

The Knowledge and Use of Speech Therapy Mobile Applications: Speech-Language Pathologists' Perspectives in Malaysia

Afiqah Iylia Kamaruddin^{1,2*}, Maslin Masrom¹, Mohd Azmarul A Aziz³, Maria Garraffa⁴, Norliza Mohd Noor¹

¹Razak Faculty of Technology and Informatics,
Universiti Teknologi Malaysia, Kuala Lumpur, MALAYSIA

²Pusat Rehabilitasi PERKESO Tun Abdul Razak, Melaka, MALAYSIA

³Speech Pathology Program, School of Health Sciences,
Universiti Sains Malaysia, Kubang Kerian, MALAYSIA

⁴University of East Anglia,
Norwich, UNITED KINGDOM

*Corresponding Author

DOI: <https://doi.org/10.30880/ijie.2023.15.03.003>

Received 30 October 2022; Accepted 29 December 2022; Available online 31 July 2023

Abstract: Technology incorporation in speech therapy has been growing over the years. Mobile applications are among the adoptions that facilitate delivering speech therapy services. The situation in Malaysia is discouraging because there are not enough speech-language pathologists (SLPs) to serve the growing number of populations. Despite the abundance of available speech therapy mobile applications in the market, there is a lack of information focusing on the SLP's knowledge and usage perspectives, especially in Malaysia. The objectives of this study are to describe the knowledge and usage perspectives of speech therapy mobile applications among SLPs in Malaysia and to analyze the instructional features and functional features relationships within the perspectives of SLPs. Surveys are established in three parts, with demographic questions in Part A, Likert scale responses for statements in Part B, and open-ended questions in Part C. This study is co-designed to relate to the results from an initial study that adopted PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) and features analysis. The data from the initial study includes a review of 161 apps out of 1797 that have been identified. Five instructional features and nine functional features are presented. There are 35 SLPs participating in the survey. Their responses demonstrate evidence of SLPs' knowledge and usage of speech therapy mobile applications. We will propose a conceptual framework for the features of speech therapy mobile applications, using people with aphasia as a point of reference for users with speech and language disorders.

Keywords: speech therapy, mobile applications, SLP, mHealth, technology

1. Introduction

Speech therapy has a significant role in the rehabilitation of people with speech and language disorders. Speech-language pathologists (SLPs) are responsible for delivering speech therapy during the rehabilitation process for patients. SLPs are responsible for screening, assessing, diagnosing, and treating people with speech and language

*Corresponding author: afiqahiylia@graduate.utm.my

2023 UTHM Publisher. All rights reserved.

penerbit.uthm.edu.my/ojs/index.php/ijie

difficulties [1]. In general, it is indisputable that the demands for speech therapy need to be supported by sufficient SLPs. The situation in Malaysia is not superlative, which is reinforced by the data from the statistics. The ratio of SLPs to population is a startling 1 to 100,000 people [2]. In Malaysia, there are approximately 300 SLPs who are qualified as of 2019 [2]. The differences are massive compared to more than 175,000 ASHA-certified (American Speech-Language-Hearing Association) SLPs [3].

Speech and language disorders are common in children and adults. Aphasia is one of the common language disorders affecting adults. Common causes of aphasia are stroke, traumatic brain injury, brain tumors, brain surgery, brain infections, and neurological diseases such as dementia. Aphasia severity can vary from very mild to severe. It can affect either a single aspect of language use such as retrieving objects' names or the ability to produce sentences or even affecting literacy skills such as reading [1]. 'Golden time' which lies between the first six months to one-year post-stroke is crucial in aphasia rehabilitation. Spontaneous recovery and intensive therapy could lead to better outcomes for PWA. Based on existing research, the hypothesis on the success rate of aphasia therapy is therapy should be intensive instead of focusing on the approach [4,5,6].

With the advancement of technology and information sharing, awareness of speech and language disorders is increasing at the community level. Thus, the demand for speech therapy services is intensifying. Looking at the situation in Malaysia [2], the delivery of traditional face-to-face therapy seems elusive and incapable of early intervention for some patients. Barriers like cost, socioeconomic trauma, and immobility in aphasia cases contribute to the lack of receiving intensive therapy [7]. Some studies put forth the issue of getting intensive traditional therapy for people with aphasia (PWA) which relates to the limitations of qualified SLPs and resources, cost, and immobility [7,8].

The delivery of healthcare services is improved using apps. Mobile health (mHealth) is presently the trend in which the term signifies the usage of mobile devices and technologies in healthcare services [13]. mHealth offers a cost-effective and efficient approach that allows healthcare providers to deliver their services even in rural areas [13]. Particularly in speech therapy services, studies have reported several good quality apps that benefit users in supplementing the lack of intensive therapy [14,15,16]. In 2019, 36.1% of pediatric SLPs responded that apps are most useful for intervention compared to other areas of use (parent education, clinical information, assessment, and client education) [17].

Technology incorporation in speech therapy is becoming increasingly common. Furthermore, the effects of the pandemic are causing integration to evolve and become acceptable to many SLPs and patients. Research has shown that patients with language and cognitive deficits that utilize self-delivery apps improve on iPad-based tasks and standardized tests [9]. Regardless of the therapy approach used, intensive therapy benefits patients [10,11]. The use of speech therapy mobile applications (apps) has been adapted to serve as therapy approaches to compensate for the lack of SLPs. Studies over the last few years have supported the feasibility of apps as an auxiliary for the lack of face-to-face therapy sessions [12].

Presently there are existing mobile applications that target to improve the language skills of PWA to compensate for the lack of SLPs. Available resources are existing in languages such as English, French, Spanish, and German. However, cultural, and linguistic differences appear challenging for adaptation to the Malay language for PWA in Malaysia. Some of the known apps for PWA are Constant Therapy, Proloquo2Go, and Tactus Therapy. Those apps focus on speech and language skills for PWA. The features of the apps are categorized as instructional features and functional features to identify the factors for the adoption of the apps as speech therapy tools.

The instructional features refer to the speech therapy components which help set up suitable target goals for PWA improvement. Suitable and specific goals from the expectation of PWA and caregivers combined with consultation from SLP is a principle to a holistic approach to aphasia rehabilitation. PWA and caregivers' opinions ensure SLP plans therapy goals according to the current individuals' needs. Meanwhile, functional features focus more on users' friendly approach and appropriateness of support functions in the apps. Those features need to be incorporated carefully to cater to the requirement of users' needs with consideration of other functional disabilities such as physical or cognitive limitations. Positive user experience is the key requirement to make certain users get the full benefits from the app's usage. Hence, increase the likelihood of consistent app usage to achieve the speech therapy goals.

