two stages, namely alpha test and beta test. The results of the alpha test are as follows:

Table 1. The results of the alpha test

No.	Aspects	IT Expert	Media Member	Disability Reviewer
1	Learnability	88,4	83,4	86
2	Efficiency	86,5	82,2	87
3	Memorability	78,6	87,4	84
4	Errors	86,0	81,4	86
5	Statisfication	92,4	90,2	82

Alpha testing is conducted by IT practitioners, learning media experts, and disability reviewers with a *black box testing* approach. The results showed that most aspects were rated "very feasible", with a score above 80. The only score below 80 is the *memorability aspect* of the IT expert's assessment (78.6), which remains categorized as "decent". This shows that the application in general has met the standards of functionality, efficiency, and user convenience.

Meanwhile, at the beta test stage, the application is tested directly by lecturers and students as end users. Aspects such as learningability, efficiency, memorability, error rate, and satisfaction all scored above 80. This reinforces the findings that the Talkbuddy app has successfully met user expectations and is ready for wider distribution as an interactive learning medium. Beta tests are conducted to provide input and suggestions to the Talkbuddy application that is developed.

Table 2. The result of Beta tests

No.	Aspects	Lecturer	Student
1	Learnability	82,4	84,6
2	Efficiency	80,6	82,5
3	Memorability	83,6	87,5
4	Errors	86,4	85,6
5	Statisfication	81,4	82,4

Discussion

The findings of this study offer significant conceptual implications for strengthening theories of communication and inclusive learning, particularly within the context of higher education. The development of the Talkbuddy application demonstrates that digital media

can function not only as a tool for content delivery but also as an effective means of two-way communication for deaf students. This supports the expansion of the concept of Universal Design for Learning (UDL), wherein educational technologies are designed to be accessible to all learners, including those with special needs. Accordingly, this study enriches the body of literature related to instructional design tailored to special needs education.

From a media development perspective, the findings confirm that integrating visual communication features, text, and interactive learning materials within a single application can effectively address the challenges of teaching and learning in inclusive classrooms. This underscores the necessity for media development approaches to comprehensively consider user characteristics, including sensory barriers such as hearing impairments. Therefore, Talkbuddy can serve as an initial model for the development of similar applications targeting other disability groups, thereby expanding the scope of innovation in technology-based inclusive education.

Practically, the Talkbuddy application provides a tangible solution for lecturers and institutions to support teaching and learning processes involving deaf students. The application not only facilitates the visual and interactive delivery of English and Statistics materials but also enables deaf students to engage actively in the learning process. These implications indicate that the use of digital applications can enhance student engagement, comprehension, and active participation in academic activities. The results of this study may serve as a foundation for higher education institutions to design more systematic policies and programs for the development of inclusive learning technologies. The Talkbuddy application also holds potential for adaptation by special education schools, training centers, or course institutions that serve learners with communication barriers. Thus, this research contributes not only theoretically to the fields of education and technology but also practically to improving the quality of educational services for students with special needs. The following is a discussion of the Talkbuddy research findings.

1) Concept

This study began with a needs assessment of deaf students at Pamulang University in relation to their participation in English and Statistics courses, which still heavily rely on verbal communication without adequate visual support. Interview findings revealed that these students faced difficulties in understanding pronunciation, technical terminology, and participating in classroom discussions due to the absence of media that support two-way text-based communication. To address these challenges, the TalkBuddy was developed, featuring voice-to-text functionality, interactive visual modules, subtitled educational videos, and text-based discussion forums. These features were designed to create a more inclusive and accessible learning environment for deaf students. This challenge is compounded by the lack of digital platforms that are able to support text-based two-way communication and provide access to learning materials in a form that can be understood well by students with hearing impairments (Pradikja Hendra et al., 2018).

In response to this need, the *concept of the TalkBuddy* application was developed which is designed to bridge the gap between communication and information access. Features such as voice-to-text allow deaf students to get instant transcriptions of lecturers' oral explanations, which is especially useful when taking English and Statistics classes. In addition, there are visual learning modules and educational videos, which feature English content with subtitles as well as explanations of Statistics using animations and graphics. The discussion group feature also allows students to ask questions and discuss in real time with lecturers and classmates in the form of text, creating an inclusive collaborative learning space.

