Developing a WARA in Upper Elementary School Students With Reading Difficulties

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Abstract

The purpose of this research is to develop a web application learning innovation for promoting reading ability: WARA in upper elementary school students with reading difficulties. Phase one was concerned with the creation of the web application learning innovation learning innovation for promoting reading ability in upper elementary school students with reading difficulties and the population consisted of nine experts. The instruments included a draft of a web application learning innovation package and a draft evaluation web application form. The data was statistically analyzed by mean average and standard deviation. Phase Two was experimental, with a focus on improvement. The population consisted of fifteen grades 4-6 students with reading difficulties and five teachers. The instruments included a web application learning innovation package and questionnaires. The data were statistically analyzed by mean average, standard deviation, E1/E2 and E.I. The findings were as follows: (1) A web application learning innovation for promoting reading ability in upper elementary school students with reading difficulties has the highest level of suitability evaluation results ($\mu = 4.82$, $\sigma. = 0.40$) and (2) the efficiency was 82.06/82.92, and the effectiveness was E.I. = 0.75.

Keywords: web application, reading abilities, students with reading difficulties

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Introduction

Dyslexia is a significant issue that must be addressed because it impacts kids' learning in all subjects as well as their motivation for self-development. Some dyslexic students experience low self-esteem, while others develop behavioral issues as a result. As a result, all educational institutions must rapidly identify solutions to the problem and promote reading. The importance of reading for Thai children can be seen in the definition of their characteristics in the 21st century, or Thailand 4.0 era, which emphasizes the 3Rs principle: Reading, Writing, and Arithmetic. Reading is an essential skill for Thai children to become significant contributors to the further development of their country. Additionally, other skills are also not neglected and developed accordingly (Education Council, 2019). Most students who receive appropriate instruction can read according to their age. Despite receiving appropriate instruction, some students struggle to read. These students, who have normal or above-average intelligence, are often diagnosed with learning disabilities (LD) after screening and diagnosis.

Students with learning disabilities are individuals whose psychological processes are impaired, resulting in challenges related to language use encompassing listening, reading, speaking, writing, and spelling, as well as difficulties in mathematics. It is important to note that these challenges are not attributed to physical, visual, hearing, or intellectual impairments, nor are they associated with cultural, economic, or environmental disadvantages in their surroundings (Arayawinyu, 2001). In fact, their intelligence levels are generally within the normal or even high range, yet they often exhibit suboptimal academic achievement (Korsuwan, 2010).

Elementary students with learning disabilities often experience problems with reading, speaking, language expression, and behavior. Without appropriate intervention, these students could potentially pose challenges to society (Arayawinyu, 2001). Reading disabilities are the most common type of learning disability, accounting for approximately 80% of all cases (Sriwanyong, 2009). Students with reading disabilities have difficulty remembering consonants and vowels, spelling words, and learning new vocabulary. As a result, they may struggle to read, read only simple words, read incorrectly, or stutter (Rajanakul Institute, 2012).

There are many ways to teach reading to students with reading difficulties, depending on the nature of the problem and the student's reading level. In all cases, it is important to make reading fun and motivating for students.

The Application for Education (WARA) is an educational innovation that meets this need, especially during the COVID-19 pandemic. Learners can access lessons anywhere, anytime, and on any digital device with an internet connection, such as a personal computer, laptop, smartphone, or tablet. WARA is easy to access and meets the diverse needs of users, reducing limitations on access devices. The application is also a new and innovative type of media that can be designed for a variety of academic purposes and functions.

WARA was primarily designed as a learning media, instruction media, or construction media (Office of the Basic Education Commission, 2012). It also promotes interaction between students and lessons, developing learning skills and creating value for learners. Learners can learn at their own pace and select or do exercises on topics that interest them first. They can easily go back and forth or to the starting point to review lessons if needed. This allows

learners to practice and learn anytime, anytime, fulfilling their needs and abilities, and helping them achieve their goals more easily. The Application for Education can be designed to be colorful and beautiful, with text, images, animations, videos, and sounds combined to make them interesting, exciting, and engaging. This can help students respond and learn more quickly. (Chinsri & Wasukree, 2015; Donnelly, 2020; Konglun & Runawat, 2016; Lichanporn, 2013; Office of the Basic Education Commission, 2012; Suwanno, 2020; Udomphon et al., 2016).