In this article, we put focus on the knowledge and usage perspectives of speech therapy mobile applications for SLPs in Malaysia. The first phase of the study highlighted the instructional and functional features of a mobile application for speech therapy [14]. Then the information is synthesized and surveys are developed to further answer the objectives of this study. Thus, this study aims (i) to describe the knowledge and usage perspectives of speech therapy mobile applications among SLPs in Malaysia and (ii) to analyze the instructional features and functional features relationships within the perspectives of SLPs.

2. Materials and Methods

Mobile apps that were used in the study were analyzed to propose instructional features (speech therapy components) and functional features (non-linguistic components and technology components) of speech therapy mobile applications for PWA. There were eligibility criteria set in order to identify all the suitable apps to analyze the features. Apps selection was based on keywords search that includes a few terms related to speech therapy e.g., aphasia and

speech therapy. There were a total of 1797 apps identified from the Google Play store (993) and Apple App Store (804) based on the keywords search. From that, 161 apps were eligible based on the inclusion criteria.

Co-design methods were incorporated as well to elicit users’ needs and perspectives of speech therapy mobile apps specifically for PWA. Therefore, questionnaires were developed to achieve the objective. SLPs were set as target participants of the survey based on their significant role in aphasia therapy and as advocates for speech therapy mobile applications usage in aphasia therapy. The questionnaires were validated by qualified and experienced SLPs.

2.1. Data Used in This Study

The data used in this study were collected through a survey done by the SLPs in Malaysia. The participants were selected through convenience sampling and reached out by means of social media and emails. Approximately more than 200 SLPs were reached out and there were 35 SLPs participated in the survey.

2.2. Operational Research Framework

The steps taken in this study are aligned with the operational research framework [18] to achieve the objectives. Fig. 1 showed the operational research framework of the study in the sequence of phases.

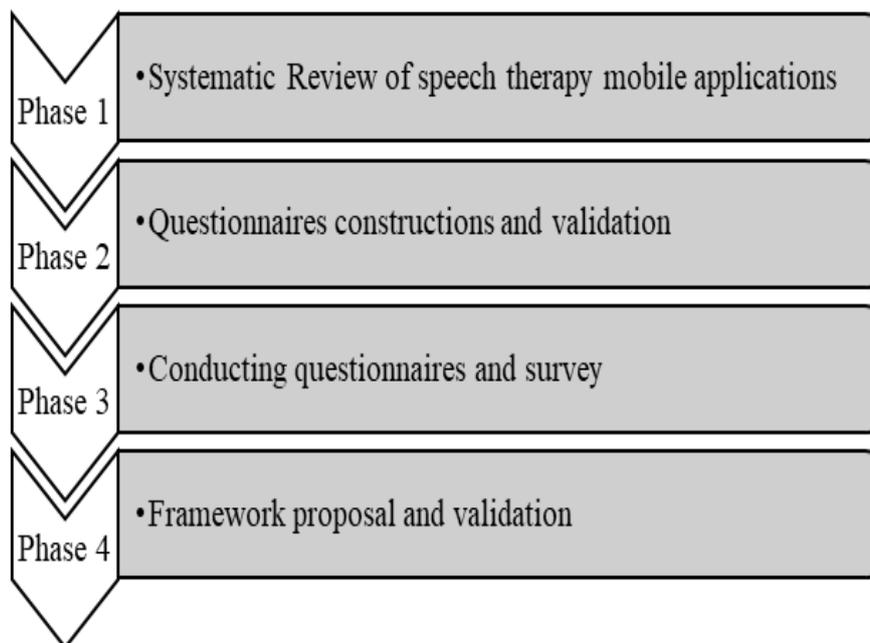


Fig. 1 - Operational research framework [18]

2.2.1 Phase 1: Systematic Review of Speech Therapy Mobile Applications

In phase one, PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was adopted to review 161 eligible apps out of a total of 1797 apps identified. Apps selection was based on keywords search in the Google Play Store and Apple App Store. Inclusion criteria for the apps were free apps and targets for speech, language, and communication. Meanwhile, paid apps, apps built for learning a new language, and apps for assessment only are excluded. The PRISMA flow diagram [18] in Fig. 2 depicts the process of summarizing and analyzing the app selection compilation.

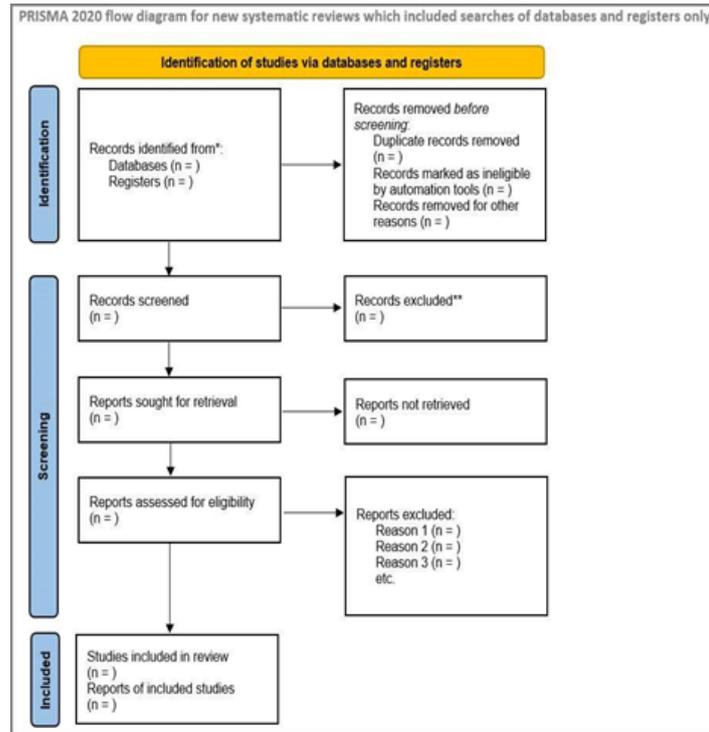


Fig. 2 - PRISMA flow diagram [<https://guides.lib.monash.edu/systematic-review/prisma>]

2.2.2 Phase 2: Questionnaires Constructions and Validation

Previous studies [19,20] have suggested the implementation of a co-design of a systematic review and including end users' perspectives in analyzing the quality of speech therapy mobile applications. Therefore, surveys are established in phase two to ensure those users' insights are considered. The surveys were constructed to yield the objectives of the study and allow for more open-ended questions to be embedded. Three qualified and experienced SLPs revised the questionnaires and contributed to the content validity.

2.2.3 Phase 3: Conducting Questionnaires and Surveys

In phase three, participants were recruited through convenience sampling on social media and emails. The informed consent includes details about the researchers, the objectives of the study, the estimated time frame of completing the surveys, and the confidentiality of the data collected. Approximately 200 participants were reached out within four months, and 35 responded within the timeline.