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The development of this application refers to the Design Thinking framework as stated by (Walker et al., 2019), which is a design approach that focuses on the needs of users as the center of the innovation process. By delving directly into the experiences of deaf students, TalkBuddy is designed in an empathetic and solution-oriented way, where each feature is present to address the real barriers they face in understanding English and Statistics. The voice-to-text feature, for example, is not only a transcription aid, but also a means of learning vocabulary and sentence structure in English through consistent exposure to text.

Furthermore, this developmental approach is also in line with the Universal Design for Learning (UDL) theory from (Rose, 2001), which emphasizes the importance of learning design that is accessible to all students without exception. In this context, TalkBuddy presents English material with a visual structure and Statistics with a narrative-visual approach, so that students not only read numbers or symbols, but also understand their meaning through a visual context. This initiative is also in line with (Apriyanti & Puspitasari, 2024) thinking that inclusive education technology must consider the diversity of user characteristics, especially in digital learning that is increasingly growing.

Other literature studies that form the basis for the development of this application include the view of (Arnett, 2017) who affirm that the development of technology that is able to respond to the needs of people with disabilities is an integral part of achieving educational equity. By providing an inclusive communication and learning platform, TalkBuddy is an essential tool in supporting deaf students to take verbal-auditory English and Statistics lessons that require an understanding of numerical and visual data. In line with that, Meijer (2020) highlights the importance of technology-based communication as a link between students with disabilities and the academic environment, which is increasingly manifested in the design of this application.

TalkBuddy's contribution in supporting educational inclusion also emphasizes that access to adaptive learning information and materials is part of the right to equal education. (Lawal et al., 2024) mentioned that inclusive technology is the key to ensuring the full participation of students with special needs in the learning environment. Therefore, the presence of this application is not only a means of learning aid, but also as a tool for social transformation in creating a more friendly and empowering academic space. Thus, the stage of identifying needs and developing TalkBuddy is an important foundation in creating an inclusive digital learning environment, especially in supporting deaf students at Pamulang University to better understand English and Statistics. This step also reflects real efforts in implementing the principles of justice and equal access to technology-based higher education.

2) Design

At the design stage, the main concern is the development of application prototypes using *the Human-Centered Design* (HCD) approach, which aims to create a solution that is not only functional but also easily accessible to users with special needs. In this case, deaf students at Pamulang University are the main user group that is prioritized in the development of the application interface. The app is designed with a simple and intuitive interface, as well as clear color contrast to support visibility, making it easy for deaf users, especially in English and statistics learning.

Deaf students often face difficulties in learning English, especially in understanding material that involves verbal aspects and verbal communication. The use of English in an academic context is also a big challenge, as they need to understand technical terms, sentence structure, and the ability to speak or discuss in English. The same is true in learning statistics,

where instructions or math problems involving data analysis and calculations are often delivered orally or in the form of graphs that require verbal explanation (Pane et al., 2017). Difficulty in accessing information visually or listening to oral explanations is a major obstacle to achieving a deep understanding of this material.

To address this problem, a prototype of the TalkBuddy app was developed with features such as *voice-to-text* and *text-to-voice*, which allow deaf students to convert verbal conversations into text, as well as listen to the text they read. These features not only help in communicating effectively, but also allow deaf students to more easily take English and statistics lessons, which often require verbal interaction and an understanding of abstract concepts explained orally. The appearance of Talkbuddy is:

Figure 2. The Visual Design of the TalkBuddy

In addition, access to text-based learning modules and discussion groups was also developed to help deaf students better engage in academic discussions and understand the material more deeply. For example, in English learning, text-based discussion groups provide a space for students to practice writing and reading in English without having to rely on speaking skills. The same is true in statistical learning, where text-based discussions allow students to talk about data analysis or calculation without being constrained by verbal communication barriers.

This prototype was tested with two deaf students through simulations to assess the feasibility and effectiveness of the existing features. This initial testing aims to get feedback on the basic functionality of the app, with a focus on how the app can help students access and understand English and statistics learning materials (Park & Shea, 2020). The results of this test provided positive feedback on the ease of use of the interface and the functionality of key features, indicating that the design of this app is in line with the real needs of deaf users in the context of academic learning.

Research by (Koehler et al., 2013) states that apps designed for users with special needs should prioritize simple, user-friendly interactions. So does Schneiderman & Plaisant (2019), who emphasize the importance of simplicity in interface design to maximize user comfort and efficiency. Taking into account the characteristics of deaf users, the TalkBuddy app is designed to minimize the technical barriers that may arise due to complex design, allowing deaf students to focus more on understanding the English and statistics material they are studying.

