The Results of Using Online Interactive Learning to Enhance English in Daily Life towards ASEAN for Lower Secondary Students with Hearing Impairment: A Case Study of Deaf School in Surin Province

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Abstract

This research aimed to: firstly, find out the effectiveness of a developed online interactive learning in enhancing English in daily life towards ASEAN for hearing-impaired students at the lower secondary level. Secondly, to determine the learning achievement of the students who used the online interactive learning. Thirdly, to calculate the effectiveness index of the online interactive learning in enhancing English for the hearing-impaired students. Fourthly, to examine the relationship between learning avidity scores and learning achievement of the hearing-impaired students who used the online interactive learning. The research utilized a one-group pre-test and post-test design. The sample consisted of 35 hearing-impaired students at the lower secondary level from the School for the Deaf in Surin Province, who expressed interest and readiness. The data was collected during the first semester of the academic year 2022. The research employed four tools: online interactive learning related to English in daily life towards ASEAN, pre-test, post-test, and learning avidity scores based on the eight desirable characteristics of students. The data analysis involved the use of percentage, effectiveness index, dependent t-test, and Pearson's Product Correlation Coefficient. The research findings indicated that online interactive learning enhanced knowledge of English in everyday life towards ASEAN, with an efficiency rating of 1.82 according to the Meguigans' criterion. Similarly, the learners' learning achievement after using online interactive learning was higher compared to before learning, with a statistical significance level of 0.05. The effectiveness index of online interactive learning was found to be 0.3139, indicating that the learners experienced a learning progress of 31.39 percent, which did not align with the set assumptions (more than 0.80 or 80 percent). Furthermore, the study revealed that the learning avidity scores and learning achievement of the learners were significantly correlated at the 0.05 level.

1. Introduction

Human beings have the ability to access scientific sources and apply knowledge to solve problems that arise in daily life. This ability is largely dependent on communication. Poor or inadequate communication skills can make it challenging for someone to effectively communicate with others, particularly those with hearing impairments. There is currently Bilingual Education for the Deaf that utilizes sign language and general language for the hearing impaired [1]. However, this group of people with hearing disabilities still faces challenges in listening and speaking. They are unable to use spoken language to communicate like individuals without hearing impairments due to the loss of their auditory senses [2].

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Therefore, these individuals use sign language instead of spoken language to communicate, which differs from the communication methods of the general population [3-5].

Sign language is at the heart of communication for people with hearing impairments [3], [4]. It involves the use of body language and facial expressions to convey internal emotions and enables others to accurately understand the intended meaning. Additionally, sign language helps them access various sources of information, just like individuals without hearing impairments [6]. However, modern technology is not limited to specific individuals; it has a role for everyone. Consequently, communication and information dissemination in education are happening at a rapid pace. For individuals with hearing impairments, they utilize sign language to communicate and rely on their eyes to perceive information, in contrast to individuals without hearing impairments who primarily use speaking and listening [2], [6]. This results in people with hearing impairments being quite disadvantaged in terms of cognition and learning. Likewise, Makeshine, Viriyavejakul, and Sovajassatakul. [7] has conducted a study and reviewed literature on academic achievement for deaf and hard of hearing learners in the United States, the United Kingdom, and Thailand. Researchers and educators have revealed that the reading and comprehension skills of hearing-impaired learners are significantly lower than those of their normal peers of the same age. The achievement gap further widens with the learners' age. Therefore, it is essential to conduct studies on designing instructional systems and learning strategies tailored to this group of learners. These studies aim to address the problem and promote the use of visual content to enhance learning achievement. Consequently, organizing education to meet the needs and ensure comprehensive learning among this group of individuals becomes imperative. The policy of the Ministry of Education in 1999 designated the academic year for persons with disabilities, with the slogan "Every person with a disability who desires to learn must have the opportunity to study" [8]. This is because education serves as the foundation that helps all groups of disabled people to develop themselves,

enabling them to lead fulfilling lives in society and pursue studies in universities or specialized fields. Additionally, education allows them to enter the regional and ASEAN labor market, providing opportunities for a successful career.