2.2.4 Phase 4: Framework proposal and Validation

Phase 4 is set to be done in the future utilizing the data from systematic reviews and surveys. The proposal of the framework for the speech therapy mobile applications is expected to benefit aphasia therapy as well as PWAs and caregivers.

3. Results and Discussions

Based on the operational research framework, a systematic review of speech therapy mobile applications is done to analyze the features that can be proposed are instructional and functional. Then, followed by the analysis of the surveys to further support the connection between features and the needs of users for the synthesis of the framework to be put upfront as the framework reference for speech therapy mobile apps in the Malay language for PWA.

3.1 Phase 1: PRISMA Review and Features Analysis

A total of 161 apps were eligible for review out of the 1797 apps identified from the Google Play Store (Android) and Apple App Store (iOS). The systematic review commenced with the identification of apps, followed by screening and inclusion of apps for further analysis of features. Fig.3 displays the search and selection process for apps using PRISMA. Fig. 4(a) showed the distribution of apps based on platforms, followed by Fig. 4(b) which displayed the distribution of app prices, and Fig. 4(c) showed the distribution of app categories in detail. The included apps were then

put through the process of feature analysis. The features analyzed are categorized into instructional features, which focus on speech therapy components, and functional features, which are the non-linguistic and technological components, as displayed in Fig.5(a) and Fig.5(b). Each feature is defined in detail for use in surveys, which will serve as the foundation for developing frameworks for mobile apps in Malay for PWA.

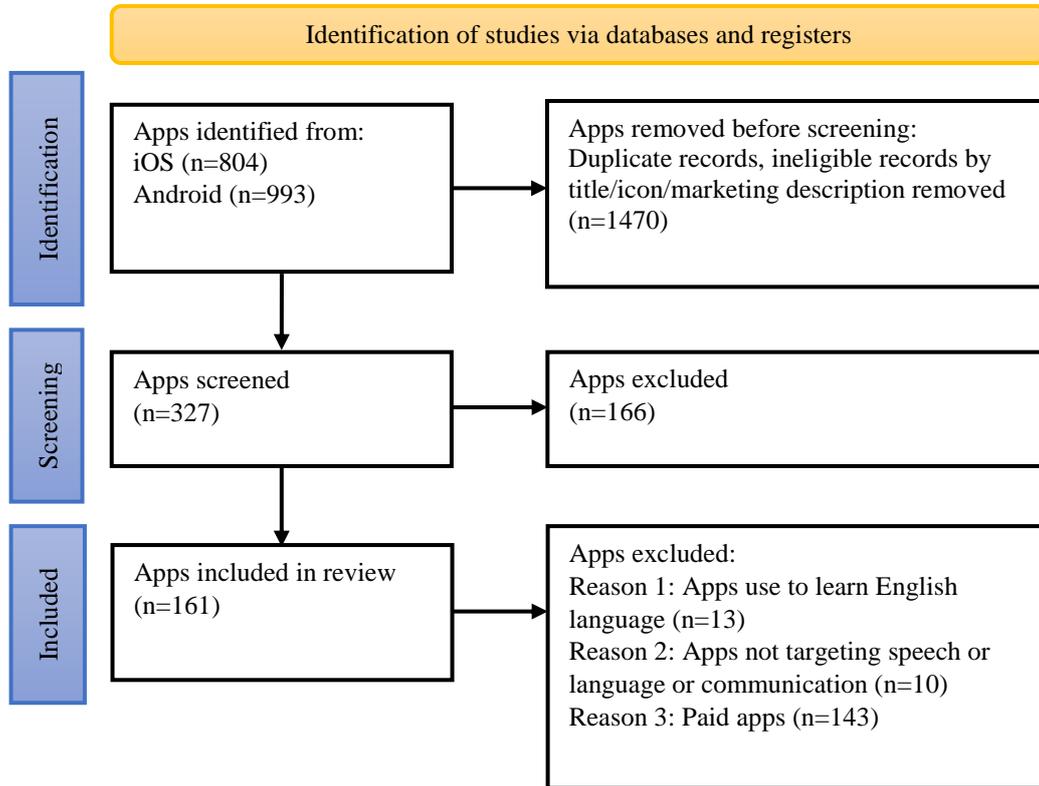


Fig. 3 - Search and selection process for apps [18]

Platform	Number of apps	Percentage (%)
iOS	106	65.8
Android	34	21.2
Both	21	13
Total	161	100

(a)

App Price	Number of apps	Percentage (%)
Free	79	49.1
Free (lite)	82	50.9
Total	161	100

(b)

Category	Number of apps	Percentage (%)
Education	86	53.4
Medical	56	34.8
Health & Fitness	8	5.0
Communication	5	3.1
Productivity	2	1.2
Games	1	0.6
Multiple categories	3	1.9
Total	161	100

(c)

Fig. 4 - Distribution of (a) apps platforms; (b) app price and (c) apps category [18]

Instructional Features (Speech Therapy Components)	Details and Explanation	Functional Features (Non-linguistic Components and Technology Components)	Details and Explanation
Activities	Target speech skills - Articulation (pronunciation of speech sounds) - Fluency - Phonation (voice productions) Target language skills - Comprehension - Speaking - Reading - Writing Communication functions - Cognitive - Memory - Problem-solving	Pictures	Appropriate to the Malaysia cultures and settings Size: big or small
Augmentative and Alternative Communication (AAC)	To facilitate speech and language impairments	Interface and Layout	Pleasant and comfortable Responsiveness and adaptive in consideration of PWA’s physical limitation Simple and not crowded Easy maneuvering
Choices of stimulus (words, sentences, stories, and others)	Need to be varied and culturally appropriate for the Malaysian population	Buttons and Color	Size: big or small
Cues and Prompts	To facilitate self-training and continuation of therapy at home	Font size	Need to cater to PWA (adult to the older generation with reduced vision ability)
Progress reporting	To monitor the progress of SLPs, PWAs, and caregivers	Voice output	Availability of the functions Type of voice: AI voice or human voice with natural intonation
		Settings	Adjustability for: - Speed of reading aloud - Changing the level of difficulty - Add on or reduce the frequency of trials or repetition
		Recording functions	For monitoring (either in audio form or summary of progress)
		Tutorial and explanation	In written and voice recording
		Automatic Speech Recognition (ASR)	For activities targeting verbal expressions

Fig. 5 - Features identified from analysis of the apps (a) instructional features; (b) functional features [18]

3.2 Phase 2: Questionnaires Constructions and Validation

The surveys are constructed into three parts; Part A, Part B, and Part C. Part A is developed to gather information on the demographic data of the participants with a total of eight questions. Part B utilizes the Likert scale to gain participants' opinions on the usage of speech therapy mobile applications. Ten statements are set in part B, with each statement having choices of 1 (strongly disagree/Never) to 5 (strongly agree/Yes) point scale for participants to choose from as the best representation of their opinion. Meanwhile, Part C encompasses the knowledge and opinions of speech therapy mobile applications with an emphasis on five open-ended questions for participants to share their responses comprehensively.