Furthermore, research by Norman (2020) states that designs that focus on user experience can promote more effective interactions in applications. In this regard, the TalkBuddy app seeks to reduce communication barriers and increase the active participation of deaf students in English language learning and statistics. For example, the use of *the text-to-voice* feature is very helpful for students in understanding terms or explanations in statistics that require verbal interpretation. Similarly, English language learning that involves listening practice and speaking skills can be facilitated by the use of these features, so that they can more easily interact in the context of learning. Thus, the design stage of the TalkBuddy app not only includes the development of functional features, but also ensures

that the app meets the specific needs of deaf students in the face of difficulties in learning English and statistics.

3) Material Collecting

At the material collection stage, the main focus is to gather the technical components necessary for application development, with special attention to the software and API libraries that will support the implementation of the application's features. The use of this API library allows the TalkBuddy application to support smoother two-way communication between deaf students and other students, given that English is an academic course that demands listening and speaking skills. In learning English, the ability to understand verbal conversation is crucial, whereas in learning statistics, students are often confronted with technical terms and formulas that are usually explained orally (Rival Kurniawan et al., 2023). The use of Google Speech-to-Text and Text-to-Speech allows deaf students to access and understand these materials more easily and without barriers to verbal communication.

Material selection at this stage refers to the theory *of Sustainable Material Selection* (Ashby, 2020), which emphasizes the importance of choosing tools and software that are not only efficient but can also support the sustainability of application development in the long term. Android Studio and Google's API libraries were chosen because they both have a strong reputation in app development, are easily accessible, and have extensive community support. This advantage guarantees that the TalkBuddy app can be continuously updated with new features and relevance that is maintained. This is especially important in the context of English language learning and statistics, where the needs of deaf students are constantly evolving, and applications need to remain adaptive to technological developments (Hikmalansya, 2016).

The use of a proven API library also allows for optimal integration of apps with Android systems, which improves app performance and user experience. This, as stated by (Sun & Eisenman, 2021), ensures that applications can run efficiently, reduces the potential for technical errors, and promotes a more seamless interaction between deaf students and the learning materials provided. These technical qualities contribute directly to the app's effectiveness in supporting English language learning and statistics. The success in the collection and selection of these technical materials, as suggested by (Parmar et al., 2024), also supports the sustainability and resilience of the TalkBuddy app project. They emphasize that the efficient and ever-evolving use of technology is essential to ensure that applications remain relevant and can meet the long-term needs of users.

***4)* Assembly**

In *the Assembly* stage, all of the core components of the previously developed application, such as voice-to-text, text-to-speech features, learning modules, educational videos, and virtual discussion rooms are combined into a complete and integrated learning platform. In the context of learning English and statistics, two areas that have their own challenges for deaf students, voice-to-text and text-to-speech features are important means of facilitating access to learning materials. English, with its complex phonetic and idiomatic structure, often poses comprehension barriers for deaf students (Bala & Song, 2020). Similarly, in statistics, an understanding of mathematical terminology and verbal instructions requires clear visual and textual support. With the app's ability to convert voice to text and vice versa, the learning process becomes more participatory and communicative.

This assembly process follows the principles *of Lean Development* (Womack & Jones, 2018), which emphasizes efficiency by avoiding features that do not provide direct value to the user. Each combined application component has been prioritized based on the real needs of the user, so that time and resources can be optimized to the maximum. In

addition, *the Agile Development* approach is also applied, where development is carried out iteratively and responsively to the feedback obtained from the testing stage. This allows for continuous improvement of features and rapid adaptation to the needs of students, especially in answering their difficulties in understanding foreign language terms and abstract statistical concepts.

System integration in this process also refers to the idea of (Kumar Basak et al., 2018), who affirm the importance of harmonious collaboration between subsystems in technology development. In this case, the efficient integration between learning features, inclusive interfaces, and communication functions reinforces the app's role as a disability-friendly, adaptive learning tool. The development of TalkBuddy not only addresses the need for technical accessibility, but also provides a more meaningful learning experience for deaf students in understanding English as an international language and statistics as an important analytical tool in higher education (Siemens et al., 2019).