In the year 2015, Thailand became a member of the ASEAN Community. It is crucial to establish a mechanism that fosters interconnections and mutual understanding among member countries, and language serves as a vital means of communication. English, being an international language, is widely used to connect countries and facilitate communication in trade negotiations, business interactions, politics, and education. To prepare Thailand for its participation in the ASEAN community, the Office of the Basic Education Commission has implemented a project on learning management. The project emphasizes that Thai children should possess basic communication skills in at least two languages: English and at least one language spoken in neighboring countries [9]. Therefore, language communication is one of the crucial issues for people with hearing impairments. The various academic learning methods employed in educational institutions do not align with the learning style of this group, resulting in difficulties in language acquisition. Communication for individuals with hearing impairments must be translated into sign language to ensure comprehension [10], [11]. English, which is a crucial foreign language as majority of information is available in English, is particularly taught as a third language to individuals with hearing impairments [1]. According to the research reports on the teaching and learning of English among Thai children as a whole, it was found that English is perceived as boring, lacking motivation, and lacking interesting teaching materials [12-14]. To motivate students, enable effective English language usage, support entry into the ASEAN labor market, and improve the quality of life for individuals with hearing impairments, it is necessary to develop electronic media that capture their attention and enhance their intellectual development for continuous learning. This, in turn, will lead to effective learning.

Online learning is a significant innovation in education.

In today's era, information and communication technology is employed in teaching and learning to create a flexible and suitable learning experience for students. They can choose to study according to their individual needs, including factors such as time, location, satisfaction, and intellectual ability [15-17]. This allows learners to comprehend the content and enhance their learning potential, leading to better retention of the material compared to other methods of presentation [18]. With outstanding features in both activities and technologies that support and facilitate learning, online learning is widely utilized in presenting content or lessons. However, interaction is another crucial factor that needs to be considered when designing and developing online learning. Educators have proposed various types of online learning interactions, three of which are commonly observed: student-student interaction, teacher-learner interaction, and learner interaction with the content [19-21]. These aspects are highly significant in design of learners' education. Specifically, the interaction between the learner and the content involves one-way communication between the learner and the content. Presently, most online courses learning are designed to enable learners to interact with the content. This involvement allows learners to engage and interact with the lesson independently, such as by clicking the mouse, typing dialogues related to the lesson, and navigating the mouse over the text or image to trigger certain events [21], [22]. These design elements aim to captivate and stimulate learners' interest in the lessons, promoting an active learning style [23]. They also enable learners to establish connections and alleviate feelings of loneliness in online learning, similar to traditional classroom teaching.

Online learning materials remain popular and extensively developed for almost every subject. These materials are primarily presented in the form of text, images, audio, and videos to engage and motivate learners to explore and investigate. Nevertheless, it is crucial to acknowledge that these materials are not designed to cater to the specific needs of individuals with hearing impairments. As pointed out by Anggraeni, Maulania, and Sarinastiti [24], the lack of technological learning materials for children with hearing impairments contrasts with the current advancements in information and communication technologies, particularly in English language learning. It is unlikely that a person with a hearing impairment will learn English from materials designed for those without hearing impairments. Due to the limitations in perception experienced by this group, particularly in regards to speaking and writing skills that require sign language, gestures, and facial expressions for communication, inclusive methods for English encompassing all four language skills (listening, speaking, reading, and writing) must be considered. Consequently, in order to address the special educational needs of individuals with hearing impairments, relevant organizations and stakeholders must innovate information technology and assistive technology to ensure equal access to education for this population. Specifically designed and developed online learning materials for individuals with hearing impairments could be one of the options to help enhance their knowledge, skills, and abilities. This would play a significant role in driving and advancing the country's development in the future.

Therefore, in line with the Education Management Act for Persons with Disabilities B.E. 2551 [25], which emphasizes the provision of quality education without lifelong expenses and access to technologies that support their educational needs, should align with the ASEAN Master Plan 2025, which promotes the rights of persons with disabilities. Sirirungruang and Sriboonroj [26] highlighted the need for economic linkages in various fields, including comprehensive information and communication technology, with a focus on accessibility and usability for people with disabilities. This is to ensure that individuals with disabilities have access to education, including lifelong learning. Developing effective electronic learning that promotes English language proficiency for people with hearing impairments is crucial for their success and integration into the ASEAN community. Similarly, Amnu et al. [5] emphasized the significance of providing appropriate education for the hearing impaired. Hence, researchers believe it is essential to investigate the impact of online learning

tailored to the needs and lifestyle of individuals with hearing impairments. This involves presenting content through a combination of letters, pictures, and videos in sign language and written language to enhance their English language skills in everyday life and within the ASEAN context. Such an approach would facilitate their communication access and understanding, enabling them to use language like any other individual.