3.3 Phase 3: Part A - Demographic Information

Based on the PRISMA review and features analysis [18], surveys are constructed with the basis of the features as references and emphasis on the SLPs’ perspectives. The demographic data for this study is as in Table 1. There are 35 participants in this study. All 35 participants have given consent to be involved in this study.

Table 1 - Demographic data of participants (SLPs)

Variable	Percentage (%)
Age	
<20 years	0
21 - 30 years	45.7
31 - 40 years	48.6
41 - 50 years	5.7
51 - 60 years	0
>60 years	0
Gender	
Male	5.7
Female	94.3
Race	
Malay	74.3
Chinese	14.3
Indian	5.7
Others	5.7
Marital status	
Single	37.1
Married	62.7
Education level	
Bachelor's Degree	91.4
Master Degree	8.6
Occupational sector	
Government	74.3
Private	20.0
Self-employed	2.9
Unemployed	2.9
Working experience as SLP	
<2 years	20.0
2 - 5 years	20.0
6 - 10 years	31.4
>10 years	28.6
Working with PWA experience	
<2 years	25.7
2 - 5 years	28.6
6 - 10 years	22.9
>10 years	22.9

Among the 35 participants in the study, there are three main age groups. 48.6% of participants are within the age range of 31 to 40 years. While 45.7% are from the group of 21 to 30 years, the remaining 5.7% of SLPs are within the age range of 41 to 50 years. Females are dominant with 94.3%, while males constitute only 5.7% of the total number of participants. 74.3% of participants are Malay, followed by 14.3%, Chinese. Meanwhile, participants who are Indian and others shared the same percentage of 5.7%. There are 62.9% of the participants are married, while 37.1% are single. Of the 35 participants, the majority have a bachelor's degree background of educational level 91.4%. Only a few of them have a Master's degree background, with a percentage of 8.6%. There is variety in the occupational sector of the

participants. The majority came from the government sector (74.3%), followed by 20% of them from the private sector. 2.9% of them are self-employed and another 2.9% are unemployed. In terms of working experience, 31.4% have between 6 to 10 years of experience working as an SLP. 28.6% have more than 10 years of experience. Another 20% of them have 2 to 5 years of experience. There are also 20% of the SLP that have less than 2 years of working experience. Although most of the SLPs have between 6 to 10 years of working experience, the percentage of those working with PWA is different. 28.6% of SLPs have 2 to 5 years of experience working with PWA. Following that, 25.7% of the participants have less than 2 years of work experience with PWA. Experience of 6 to 10 years and more than 10 years of working with PWA, both constitute 22.9% of the participants.

3.4 Part B - Opinions on General Statements of Speech Therapy Mobile Applications

There are ten statements in Part B of the survey. The statements are revolving around the knowledge, opinion, and usage of speech therapy mobile applications. Table 2 are showing the correlation of the statements in Part B. Variations of correlation degree were detected but a positive significant correlation is verified.

Table 2 - Correlations of statements in part B using Pearson Correlation Significant (2-tailed)

	Statement 1	Statement 2	Statement 3	Statement 4	Statement 5	Statement 6	Statement 7	Statement 8	Statement 9	Statement 10
Statement 1	1	.686** .000	.461** .005	.569** .000	.596** .000	.435** .009	.198 .254	.337* .048	.400* .017	.267 .121
Statement 2	.686** .000	1	.713** .000	.566** .000	.568** .000	.481** .003	.309 .071	.537** .001	.589** .000	.222 .201
Statement 3	.461** .005	.713** .000	1	.420* .012	.490** .003	.290 .091	.406* .015	.585** .000	.636** .000	.420* .012
Statement 4	.569** .000	.566** .000	.420* .012	1	.806** .000	.472** .004	.219 .206	.533** .001	.542** .001	.329 .053
Statement 5	.596** .000	.568** .000	.490** .003	.806** .000	1	.363* .032	.135 .440	.498** .002	.492** .003	.339* .046
Statement 6	.435** .009	.481** .003	.290 .091	.472** .004	.363* .032	1	.063 .720	.532** .001	.459** .006	.494** .003
Statement 7	.198 .254	.309 .071	.406* .015	.219 .206	.135 .440	.063 .720	1	.134 .443	.223 .199	.164 .347
Statement 8	.337* .048	.537** .001	.585** .000	.533** .001	.498** .002	.532** .001	.134 .443	1	.824** .000	.761** .000
Statement 9	.400* .017	.589** .000	.636** .000	.542** .001	.492** .003	.459** .006	.223 .199	.824** .000	1	.713** .000
Statement 10	.267 .121	.222 .201	.420* .012	.329 .053	.339* .046	.494** .003	.164 .347	.761** .000	.713** .000	1

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table 3 and Fig. 6 display the distribution of responses from all participants. The dispersion of responses is regarding the general statements on the usage of speech therapy mobile applications. Participants are required to

describe their smartphone usage and the utilization of speech therapy mobile applications based on their personal experiences.

Table 3 - Percentage of responses on statements related to speech therapy mobile applications

Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I have speech therapy mobile applications on my smartphone or tablet	10 (28.6%)	2 (5.7%)	1 (2.9%)	5 (14.3%)	17 (48.6%)
2. I use speech therapy mobile applications for the aphasia therapy sessions	9 (25.7%)	4 (11.4%)	4 (11.4%)	13 (37.1%)	5 (14.3%)
3. I use other mobile applications (not categorized under speech therapy) for the aphasia therapy sessions	11 (31.4%)	6 (17.1%)	3 (8.6%)	8 (22.9%)	7 (20.0%)
4. I will recommend the usage of speech therapy mobile applications to PWA and caregivers	3 (8.6%)	0 (0.0%)	5 (14.3%)	15 (42.9%)	12 (34.3%)
5. I always look for available and suitable speech therapy mobile applications to use in therapy sessions or to be suggested for PWA or caregivers	3 (8.6%)	2 (5.7%)	5 (14.3%)	14 (40.0%)	11 (31.4%)
6. I prefer to use speech therapy mobile applications as speech therapy tools	3 (8.6%)	3 (8.6%)	14 (40.0%)	11 (31.4%)	4 (11.4%)
7. I have a problem with the usage of speech therapy mobile applications as speech therapy tools	7 (20.0%)	5 (14.3%)	14 (40.0%)	8 (22.9%)	1 (2.9%)
8. My client showed a positive response to using speech therapy mobile applications as speech therapy tools	2 (5.7%)	5 (14.3%)	13 (37.1%)	14 (40.0%)	0 (0.0%)
9. My client showed good improvement with the usage of speech therapy mobile applications	2 (5.7%)	5 (14.3%)	12 (34.3%)	14 (40.0%)	2 (5.7%)
10. My client prefers to use speech therapy mobile applications as speech therapy tools	3 (8.6%)	7 (20.0%)	19 (54.3%)	6 (17.1%)	0 (0.0%)