Application developers can motivate and engage learners by incorporating game concepts into educational applications. This creates a fun and motivating learning environment that stimulates interest in learning and makes learning more enjoyable (Poondet & Lertphonkulrat, 2016). As a result, learning becomes more sustainable and meaningful. Studies have shown that introducing game mechanics or gamification into education is a significant and necessary way to motivate learners, enhance academic achievement, and improve learner attitudes. Students' concerns decline, while positive motivation increases at all levels.

Researches have shown that game-based applications are suitable for groups of learners with special needs, such as ADHD, mild intellectual disabilities, and learning disabilities (e.g., reading disabilities) (Gooch et al., 2016; Simões et al., 2013; Sitra et al., 2017; Yonwilas, 2019). The Application for Education can also be designed to provide individualized academic performance reports, informing learners, teachers, and parents of the results and allowing them to follow up and check students' learning progress. Analysis of the features and functionalities above reveals that the application can be purposefully designed and developed to adhere to a specific format conducive to learning. Such a format facilitates the realization of clearly defined learning objectives set by instructors (Steven et al., 2018). Consequently, the application emerges as a supplementary tool that effectively bolsters the learning skills and capacities of students with disabilities.

Motivated by these considerations, the researcher embarked on a study focusing on the development of the WARA as an innovative tool aimed at enhancing students' proficiency in reading basic words with accuracy, speed, and efficiency. Additionally, it aspires to cultivate a heightened motivation for reading while affording learners opportunities for communication and active participation in activities with both teachers and peers.

Research Objectives

To develop a web application learning innovation for promoting reading ability in upper elementary school students with reading difficulties.

Literature Review

Elements of Reading

Summary of the essential elements of reading according to the National Reading Panel (USDHHS, 2000) consisting of 5 important reading points as follows:
1. Phonemic awareness is an auditory process that involves hearing the sounds of words. This skill includes rhyming sounds. Mixing sounds to form words and separating sounds in words.

2. Phonics is the realization that sounds are linked to letters and that those letters come together to form words. In reading and spelling Readers will use their knowledge of language to identify the pattern of letter sounds.

3. Fluency is reading easily and automatically. Taking into account each word only by sight (by sight), reading fluently and naturally. Like when speaking informally.

4. Vocabulary: Understanding the meaning of words and using words in listening, speaking, reading, and writing.

5. Comprehension is considered the objective of reading. It is a process of perception. complex, which allows the reader to understand the meaning of the message and can correct incorrect or unintelligible messages.

Target Group

This study was conducted in two phases, each involving specific participant groups aligned with the research objectives: development, evaluation, and implementation of the web-based learning innovation designed to promote reading ability among upper primary school students with reading difficulties.

Participants

Phase 1: Development of the Web-Based Learning Innovation

A total of nine experts participated in the evaluation of the draft web-based learning innovation. The experts were selected based on purposive sampling and met at least one of the following criteria: possession of a master's degree or higher, a special academic rank, or a minimum of ten years of relevant professional experience. The panel was composed of: Three Thai language education specialists, Three experts in special education, and Three specialists in educational technology and web-based learning innovations. These experts provided feedback on content accuracy, pedagogical soundness, technical design, and applicability for students with reading difficulties.

Phase 2: Implementation and Evaluation of the Learning Innovation

1. Students With Reading Difficulties

A group of 15 upper primary students (Years 4–6) identified as having reading difficulties participated in the experimental phase of the study. These participants were selected using purposive sampling, based on the following inclusion criteria established by the researcher: Currently enrolled in Year 4 to Year 6 at the primary education level; Demonstrated difficulty reading Thai words containing the orthographic patterns of *Mae Kok*, *Mae Kob*, *Mae Kod*, and *Mae Kon*, including both regular and irregular spelling forms; Possessed an intelligence quotient (IQ) of 90 or above; Demonstrated adequate listening, speaking, and communicative abilities; Received informed parental consent and were able to participate fully in the study for its entire duration.