This research has four objectives: first, to determine the effectiveness of online interactive learning in enhancing knowledge of English in daily life for ASEAN. Second, to assess the learning achievements of learners who studied using the developed online interactive learning media. Third, to calculate the effectiveness index of the developed online interactive learning. Finally, to investigate the relationship between the scores of learning avidity and the learning achievements of learners who studied using the developed online interactive learning. The research hypotheses are as follows: Firstly, the effectiveness of online interactive learning in enhancing everyday English knowledge for ASEAN meets the criteria set by Meguigans. Secondly, there is a significant difference between the pre-learning and post-learning achievements of the learners who studied using the developed online interactive learning at the 0.05 level. Thirdly, the effectiveness index of online interactive learning in enhancing everyday English knowledge for the developed ASEAN is greater than 0.80. And fourth, there is a positive correlation between the scores of learning avidity and the learning achievements of the learners who learned using the developed online interactive learning, with statistical significance at the 0.05 level.

2. Theoretical Background and Related Researches

2.1 Characteristics of people with hearing impairments

People with hearing impairments face difficulties in speaking, resulting in a lack of understanding from others [27]. Their communication heavily relies on sign language and facial expressions. Their language usage is often limited and grammatically incorrect, as they struggle to form diverse sentences.

Sentence construction may involve word or phrase swapping [2], [5] such as in Thai sentences like "Have you eaten?" being signed as "Rice has eaten," etc. [2], [4]. This is because sign language follows a different sentence structure than written language, leading to language difficulties for this group [2]. In terms of intelligence level, it has been found that people with hearing impairments possess intellectual abilities similar to those of normal children, with some individuals even displaying exceptional intelligence. However, in many cases, people with hearing impairments tend to achieve slightly lower academic performance compared to their hearing counterparts. This discrepancy often stems from teaching methods that do not cater to their specific needs and lifestyles [2], [7], [28]. These challenges present obstacles in their learning and performance on exams that are designed for individuals without hearing impairments [1].

2.2 Online Learning

Online learning is a significant educational innovation in the modern era. By leveraging information technology and communication in teaching and learning, it enhances flexible and suitable learning experiences for learners across various age groups and educational levels. Learners can access comprehensive and diverse learning content at their convenience, benefiting from online resources, activities, and experiments that support their existing knowledge [15-17]. Electronic media, in the form of multimedia, plays a crucial role in online teaching and learning. Content is delivered through various electronic mediums like CD-ROMs, Internet networks, and intranets [29-30]. This allows learning to take place without limitations of time and place, catering to the convenience of both learners and teachers [31]. The delivery of online learning content can be classified into three levels [30]:

Text online level: This level primarily focuses on textual content, which may result in learners losing interest.

Low-cost interactive online level: Multimedia elements such as text, images, sound, animation, and video are incorporated to enhance content delivery and engagement for learners.

High-quality online course level: This level involves delivering content in a sophisticated multimedia format, requiring additional tools for content production and browsing. It typically involves collaboration among experts or professionals, including content experts, instructional experts, and multimedia production experts.

2.3 Online Interactive Learning

Interactive learning refers to the action between the learner and the content using computer technology as a means of presentation. Learners can engage with lessons in various ways, controlling and participating in the learning process. It serves as a substitute for traditional classroom teaching, where learners passively consume content [32], [33]. Chaetnalao [34] further emphasizes that interactive learning media employ different types of technology and methods, such as audio, video, graphics, still images, and animations. These elements are used together to create interactive opportunities through sight, touch, hearing, and even smell. The aim is to provide a higher quality and more efficient learning experience compared to traditional classrooms.

Educators have established patterns of interaction with online teaching materials, and three main forms can be identified: learner-content interaction, student-teacher interaction, and student-student interaction [19-21]. However, the design of online learning interactions should also consider the learning styles and perceptual methods of each learner. These can be categorized into three types [35]:

Visual media: Hearing-impaired learners can perceive and learn through visual means, such as text, pictures, and other visual materials, similarly to learners without hearing impairments.