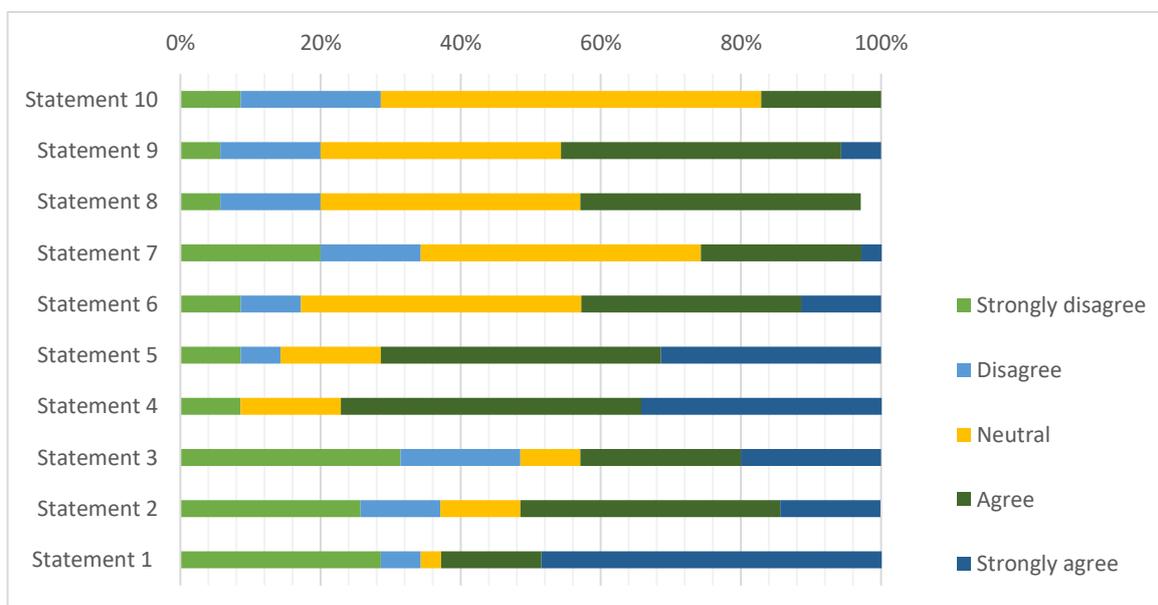


Fig. 6 - Percentage of responses on statements related to speech therapy mobile applications

There are 48.6% of the participants strongly agree that they have speech therapy mobile applications on their smartphone or tablet while 28.6% strongly disagree. For statement 2 ‘I use speech therapy mobile applications for the aphasia therapy sessions’, 37.1% of participants agreed. The responses for statement 3 showed that 31.4% are not using non-aphasia-specific mobile applications for aphasia therapy. Most of the responses for statement 4 are positive to recommend the usage of speech therapy mobile applications to PWA and caregivers. There are 71.4% agreed responses for statement 5 of ‘I always look for available and suitable speech therapy mobile applications to use in therapy sessions or to be suggested for PWA or caregivers. Responses for statement 6 and statement 7 yield more neutral responses from the SLPs. In response to statements 8 and 9, 40% SLPs agree that their client showed improvement in the usage of speech therapy mobile applications. Most of the SLPs responded neutrally with statement 10 ‘My client prefers to use speech therapy mobile applications as speech therapy tools.

Statement 1 until statement 6, concentrates on the SLPs’ knowledge and opinions on the general usage of speech therapy mobile applications. Most participants possess at least one speech therapy mobile app on their phones. This suggests that the awareness of the existence of speech therapy mobile applications in the market and the willingness of SLPs to try out the apps may have prompted the attempt to try out the apps. Responses to the second statement could be the supporting act of participants’ agreeing to use the apps in therapy sessions. Although there may be a conflict in participants’ willingness to try out non-specific or non-categorized apps for therapy sessions, as stated in statement 3, 31.4% strongly disagreed. This situation may be supported by the statement that the adoption of mHealth is positively associated with trust, apparent practicality, and ease of use [13]. Mobile apps that help with aphasia therapy will be seen as more helpful and convenient than mobile apps that do not help with aphasia therapy.

The combination of agreeing and strongly agreeing with responses to statement 4 is suggestive of the promising utilization of speech therapy mobile apps as speech therapy tools. Recommendations of speech therapy approaches are part of the professional role of SLPs [18] and benefit PWAs and caregivers in their rehabilitation journey. Further indicators of promising usage of speech therapy mobile apps can also be noted as there is a positive correlation to the statement 5 responses. The total percentage of participants who agree or strongly agree with statement 5, indicating that they are actively exploring speech therapy mobile apps, is greater than 70%. The preference for using speech therapy mobile apps as speech therapy tools in statement 6 has neutral responses more than agree [13]. When it comes to preference, a deduction can be made that effort, motivation, and cost may be the key factors in adopting the usage of mobile apps. 40% responded neutrally to statement 7. However, disagreement (strongly disagree and disagree) with statement 7 is more than responses that agree (agree and strongly agree).

Statements 8 and 9 both emphasize the PWAs’ responses as perceived by the SLPs. 40% of the participants agreed that their patients had positive responses and good improvement. Although the neutral responses are not too far behind, it may suggest that SLPs do notice improvement and the willingness of patients to utilize speech therapy mobile apps. For statement 10, 54.3% responded neutrally. The statement shares the same sentiment of preferences as in statement 6. Responses from patients could give more insight regarding preferences and can be a subject for discussion in the future.

3.4 Part C - SLPs' Knowledge and Opinions on Speech Therapy Mobile Applications

Part C consists of five open-ended questions. The resolution for open-ended questions is to elicit more responses from the SLPs’ perspectives. Responses from participants will be incorporated into the relationship for the first study of features analysis. For the first question, 60% of the participants responded yes, while 37.14% responded no, and 2.86% responded maybe. Table 4 displays the distribution in frequency and percentage. However, no explanation as to why the participants selected either the yes or the maybe or the no response was gathered from them.