2. Teachers of Students With Reading Difficulties

In addition to the student participants, five teachers responsible for instructing students with reading difficulties in Years 4–6 also participated in the study. Their role was to evaluate the

usability and effectiveness of the web-based learning innovation from a pedagogical and classroom integration perspective.

Variables

A Web Application Learning Innovation for Promoting Reading Ability in Upper Elementary School Students with Reading Difficulties.

Research Design and Data Collection

This study employed an experimental research design, specifically utilizing the One-Group Pretest–Posttest Design, to investigate the effectiveness of a web-based application aimed at enhancing reading ability among upper primary students with reading difficulties.

Phase 1: Development and Expert Evaluation of the Web-Based Learning Innovation

1. Expert Evaluation

An initial prototype of the web-based application was submitted to a panel of nine experts in the fields of educational technology, special education, and language instruction. The purpose of this stage was to evaluate the appropriateness, usability, and pedagogical suitability of the application in addressing the specific needs of students with reading difficulties.

2. Revision Based on Expert Feedback

Following the expert evaluations, revisions were made to the web application in accordance with the feedback received. Adjustments focused on content alignment, user interface design, instructional clarity, and the inclusion of engaging multimedia elements to enhance learner motivation and accessibility.

Phase 2: Implementation and Evaluation With the Target Group

1. Orientation and Preparation

The researcher coordinated with the participating school to schedule an orientation session for the target group. During this session, students and relevant stakeholders (including teachers and parents) were informed about the objectives, procedures, and expected outcomes of the research. Ethical considerations, including confidentiality and voluntary participation, were also addressed.

2. Pretest Administration

Prior to the intervention, a pretest was administered to assess the students' baseline reading ability. The assessment comprised word reading tasks focusing on Thai orthographic patterns known as Mae Kok, Mae Kob, Mae Kod, and Mae Kon. The test included both regular and irregular spelling forms, allowing for an in-depth analysis of decoding and phonological processing skills.

3. Implementation of the Web-Based Learning Innovation

The instructional phase involved the integration of the developed web application into the students' reading lessons. The application was designed to provide individualized, interactive, and gamified learning experiences tailored to the needs of students with reading disabilities. Students engaged with the application over a predetermined period, with activities aligned to improve their recognition and pronunciation of words following the targeted orthographic patterns.

4. Posttest Administration

Upon completion of the intervention, a posttest identical in structure to the pretest was administered to measure any changes in students' reading performance. Comparisons between pretest and posttest scores were used to assess the effectiveness of the intervention in improving reading accuracy, fluency, and word recognition skills.

5. Evaluation of the Web Application

To assess user satisfaction and perceived effectiveness of the application, evaluation questionnaires were distributed to both the participating students and their teachers. The questionnaires included items related to the application's usability, motivational impact, content relevance, and overall learning experience. The feedback collected contributed to a holistic understanding of the application's pedagogical value and areas for future improvement.

Research Instruments

The study was conducted in two phases, each utilizing a specific set of research instruments to support the development, implementation, and evaluation of the web-based learning innovation designed to enhance reading ability among upper primary students with reading difficulties.

Phase 1: Development and Expert Review

1. Prototype of the Web-Based Learning Innovation

A preliminary version of the web application was developed to support reading instruction focused on Thai orthographic patterns (*Mae Kok*, *Mae Kob*, *Mae Kod*, and *Mae Kon*). The prototype incorporated multimedia elements, interactive activities, and gamification techniques aimed at enhancing learner engagement and literacy skills.

2. Expert Evaluation Form

An evaluation form was developed to assess the appropriateness and quality of the web application. The form included criteria such as content accuracy, pedagogical relevance, user interface design, functionality, and overall educational value. Responses were collected using a Likert scale format and supplemented by open-ended suggestions for improvement.

3. Preliminary Reading Ability Test

A diagnostic test was constructed to assess students' ability to read words with Thai orthographic features (*Mae Kok*, *Mae Kob*, *Mae Kod*, and *Mae Kon*). The test included both words that conform to typical spelling conventions and those that do not, thereby measuring decoding, pronunciation, and orthographic recognition skills.