Audio-visual media: While learners with hearing impairments may have limited perception of audio content, they can still benefit from audio-visual media. Still images, animations, and textual narration can be used to convey content and help them understand.

Computer technology media: This includes multimedia lessons, program lessons, computer-assisted instruction, e-Learning, and other computer-based materials. The use of computer technology materials greatly benefits learners with hearing impairments, as they enhance understanding beyond text alone or text combined with sign language. Moreover, interactions can be incorporated to create a more enjoyable and exciting learning experience.

The aforementioned information highlights the different strengths of educational materials for people with hearing impairments. However, the current research aimed to develop instructional media in the form of integrated computer technology media with images and videos. This decision stems from the fact that these materials are designed to enable learners to engage with animations, videos, and instant content interactions. This allows students to easily comprehend the material and review it independently.

2.4 Literature review

Bureerat et al. [36] conducted a study on the use of online learning media with augmented reality technology to teach Thai idioms to learners with hearing impairments. The findings indicated that this augmented reality technology was of a high quality, and the students' satisfaction with using it for teaching Thai idioms was also at a high level.

Meeanan et al. [37] conducted a study on online learning about general laws for learners with hearing impairments. The results showed that the online learning materials were developed and implemented with quality, suitable for the learning process of learners with hearing impairments, and could be applied to various activities. The analysis also revealed that learners expressed high satisfaction with this online teaching, and their post-learning scores were significantly higher than their pre-learning scores at a statistically significant level of 0.01.

Taosiri and Siripipattanaku [38] conducted a research on the development of interactive multimedia with active learning on the topic of the solar system, a science subject for 4th-grade students. The results showed that the media achieved an efficiency rating of 81.16/87.83 according to the specified criteria (80/80). Additionally, learners who studied with

multimedia media obtained higher post-learning scores compared to their pre-learning scores. The learners expressed a high level of satisfaction with the teaching and learning methods mentioned above.

Mingsiritham and Chanyawudhiwan [39] conducted a study on the prototype experiment of a Massive Open Online Course (MOOC) to develop life skills in the use of technology media for students with hearing impairments. The objective was to test a prototype online learning resource for MOOC and develop life skills in technology media for students with hearing impairments at the upper secondary level from Thungmahamek School for the Deaf. The results demonstrated that the post-test scores were significantly higher than the pre-test scores at the .05 level, and overall student satisfaction was at a high level.

Efendi et al. [40] conducted a study on the use of multimedia learning materials in scouting activities for deaf students in special schools (ESDB). The purpose of this study was to analyze the experimental results of using multimedia instruction for scouting skills in deaf students. The sample consisted of 41 deaf students from a special school located in the metropolitan city of Malang. The results revealed that deaf students experienced a 25.62% increase in scores after using multimedia for scouting skills. Thus, it was concluded that the use of multimedia is important for enhancing scouting skills for deaf students in special schools.

3. Research Methodology

The population consisted of 55 lower secondary school students with hearing impairments at the School for the Deaf in Surin Province during the first semester of the academic year 2023. The sample was selected from this population through purposive sampling, recruiting 35 students who were interested and ready to participate in the research.

The scope of this research was based on the one-group pretest-posttest design method [18]. The English content used in daily life included greetings, asking about health, introducing oneself, giving and asking for personal information,

asking for and offering help, expressing gratitude and apologizing, asking for and giving opinions, and asking for and giving directions.

The technical side of the system involved two parts: LearnSquare and CourseLab 2.4. LearnSquare is an open-source learning management system (LMS) that supports further development in accordance with open-source principles. It incorporates SCORM-based development and comprises a registration, monitoring, and evaluation system, along with a security login system [41]. On the other hand, CourseLab 2.4 is a freeware authoring system designed for creating online lessons. It offers a WYSIWYG interface and provides support for various e-learning standards. Furthermore, content developed using CourseLab 2.4 can be published in multiple formats, including CD-ROM and the Internet. It can also be seamlessly integrated with LMS platforms [42].