Table 4 - Question 1 response result

Question 1 response	Frequency (percentage)
Do you use a mobile application during a speech therapy session? Can you explain why?	
Yes	21/35 (60%)
Maybe	1/35 (2.86%)
No	13/35 (37.14%)

The responses received for the second question are tabulated in Table 5. The list of apps that have been used by participants in their therapy sessions is listed based on the frequency of mention in the surveys. The top three most mentioned mobile speech therapy apps are *Let Me Talk*, *Alexicom* and *SymboTalk*. These three mobile apps can be used for aphasia therapy or other speech and language disorders, but most of the time they will be used as augmentative and alternative communication (AAC). It can be observed that most of the apps mentioned are mainly used as AAC and are

flexible enough to be used to target more than one target goal in a therapy session. The results displayed represent the connection to the first study of features analysis [18] in which AAC is one of the instructional features proposed as a speech therapy mobile app’s component. Some of the apps mentioned are constructed specifically with focus therapy goals like *Oral Motor Exercise* (target the oral motor functions), *Singscope* (target the pitch control training), and *Avaz* (reading dyslexia training). One of the instructional features mentioned in [18] is activities and this highlight the components of speech and language therapy target areas in therapy sessions. The variety of the apps mentioned by participants may signify the awareness of existing apps that can be incorporated into the therapy sessions. The responses reveal the functionality of the apps as a speech therapy tool in which SLPs have goals set to achieve for their patients. The use of AAC for communication training, naming tasks, and voice therapy are some of the therapy goals that participants are integrating the apps into their therapy sessions. Interestingly, some of the apps mentioned are not specifically categorized as therapy-intentioned tools, but SLPs merge their expertise and experience to utilize them to achieve speech therapy goals. This shows that SLPs need to have knowledge and experience to figure out how well and how well-suited an app is as a speech therapy tool.

Table 5 - Speech therapy mobile applications list

Speech therapy mobile applications	Frequency of mention (n)	Percentage (%)
Let Me Talk	7	11.9
Alexicom	6	10.2
SymboTalk	6	10.2
Tactus Therapy	5	8.5
Sonoflex	4	6.8
Proloque2go	4	6.8
JabTalk	3	5.1
Oral Motor Exercise	2	3.4
Aphasia therapy online	2	3.4
Lingraphica	2	3.4
Vocalyx	1	1.7
Jellow apps	1	1.7
Malay flash card	1	1.7
English flash card	1	1.7
Avaz	1	1.7
Singscope	1	1.7
PECS IV+	1	1.7
Tell Me App	1	1.7
Vocal Pitch Monitor	1	1.7
Coughdrop	1	1.7
Voice recorder	1	1.7
Cboard	1	1.7
Cognifit	1	1.7
Comboard	1	1.7
Look to speak	1	1.7
Constant Therapy	1	1.7
Talk to me	1	1.7
Text to Speech	1	1.7

Responses received for the third question visualize the perspectives of SLPs towards the features considered before selecting mobile applications for speech therapy. The ‘Easy to use or easy access (for patients and caregivers)’ feature is most mentioned in the survey. There is an n=16 frequency of mention in the responses. The term “easy” is repetitively noted in the responses and this may account for the experience of usage by the SLPs of having any difficulty during the process. Not to mention, as SLPs have expertise in speech and language disorders, they may take

into consideration the difficulties faced by the patients if they were to use an app for therapy. Maybe it is a physical limitation, comprehension difficulties, speaking inability, or cognitive deficits that could be the key factors for SLPs to consider an app for suggestion or utilization for patients. ‘Big font (including editable fonts)’ has an n=14 frequency of being mentioned by participants. Appearance is one of the decision-making factors in adopting an app. A visually appealing and pleasant view of an app can lead to an increase in usage. SLPs consider the factor of ‘big font’ to ensure a pleasant and comfortable experience of app usage for speech therapy. Adults with aphasia certainly benefit from ‘big font’ features, and this increases their motivation to continuously engage in the app’s usage.

Another highly mentioned feature in the responses is the ‘Ability to edit or manipulate (can be personalized, create own material, can save pictures, list of words)’. The frequency of mention is n = 11. Personalization of speech therapy tools is not alien to SLPs as all patients’ difficulties are individualized and have their own target goals. The ability to customize an app without the aggravation of finding a bundle of different apps is substantial to the adoption of the app. Furthermore, the feature to manipulate the apps’ materials can help SLPs cater to patients’ goals within their residual strength to boost their motivation for therapy. Table 6 shows the frequency of mention for five of the most highly mentioned features considered by participants. Based on the features analyzed in [18], the features that are highly mentioned in this study are certainly related. The features in relation are the interface and layout, font size, and settings.

Table 6 - Features considered by participants

Features	Frequency of mention (n)	Percentage (%)
Easy to use	16	17.2
Big font	14	15.1
Ability to edit	11	11.8
Culturally appropriate	8	8.6
Free apps	6	6.5

Table 7 summarizes the three reasons that have been highlighted from the responses by participants. Speech and language disorders revolve mainly around the individuals’ language proficiency. SLPs do need to consider the language used by patients before conducting sessions; assessments, therapy, or consultation. Language plays a vital role in the delivery of treatment approaches. One of the challenges faced by SLPs in Malaysia is the adaptation of available resources to the Malay language. Features in the Malay language have the advantage of PWA in the Malaysian population compared to the adaptation of other languages [21]. Linguistic and cultural differences have an impact on language considerations in speech therapy mobile applications. Those impacts revolve around the motivation and continuation of patients to actively use the apps for speech therapy.

Table 7 - Reasons to consider the language used in speech therapy mobile applications

Reasons for language consideration	Frequency of mention (n)	Percentage (%)
Easier to use in the patient’s environment	10	27
Elicit better response	9	24.3
Easy for carryover as a home-based program	4	10.8

Opinions of SLPs regarding the importance of monitoring and feedback-giving features are being analyzed in question five. The most common responses are ‘for monitoring patient progress. Due to the high ratio of SLPs in Malaysia, patients with speech and language disorders can be difficult to track their progress. Statistics of the SLPs ratio to the population in 2019 have a massive effect on the situation [2]. Manually monitoring each patient’s progress can be exhausting and difficult for SLP. The second highest response to the importance of monitoring and feedback features is ‘to ensure the app is suitable and effective for the patient.’ In dealing with patients with speech and language difficulties, trial and error are inevitable. SLPs might need more time to explore the best app or apps for specific patients to help with their rehabilitation. How important it is to weigh in on whether an app or apps are good for a patient could change depending on how long the rehabilitation process takes.

The third highest response ‘monitoring consistency of usage’ highlighted the importance of having monitoring and feedback features. According to the study [11], PWA will benefit from any treatment approach if the therapy given is intensive. To monitor the patient’s intensity of engagement with an app, the monitoring feature must be incorporated into the app. Reliability of patients’ progress through consistency of usage can imply the successful rate of app

utilization as a speech therapy tool. This makes it more likely that some apps will be suggested to be used as speech therapy tools.