Phase 2: Implementation and Evaluation

1. Finalized Web-Based Learning Innovation

Following expert revision, the refined version of the web application was employed as the main instructional tool during the intervention phase. It was designed to offer interactive, student-centered reading practice tailored to the specific needs of learners with reading disabilities.

2. User Guide for the Web Application

A comprehensive instructional manual was developed to guide teachers and students in the effective use of the web application. The guide included directions for navigation, lesson implementation, troubleshooting tips, and instructional suggestions.

3. Reading Ability Test (Pretest and Posttest)

The same reading test developed in Phase 1 was used as both a pretest and posttest to evaluate the impact of the intervention. The test measured students' reading proficiency across words containing *Mae Kok*, *Mae Kob*, *Mae Kod*, and *Mae Kon* patterns, including both standard and non-standard spellings.

4. Evaluation Questionnaires

Two sets of questionnaires were used to gather feedback on the application's effectiveness:

Student Questionnaire: Assessed usability, motivation, engagement, and perceived learning benefits. Teacher Questionnaire: Evaluated pedagogical utility, ease of integration, learner response, and observed improvements in students' reading abilities. All instruments were validated by experts prior to use, ensuring their reliability and appropriateness for the target population.

Data Analysis

The data analysis was conducted in two phases, corresponding to the stages of development and implementation of the web-based learning innovation designed to enhance reading ability in upper primary students with reading difficulties.

Phase 1: Evaluation of the Draft Learning Innovation

The data collected from expert evaluations of the draft web-based learning package were analyzed to determine the overall appropriateness and suitability of the innovation. Descriptive statistics, specifically the mean and standard deviation, were used to assess expert

agreement on various aspects of the application's design, content, functionality, and educational relevance. The results informed revisions to ensure alignment with pedagogical goals and learner needs.

Phase 2: Implementation and Impact Assessment

The data obtained from the implementation phase were analyzed using the following statistical methods:
1. Descriptive Statistics
   The mean and standard deviation were calculated to examine students' reading performance before and after the intervention. These statistics provided a measure of central tendency and variability in reading scores, offering insight into the distribution and consistency of student performance.
2. Instructional Efficiency (E1/E2)
   The instructional efficiency of the web-based learning innovation was analyzed using the E1/E2 model, where: E1 represents the students' performance during the learning process (process efficiency), E2 represents the students' performance on the posttest (product efficiency).

This model helped evaluate whether the learning innovation supported effective engagement and knowledge retention throughout the instructional period.

3. Effectiveness Index (E.I.)
   The Effectiveness Index (E.I.) was calculated to assess the relative improvement in student performance between the pretest and posttest. This index indicates the proportion of learning gains attributable to the intervention and offers a comparative measure of its impact on reading ability.

The combined use of descriptive and inferential statistics ensured a comprehensive understanding of the innovation's effectiveness, both in terms of instructional delivery and learning outcomes.

Results

1. The Results of evaluating the suitability of the web application learning innovation for promoting reading ability in upper elementary school students with reading difficulties. overall, it was found that the web application learning innovation for promoting reading ability in upper elementary school students with reading difficulties has the highest level of suitability evaluation results. ($\mu = 4.82$, $\sigma. = 0.40$) However, when considering each issue, it was found that the suitability evaluation results were at the highest level in all 4 areas: 1) The usefulness, responding to the needs of users of the innovative web application learning set. ($\mu = 4.86$, $\sigma. = 0.40$) 2) The accuracy Complete coverage and reliability. ($\mu = 4.83$, $\sigma. = 0.41$) 3) Possibility of putting it into practice. ($\mu = 4.83$, $\sigma. = 0.41$) and 4) The appropriateness of the elements in the web application learning innovation set. ($\mu = 4.75$, $\sigma. = 0.47$) respectively.
2. The Results of the trial of using the web application learning innovation for promoting reading ability in upper elementary school students with reading difficulties, fifteen students, found the efficiency value of the web application learning innovation set to be 82.06/82.92, the effectiveness index (E.I.) value was 0.75.

Discussion

1. Results From the Development of the Web-Based Learning Innovation

The findings from the development phase revealed that the quality assessment scores of the web-based learning innovation—designed to promote reading ability among upper primary school students with reading difficulties—indicated a high level of effectiveness and suitability for use with the target group. This outcome may be attributed to the systematic approach employed by the researcher in developing the application, which adhered to established research and development methodologies as well as sound instructional design principles.