The research tools included a pretest, post-test, avidity for learning scores based on the eight desirable characteristics of students, and online interactive learning. The research tools were developed according to the ADDIE model [43], following the steps and processes outlined below:

Analysis: In this step, the learning needs and the English learning environment of learners with hearing impairments at the lower secondary level were analyzed. Through interviews with teachers, it was found that this group of learners had relatively little basic knowledge of English and struggled to communicate using English. Additionally, there was a lack of suitable teaching and learning materials, leading to longer study times for these learners compared to their peers. However, basic English communication skills in daily life were crucial as they were not only used in the classroom but also in everyday situations. Based on these findings, data was collected to analyze and determine the scope of English content that would be consistent with and relevant to the students' needs. This content included 8 units of daily English for ASEAN, covering greetings, asking about health, introducing oneself, giving and asking for personal information, asking for and offering help, expressing gratitude and apologizing,

asking for and giving opinions, and asking for and giving directions.

Design: Using the fundamental data analysis results, 39 behavioral learning objectives were formulated and 4 multiple-choice tests created with 97 items that aligned with the learning objectives. These learning objectives and quizzes were then assessed by content experts to ensure consistency. The results confirmed the consistency between the content and learning objectives. In the next step, a storyboard that included topic placement, content arrangement, pictures, and videos in sign language was designed. Each screen of the lesson content incorporated interaction principles to motivate the learners. This material was designed to facilitate learner-content interaction. It displayed messages or pop-ups when the learner hovered the mouse over a character or text, enabling them to view the content or images and initiate various activities like pausing, replaying, searching for a new topic, and more. Additionally, the test was structured to include text and images that encouraged interaction and provided feedback on the outcomes of different activities to the students. Additionally, an overall system flowchart was designed.

Development: Online learning materials were developed as designed in the previous step using the CourseLab program. The learning objectives, content, and quizzes were created using this program. Furthermore, LearnSquare was utilized to develop the pretest, post-test, and deliver content to learners through the network (see Figures 1-6 for examples). During the development process, the system for online interactive learning underwent alpha-stage piloting, which involved black box testing conducted by the research team.
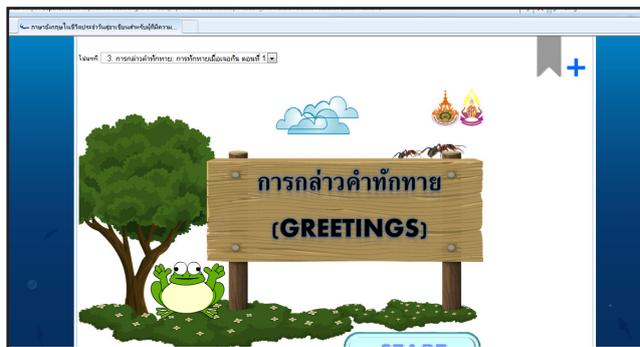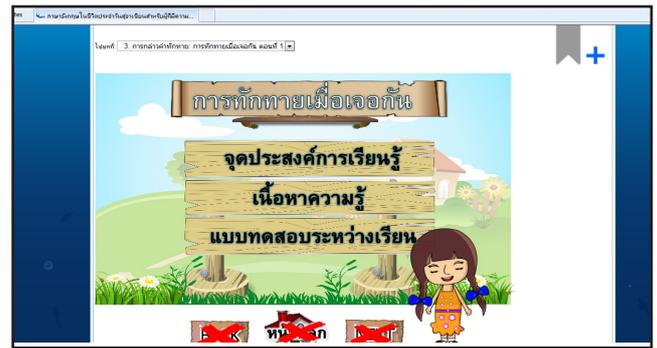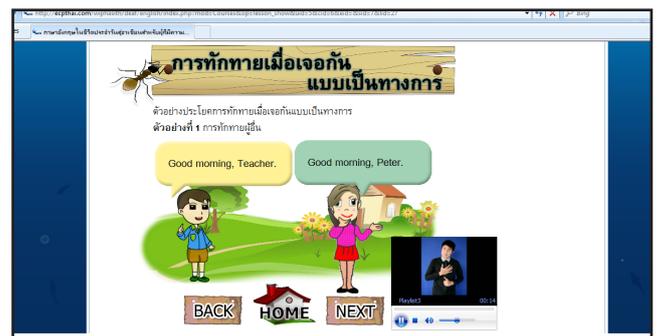