4. Conclusions

The responses indicate that SLPs in Malaysia are aware and, to some degree, have experience in suggesting or training with speech therapy mobile applications. Whether SLPs are exploring the functions of speech therapy mobile applications on their own or testing them during speech therapy sessions, the notion is that SLPs in Malaysia are familiar with the possibility of their use as speech therapy tools. Technology incorporation within the speech therapy area can be further studied irrespective of focusing on pediatric or adult patients. Since this study is a continuation of a previous one [18], there is a clear and strong link between the results.

The significance of the study is emphasized in the instructional features and functional features of speech therapy mobile applications linked to the end user (SLPs) viewpoint as a reference for speech therapy app building. Instructional features (speech therapy components) are set as the anchor of mobile apps to be built as the foundation of building speech therapy apps that serve to supplement the speech therapy sessions and cater to the lack of SLPs. Meanwhile, functional features (non-linguistic components and technology components) wrap the anchor to solidify the integrity of the speech therapy mobile apps to serve as speech therapy tools. By cautiously manipulating these features, speech therapy mobile apps will be able to work on their own to provide speech therapy services.

The proposal of the conceptual framework for speech therapy mobile app features in the Malay language for PWA is recommended as the next plan for this continuation of the study. The involvement of the end users of speech therapy mobile apps, which include SLPs, PWAs, and caregivers, serves as the holistic approach for the planning of development when merged with the best fit features' identification. A conceptual framework can be visualized in Fig.7. Starting with the user identification (in which end users should be identified), followed by the concept generation of the speech therapy mobile application. Concept generation should involve situational analysis using the necessary methods and materials. Following that, specifications will be identified based on the instructional and functional feature selections. Prototype making and usability testing are done before generating the final product. The conceptual framework that comes out of the studies (both past and present) should be used as a starting point for developing future speech therapy mobile apps.

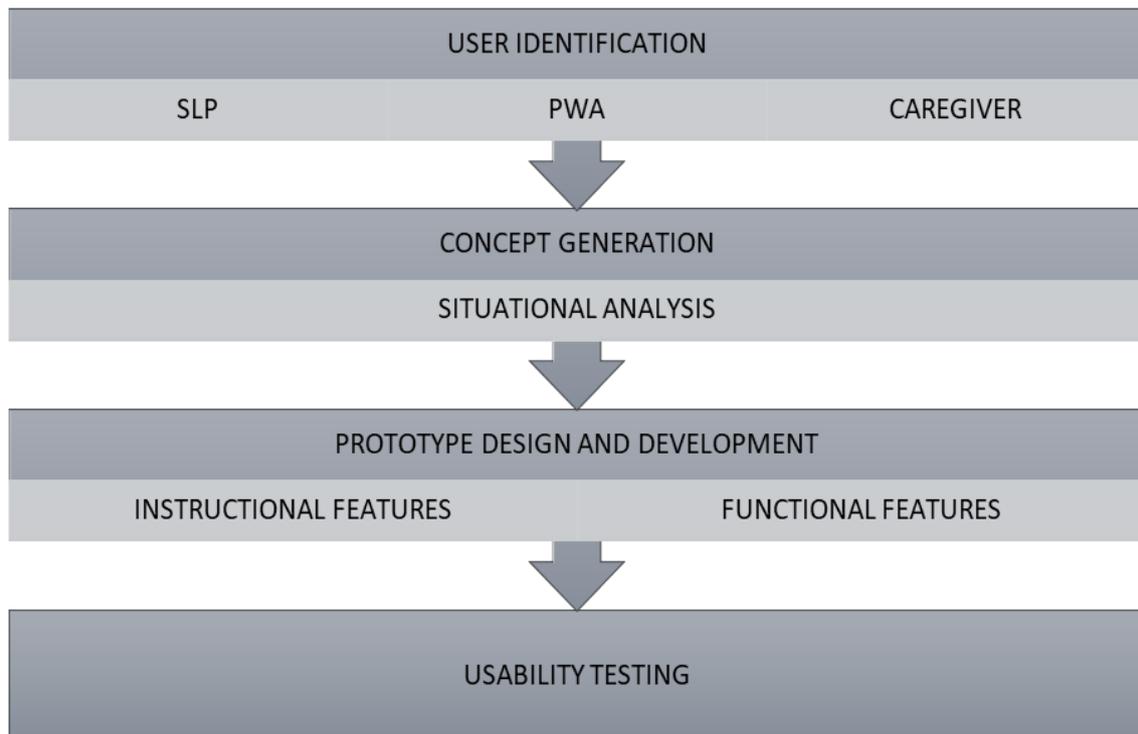


Fig. 7 Conceptual framework of features for speech therapy mobile application (PWA specific)

Acknowledgment

This study is submitted in partial fulfillment of the requirements for the award of the degree of Master of Philosophy, Universiti Teknologi Malaysia. This study is supported by the Ministry of Higher Education Malaysia.