Specifically, the development process aligned with the Waterfall Model, a well-known framework for software development proposed by Malaiwong and Punawat (1989). This model involves a linear sequence of four key stages:1) Analysis – Identifying learner needs, content requirements, and functional specifications; 2) Design – Structuring the learning content, interface, and user experience; 3) Programming – Developing and coding the web application using appropriate technologies; 4) System Testing – Evaluating and refining the system to ensure accuracy, functionality, and pedagogical integrity.

By following this structured model, the researcher ensured that the application met both technical and educational standards, resulting in a product that is both effective in enhancing reading skills and user-friendly for the intended population.

2. Teachers' Perspectives on the Use of the Web-Based Learning Innovation

The analysis of teachers' feedback regarding the use of the web-based learning innovation revealed that their overall satisfaction with its usability and effectiveness was rated at the highest level. This result suggests that the application met the functional needs and pedagogical expectations of its users. One likely reason for this positive response is that the application was designed to be intuitive and accessible, allowing teachers to integrate it easily into their instructional routines.

This finding is consistent with the principles of network-based instructional design as outlined by Teeranathanakul and Kiatkomon (1998). These scholars proposed a five-step process for developing online instructional materials, consisting of:1) Analysis – Identifying learner characteristics and instructional needs; 2) Design – Planning lesson structures, learning activities, and user interfaces; 3) Development – Creating digital content and functional components; 4) Implementation – Delivering and integrating lessons into real-world contexts; 5) Evaluation – Assessing usability, learning outcomes, and overall effectiveness.

The application in this study was developed in alignment with this model, enabling the researcher to create a tool that is both pedagogically sound and technologically efficient. The high level of teacher satisfaction thus reflects the structured and research-informed approach taken in the application's development.

3. Students' Opinions on the Use of the Web-Based Learning Innovation

Analysis of the responses from students with reading difficulties indicated that their satisfaction with the interactive features of the web-based learning innovation was rated at the highest level. This suggests that the application successfully fostered engagement and active participation, which are critical factors in supporting learners with special educational needs.

These findings align with the study conducted by Samutsri (2018), which examined the development of interactive multimedia designed to enhance emotional intelligence in Year 6 students. Samutsri's research found that interactive multimedia improved emotional intelligence by 68.36%, demonstrating the effectiveness of interactive digital tools in enhancing cognitive and emotional capacities in young learners.

Based on the present study's findings, it may be concluded that the web-based learning innovation not only supported reading development but also created a learning environment that was accessible, engaging, and effective. The flexibility of the application—allowing students to learn anytime and anywhere—further contributed to its value as a sustainable and realistic model for reading intervention in real-world educational contexts. The tool provided students with autonomy and motivation, promoting both skill development and independent learning.

Recommendations

Recommendations for Practical Application

1. Developing the web application learning innovation for promoting reading ability in upper elementary school students with reading difficulties, this time it is only a basic web application. This requires developing web applications to have more capabilities, such as more space to store data to support the increase in diverse data. Including making work more convenient, easy to understand, and communicating messages between users more effectively.
2. Developing the web application learning innovation for promoting reading ability in upper elementary school students with reading difficulties, there is still a complex sequence of presentation and usage steps that should be revised to make them easy to understand to avoid problems and obstacles to put web applications to use with maximum efficiency.
3. Promote greater use of technology in teaching because the use of technology in teaching can increase learning efficiency more than normal learning. It also helps students become more interested and understand the content.

Recommendations for Future Research

1. Developing an interactive e-book web application combining augmented reality (AR) technology for students with reading problems.
2. Developing a web application that has a learning format using games. (Gamification) for students who have reading problems.

AI Assistance Declaration

This manuscript was prepared with the assistance of ChatGPT (GPT-4), developed by OpenAI, which was used solely for the purposes of language translation (Thai to English) and proofreading. The AI tool helped refine grammar, vocabulary, and sentence structure to ensure clarity and coherence in the English-language sections of the manuscript. All content, including ideas, analysis, and conclusions, were entirely created and verified by the author.

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