Figure 2. *The main menu: greeting upon meeting.*

Figure 3. *Content: greeting upon meeting.*

Figure 4. *Example of quiz.*

Figure 1. *The title of Unit 1.*

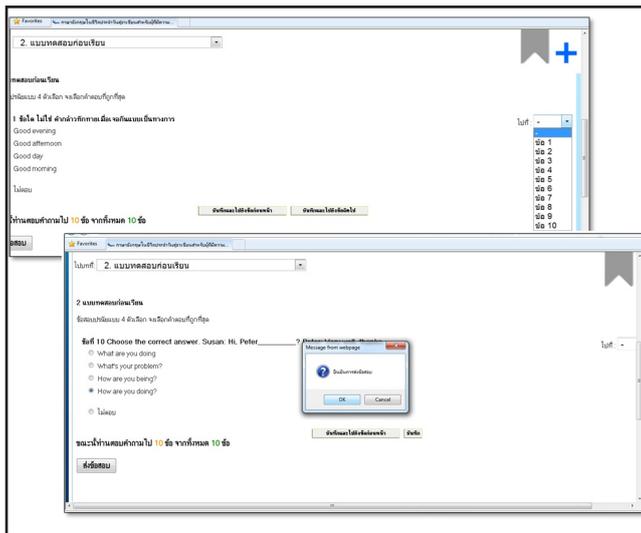**Figure 5.** *Table of Unit 1 on the LearnSquare.*

Figure 6. The pre-test of Unit 1 on the LearnSquare.

Implementation: An externally hosted rental with a Linux operating system was implemented. Subsequently, this media was installed on the Internet network, and its location was specified on the website: http://ecpthai.com/wiphasith/deaf/english/index.php. Subsequently, a user manual was created and uploaded for online learning.

Evaluation: The online interactive learning was evaluated by three experts in techniques and methods, and their opinions on this media gathered. The evaluation results showed that the experts had a positive opinion.

Quality of research tools

Finding the quality of the research tools had 2 components as follows:

1) Items: The items were tested by 15 learners who had studied English in daily life. Then, the test scores were analyzed for quality. It was found that out of the total of 97 items, 94 were of high quality. These items were moderately difficult and were able to classify strong and weak learners. The items also demonstrated high reliability (with a reliability coefficient of 0.953). Finally, these quality items were used as quizzes, pre-tests, and post-tests.

2) Online interactive learning: The material was assessed and revised according to recommendations from technical experts. Subsequently, in the beta stage, it was tested with non-sample learners. Each student studied the lesson content, completed the pre-test and post-test, and it was determined that the students were content with the developed online learning.

Data collection

1) Coordinating with the academic department of the School for the Deaf, Surin Province and requesting details on various aspects related to data collection.

2) Sending a letter to the director of the Surin School for the Deaf and requesting information about individual learners' scores on learning avidity from the results of the assessment of desirable characteristics in the first semester of the academic year 2022. Also, asking for permission to collect data and conduct experiments.

3) Conducting a pilot study using online learning media in the computer laboratory with a sample group of 35 lower secondary students with hearing impairments during the first semester of the academic year 2022. These steps were followed:

3.1) Explaining and recommending the use of online interactive learning to students and relevant individuals to ensure a correct understanding of its usage.

3.2) Conducting activities through e-learning. The learners received a username and password from the researcher to access the lesson on the specified website. Before starting their studies, learners took a pre-test in online learning, which they could complete only once. After studying the content, learners took a post-test to assess their comprehension and learning, which was also limited to one attempt.

4) Data were collected and analyzed as follows:

4.1) The effectiveness of the developed online interactive learning was analyzed using the Meguigans' criteria. The formula for finding efficiency is posttest divided by pretest [18].

4.2) The Effectiveness Index (E.I) was used to analyze the effectiveness of the developed online interactive learning, which was calculated as the difference between

all students' posttest and pretest scores, divided by the product of the number of students and the full score minus all students' pretest score [44].

4.3) Dependent t-tests were used to analyze the learning achievement of the learners who studied via the developed online interactive learning.

4.4) The Pearson's Product Correlation Coefficient was used to analyze the relationship between avidity for learning scores and the learning achievement of learners who studied with the developed online interactive learning.

4. Results

4.1 The results of finding the effectiveness of online interactive learning to enhance knowledge of English in daily life in ASEAN are as follows:

It was found that the average score of the pre-test was 26.03, and the average score of the post-test was 47.37. The efficiency level of the developed online learning was 1.82, which exceeded the 1.00 criterion based on the hypothesis. Thus, it can be concluded that this online interactive learning is effective according to Meguianes' criteria, as detailed in Table 1.