References

- [1] Rohde, A., Worrall, L., Godecke, E., O'Halloran, R., Farrell, A. & Masse, M. (2018). Diagnosis of aphasia in stroke populations: A systematic review of language tests. *PLoS ONE* 13 (3): e0194143. <https://doi.org/10.1371/journal.pone.0194143>
- [2] Chu, S. Y., Khoong, E. S. Q., Ismail, F. N. M., Altaher, A. M., & Razak, R. A. (2019). Speech-Language Pathology in Malaysia: Perspectives and Challenges. *Perspectives of the ASHA Special Interest Groups*, 4(5), 1162-1166. https://doi.org/10.1044/2019_pers-sig17-2019-0005
- [3] The ASHA Leader, Volume: 24, Issue: 7, Pages: 32-32, <https://doi.org/10.1044/leader.AAG.24072019.32>
- [4] Varley, R. (2011). Rethinking aphasia therapy: A neuroscience perspective. *International Journal of Speech-Language Pathology*, 13(1), 11-20. <https://doi.org/10.3109/17549507.2010.497561>
- [5] Mohr, B., Stahl, B., Berthier, M. L., & Pulvermüller, F. (2017). Intensive Communicative Therapy Reduces Symptoms of Depression in Chronic Nonfluent Aphasia. *Neurorehabilitation and Neural Repair*, 31(12), 1053-1062. <https://doi.org/10.1177/1545968317744275>
- [6] Stahl, B., Mohr, B., Büscher, V., Dreyer, F. R., Lucchese, G., & Pulvermüller, F. (2018). Efficacy of intensive aphasia therapy in patients with chronic stroke: A randomised controlled trial. *Journal of Neurology, Neurosurgery and Psychiatry*, 89(6), 586-592. <https://doi.org/10.1136/jnnp-2017-315962>
- [7] Gallacher, K. I., May, C. R., Langhorne, P., & Mair, F. S. (2018). A conceptual model of treatment burden and patient capacity in stroke. *BMC Family Practice*, 19(1), 1-16. <https://doi.org/10.1186/s12875-017-0691-4>
- [8] Rose, M. L., & Attard, M. C. (2015). Practices and challenges in community aphasia groups in Australia: Results of a national survey. *International Journal of Speech-Language Pathology*, 17(3), 241-251. <https://doi.org/10.3109/17549507.2015.1010582>
- [9] Kiran, S., Roches, C. Des, Balachandran, I., & Ascenso, E. (2014). Development of an impairment-based individualized treatment workflow using an iPad-based software platform. *Seminars in Speech and Language*, 35(1), 38-50. <https://doi.org/10.1055/s-0033-1362995>
- [10] Maher, L. M., Kendall, D., Swearingin, J. A., Rodriguez, A., Leon, S. A., Pingel, K., Holland, A., & Rothi, L. J. (2006). A pilot study of use-dependent learning in the context of Constraint Induced Language Therapy. *Journal of the International Neuropsychological Society*, 12(6).
- [11] Cherney, L. R., Patterson, J. P., Raymer, A., Frymark, T., & Schooling, T. (2008). Evidence-Based Systematic Review: Effects of Intensity of Treatment and Constraint-Induced Language Therapy for Individuals with Stroke-Induced Aphasia. *Journal of Speech, Language, and Hearing Research*, 51(5), 1282-1299.
- [12] Hill, A. J., & Breslin, H. M. (2016). Refining an Asynchronous Telerehabilitation Platform for Speech-Language Pathology: Engaging End-Users in the Process. *Frontiers in Human Neuroscience*, 10.
- [13] Agbenyo, J. S. (2019). A Review of Factors that Increases or Reduces the Adoption of mHealth. *International Journal of Research and Scientific Innovation (IJRSI)*, Volume VI, Issue XII, ISSN 2321-2705 www.rsisinternational.org Page 139
- [14] Furlong, L. M., Morris, M. E., Erickson, S., & Serry, T. A. (2016). Quality of Mobile Phone and Tablet Mobile Apps for Speech Sound Disorders: Protocol for an Evidence-Based Appraisal. *JMIR Research Protocols*, 5(4), e233. <https://doi.org/10.2196/resprot.6505>
- [15] Furlong, L., Morris, M., Serry, T., Erickson, S. (2018) Mobile apps for treatment of speech disorders in children: An evidence-based analysis of quality and efficacy. *PLoS ONE* 13(8): e0201513. <https://doi.org/10.1371/journal.pone.0201513>
- [16] Vaezipour, A., Campbell, J., Theodoros, D., & Russell, T. (2020). Mobile apps for speech-language therapy in adults with communication disorders: Review of content and quality (preprint). [doi:10.2196/preprints.18858](https://doi.org/10.2196/preprints.18858)
- [17] Zimmerman, E. (2019) Pediatric Speech-Language Pathologists' Use of Mobile Health Technology: Qualitative Questionnaire Study, Kelsey Thompson, MS, CCC-SLP; Emily Zimmerman, PhD, CCC-SLP, *JMIR Rehabil Assist Technol*, 6(2), e13966.
- [18] Kamaruddin, A. I., Masrom, M., A Aziz, M. A., & Mohd Noor, N. (2021). Speech Therapy Mobile Applications for People with Aphasia: PRISMA review and features analysis. *IEEE National Biomedical Engineering Conference NBEC*, pp. 77-81, DOI: 10.1109/NBEC53282.2021.9618755.
- [19] Vaezipour, A., Campbell, J., Theodoros, D., & Russell, T. (2020). Apps for Speech-Language Therapy in Adults with Communication Disorders: Review of Content and Quality. *JMIR mHealth and uHealth*, vol. 8, no. 10.

- [20] Orehovacki, T., Plantak Vukovac, D., Stapic, Z., & Novosel-Herceg, T. (2017). Features and Quality of a Mobile Application Employed in a Speech Language Therapy. *Lecture Notes in Computer Science*, pp. 250-262.
- [21] Hassan, F. H., Heng, P. W., & Kamal, R. M. (2020). Evaluation of aphasia in a culturally and linguistically diverse context: Practices of and challenges faced by speech-language pathologists.
- [22] Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., McGuinness, L. A., Stewart, L. A., Thomas, J., Tricco, A. C., Welch, V. A., Whiting, P., & Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *Journal of Clinical Epidemiology*, 134, 178-189.
- [23] Archibald, L. M., Orange, J. B., & Jamieson, D. J. (2009). Implementation of computer-based language therapy in aphasia. *Therapeutic Advances in Neurological Disorders*, 2(5), 299-311. DOI: 10.1177/1756285609336548
- [24] Jamal, N., Shanta, S., Mahmud, F., & Sha'Abani, M. (2017). Automatic speech recognition (ASR) based approach for speech therapy of aphasic patients: A review. DOI: 10.1063/1.5002046
- [25] Munoz, M. L., Hoffman, L. M & Brimo, D. (2013). Be Smarter Than Your Phone: A Framework for Using Apps in Clinical Practice. *Contemporary Issues in Communication Science and Disorders*, 40, 138-150. Retrieved from: <https://pubs.asha.org> 14.192.209.56 on 10/14/2020
- [26] Stark, B. C., & Warburton, E. A. (2018). Improved language in chronic aphasia after self-delivered iPad speech therapy. *Neuropsychological Rehabilitation*, 28(5), 818-831. <https://doi.org/10.1080/09602011.2016.1146150>
- [27] Szabo, G. & Dittelman, J. (2014). Using Mobile Technology with Individuals with Aphasia: Native iPad Features and Everyday Apps. *Seminars in Speech and Language*, 35(01), 005-016. DOI: 10.1055/s- 0033-1362993
- [28] Thompson, K. & Zimmerman, E. (2019). Pediatric Speech-Language Pathologists' Use of Mobile Health Technology: Qualitative Questionnaire Study. *JMIR Rehabilitation and Assistive Technologies*, 6(2), e13966. <https://doi.org/10.2196/13966>
- [29] Vuuren, S. V. & Cherney, L. R. (2014). A Virtual Therapist for Speech and Language Therapy. *Intelligent Virtual Agents Lecture Notes in Computer Science*, 438-448. DOI: 10.1007/978-3-319-09767-1_55
- [30] Wade, J., Mortley, J. & Enderby, P. (2003). Talk about IT: Views of people with aphasia and their partners on receiving remotely monitored computer - based word finding therapy. *Aphasiology*, 17(11), 1031-1056. DOI: 10.1080/02687030344000373