5) Testing

During the testing phase, the *TalkBuddy* application was trialed on a limited scale with two deaf students to evaluate the functionality and relevance of its features in English and Statistics learning. This evaluation employed observation, interviews, and questionnaires as data collection methods. The results indicated that the voice-to-text, text-to-speech, and text-based discussion group features significantly enhanced students' understanding of the material, particularly in overcoming phonetic difficulties and technical terminology. The testing followed a User Acceptance Testing (UAT) approach, which emphasizes the importance of direct user involvement, and yielded positive feedback regarding usability, accessibility, and the alignment of the design with the visual learning styles of deaf students. These findings suggest that the application has strong potential to effectively support inclusive learning (Rubin & Chisnell, 2020).

Theoretically, this success is in line with the principle *of Inclusive Learning Design* put forward by Crispin and Gregory (2020), which states that learning technology must be adaptive to the variation in students' abilities and needs. The *TalkBuddy* app is designed with an inclusive spirit that not only removes communication barriers, but also facilitates the understanding of complex material such as statistics and foreign languages through a multimodal (visual-audio-textual) approach. This is crucial considering that both courses require conceptual and symbolic understanding that is often difficult for deaf students to reach without the right technological support.

The test results show the effectiveness of the TalkBuddy application in enhancing the participation and comprehension of deaf students in English and Statistics learning, it can be seen from the increase in post-test scores from an average of 67 to 78 among three deaf students. The application holds considerable potential for further development as an inclusive, technology-based educational solution. Its promising outcomes suggest that TalkBuddy could be widely adopted within higher education institutions to support accessible and equitable learning environments.

6) Distribution

Following the initial testing, the *TalkBuddy* application was distributed on a limited basis via the Google Play Store (in beta mode) to deaf students at Pamulang University for field testing. This distribution was supported by promotional efforts on social media and collaboration with inclusive student communities, which helped expand user participation and feedback. Students reported that the text-to-speech feature was particularly helpful for understanding English pronunciation, while the voice-to-text function facilitated reading questions and comprehending terminology in Statistics. Additionally, the interactive modules

within the application were considered effective in supporting the understanding of fundamental statistical concepts.

This distribution approach is in line with the *theory of Go-to-Market Strategy* (Moorman & Rust, 2019), which emphasizes the importance of a product launch strategy that is geared towards the core audience first before reaching a wider market. In this context, deaf students are an important initial target to get validation of the application's functions directly. In addition, beta-based distribution also provides room for continuous iteration, as described in the principles of *Customer-Centric Marketing* by Kotler & Keller (2019), which underscores the importance of tailoring product features to specific user needs.

Furthermore, this distribution strategy also reflects the concept *of Innovator's Dilemma* from (Rival Kurniawan et al., 2023), where technology developers should focus first on niche markets to test the usability and impact of innovation. In this case, deaf students who have difficulty learning English and Statistics are the main users who benefit greatly. Distribution through platforms like Google Play Store facilitates easy access, seamless updates, and real-time data collection, enabling continuous improvement of TalkBuddy to enhance learning comfort and effectiveness. Initial feedback from the UNPAM community shows the app effectively overcomes communication barriers for deaf students, especially in English and Statistics, boosting their understanding, confidence, and active participation in academic discussions. Features like automatic subtitles, grammar visualizations, and simulation graphics make complex subjects more accessible, fostering an adaptive and disability-friendly learning environment. Overall, TalkBuddy demonstrates strong potential as a model for inclusive education, with opportunities to expand its use to other disabled groups facing challenges in conventional learning settings.

Conclusion

Based on the findings and discussion, it can be concluded that the Talkbuddy application enhances communication accessibility and supports inclusive learning processes in English and Statistics courses, with average scores in alpha and beta testing exceeding 80, indicating a high level of feasibility. This application not only facilitates access to learning materials but also fosters an inclusive and communicative digital learning ecosystem. Deaf students are no longer passive recipients of information but become active participants in the learning process, supported by the following features: (1) voice-to-text and text-to-speech features address audiocommunication barriers; (2) visual modules and educational videos enhance understanding of complex concepts; (3) text-based group discussions promote collaborative and inclusive learning; (4) story feature facilitates self-expression and social engagement; (5) integrated access to unpam website supports academic connectivity.

Recommendation

Based on the findings, lecturers are encouraged to integrate apps like TalkBuddy with inclusive strategies, visual aids, sign language, and interactive activities, to support deaf students. Policymakers should fund accessible educational technologies to ensure equal learning opportunities. Future research should explore the long-term impact of such apps on deaf students' academic and social development in inclusive classrooms.

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is hoped that the TalkBuddy app will support learning communication for deaf students, particularly in English and statistics, and benefit all levels of education.

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