Table 1. *Efficacy of online interaction learning.*

Test	N	Full score	$\bar{x}$	Meguigans' Ratio
Pre-test	35	94	26.03	1.82
Post-test			47.37	

4.2 The results of learning achievement of learners who studied with online interactive learning to enhance knowledge of English in daily life in ASEAN are as follows:

Considering the mean score of the pre-test was 26.03, while the average score on the post-test was 47.37 out of a total possible score of 94 points. The mean score difference between the pre-test and the post-test was 21.34. The t-test value was -6.866, and the P-value was 0.00, which is less than the predetermined P-value in the hypothesis (0.05) (see Table 2). This indicates that the pre-test and post-test achievements of the learners who studied with this online interactive learning differed significantly at the 0.05 level. Thus, it can be

concluded that this online interactive learning has a significant impact on the learners' post-learning achievement, which is higher than their pre-learning achievement.

Table 2. *The results of the analysis of the scores of the pre-learning and post-learning achievement of the learners.*

Test	N	Full score	$\bar{x}$	S.D	t	Sig.
Pre-test	35	94	26.03	4.44	-6.866	0.000
Post-test			47.37	16.89		

*p<0.05

4.3 The results of the effectiveness index of online interactive learning to enhance knowledge of English in everyday life in ASEAN were as follows:

It was found that the overall effectiveness index was 0.3139, which represented 31.39 percent, contradicting the assumption. Based on this information, it was concluded that the learners' scores increased by 31.39 percent overall. The details are shown in Table 3.

Table 3. *The results of the analysis of the effectiveness index of the online interactive learning.*

The product of the number of learners with a full score	The sum of score		Effectiveness Index (E.I)
	Pre-test	Post-test	
35x94	1658	911	0.3139

4.4 The results of determining the relationship between avidity for learning scores and learning achievements of learners who studied with this media to enhance knowledge of English in daily life in ASEAN were as follows:

The correlation between learning avidity scores and learning achievement scores was analyzed using the Pearson's Product Correlation Coefficient with a two-tailed hypothesis test. It was found that the sig. value is 0.032, which was less than the predetermined value (0.05), aligning with the set assumption. This indicated that the learning avidity for learning score was correlated with learners' post-learning achievement at a statistical significance level of 0.05, with a correlation

coefficient of 0.363. Both variables were related in the same direction. The details are presented in Table 4.

Table 4. *The results of the relationship between learning avidity scores and learning achievement score of learners who studied with the online interaction learning.*

	Post-test	**Avidity for learning**	**Sig.**
Post-test	1.00	0.363	0.032*
Avidity for learning	0.363	1.00	

*p<0.05

5. Conclusion and Discussion

5.1 Efficiency of online interaction learning to enhance knowledge of English in daily life in ASEAN according to the Meguigans' criteria:

The developed online interactive learning had an efficiency of 1.82, which was higher than 1.00 according to the Meguigans' criteria. Therefore, this hypothesis is accepted. The online learning was designed and developed based on instructional design principles, with content analysis and design tailored to the learners. The integration of interaction and expert input resulted in an effective learning medium. This finding was consistent with the research conducted by Na-Nakhon [45], who emphasized the importance of media effectiveness for learners' confidence in its benefits. Similarly, Chailapo et al. [46] found that effective online lessons should align with learners' fundamentals, present content systematically and clearly, and undergo quality checks to minimize errors. Furthermore, Na-Nakhon and Insa-ard [47] highlighted that well-designed learning materials contributed to clear and unambiguous messaging, facilitating understanding for the target audience.

5.2 The pre-learning and post-learning achievements of the learners who studied with the developed online interactive learning were significantly different at the 0.05 level:

This hypothesis is accepted as the research results demonstrated that the pre-learning and post-learning achievements of learners using the developed online interactive learning media differed significantly, aligning with the set assumptions. Learners achieved higher post-learning outcomes compared to their pre-learning achievements. This effect can be attributed to the utilization of online interactive learning materials, including still images, animations, and sign language videos, which aided content comprehension and fostered student engagement. By creating an enjoyable and stimulating learning environment, students became more motivated to participate actively and achieved higher learning outcomes. These findings aligned with the research conducted by Meeanan [37], Mingsiritham and Chanyawudhiwan [39], and Efendi et al. [40], who developed online learning materials for students with hearing impairments and observed improved learning achievements. The interactive and engaging nature of the developed online learning materials, which provided feedback and facilitated learner participation, enhanced information acquisition, understanding, and overall learning experience. This finding was in line with the research by Wongkorm [48], which emphasized that media interaction stimulates learning, sustains attention, and promotes enjoyment and retention. The development of appropriate teaching materials contributes to language development and effective communication in sign language among learners with hearing impairments, ultimately leading to progress in various aspects for both students and society in the future. Similar research by Bustam et al. [49] focused on an interactive application for teaching Indonesian Sign Language to support hearing-impaired children, with positive outcomes in terms of learner motivation and parental support for sign language instruction. Another relevant study by Taosiri and Siripipattanakul [38] explored interactive multimedia with active learning in teaching the solar system, leading to higher post-learning achievements compared to pre-learning outcomes.

5.3 The effectiveness index of the online interactive learning media for enhancing daily English knowledge in ASEAN was greater than 0.80:

This hypothesis is rejected as the developed online interactive learning yielded an effectiveness index of 0.3139 (31.39%), which fell below the predetermined value in the assumption. However, this effectiveness index indicated an overall increase of 31.39% in learner scores or development. This finding suggested that learners' progress fell within the moderate level of development criteria. It is important to note that Arayawinyu [2] and Limtasriri [50] highlighted that learners with hearing impairments exhibited similar levels of development and intelligence as their peers without disabilities, and some might even demonstrate exceptional abilities. However, the measurement and evaluation methods commonly used might not fully capture the performance of this particular group of learners [51].

5.4 The avidity for learning scores and learning achievement scores of the learners who studied with the online interactive learning to enhance their knowledge of English in daily life in ASEAN had a statistically significant positive relationship at the 0.05 level:

There was a very low positive correlation between the avidity for learning scores and learning achievement scores of learners who studied with the online interactive learning to enhance their everyday English knowledge in ASEAN, which aligns with the hypothesis. This positive correlation can be attributed to the content and activities provided in the developed media, which catered to the learners' needs and captured their attention, fostering continuous interest in learning. Avidity for learning represents a strong willingness and commitment to learning, indicating that learners are dedicated to their studies and possess a desire for self-improvement. Such learners are more likely to comprehend and apply their knowledge effectively, resulting in higher learning achievements. These findings were consistent with previous research that examined the relationship between learning outcomes and avidity for learning or intention. It was observed that avidity for learning serves as an indicator of academic achievement, as learners who display enthusiasm, intention, and commitment toward learning tend to excel

academically [52], [53]. Conversely, learning proficiency scores may not accurately predict academic achievement at times, as students might perform well in test-like situations but encounter behavioral issues in other contexts or within the classroom [54]. Therefore, designing and developing online learning materials that stimulate interest, enjoyment, and active participation among students is crucial. Teachers must focus on understanding the learners' nature and tailor the online learning experience accordingly.

Overall, the research results support the hypotheses and provide valuable insights into the effectiveness of online interactive learning in enhancing English language knowledge in daily life for learners in ASEAN. The developed media demonstrated efficiency, positive correlations between avidity for learning and learning achievements, and significant differences in pre-learning and post-learning outcomes. These findings contribute to the existing body of research and highlight the importance of designing interactive and engaging online learning materials that meet the unique needs of learners with hearing impairments.

6. Suggestions

6.1 Suggestions of this research:

6.1.1 The findings obtained from this research can be applied to the development of learning outcomes in other subjects.

6.1.2 The results of this research can be utilized in the development of online interactive learning for learners with intellectual disabilities and others by adapting the content to meet their specific needs.

6.2 Suggestions for future research:

6.2.1 It is recommended to conduct comparative studies between online interactive learning media and other teaching methods to determine the most suitable approach for learners.

6.2.2 There should be further exploration of the relationships between various variables and learning outcomes to investigate their impact on learning effectiveness.

6.2.3 Certain content is created using an authoring system that cannot be showcased on mobile devices due to a limitation within this system. Nevertheless, moving forward, we plan to generate all content that is compatible with mobile devices, in order to fulfill the requirements of our users.

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8. References

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