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Designing and Studying the Effectiveness of Nava Game Multimedia Software in Teaching the Diagnosis of Dysarthria Symptoms in Speech Therapy Students

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ABSTRACT

Background: Previous studies have found educational games effective in improving students' learning quality and enhancing their ability to apply material in clinical environments. Therefore, this study designed the Nava Game Multimedia Software to teach dysarthria diagnostic skills to speech therapy students and examined its effectiveness in this population.

Methods: This non-experimental descriptive-analytical study evaluated 42 speech therapy students who were divided into two groups. After designing and producing the content for the Nava educational game, the first group learned about dysarthria through theoretical instruction. In contrast, the second group received theoretical instruction supplemented by the Nava software. At the end of the training, students' knowledge was assessed through final exam scores, and their attitudes were measured using a researcher-developed questionnaire.

Results: The mean ± standard deviation scores for the first group were 15.01 ± 1.32, and for the second group were 17.86 ± 1.04. The difference between the two groups was significant ($p < 0.001$). Attitude scores also differed significantly between the first group (29.61 ± 14.72) and the second group (43.14 ± 16.50) ($p < 0.001$).

Conclusion: Nava is a game-based software that can be installed on an Android phone. Its use led to increased learning, improved students' attitudes toward learning, and greater satisfaction among both instructors and students regarding dysarthria diagnosis.

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Introduction

Today, games and e-learning are increasingly used in medical education due to their influence on various aspects of teaching and treatment [1, 2]. Games offer an educational dimension in addition to their entertainment value [3]. Gamification comprises a set of intellectual games that encourage users to think critically and solve problems [4]. Educational games enable individuals to develop new mental concepts, improve their skills, and learn material intrinsically rather than under pressure [3]. Using games as teaching aids is an appealing method for increasing learners' attention and concentration, enhancing multisensory involvement in the learning process, and ultimately facilitating knowledge transfer [5, 6].

The advancement of mobile technologies, including smartphones, has further facilitated electronic education. Learning through electronic devices and games increases learner satisfaction, enhances motivation, enriches interactions, and results in more effective communicative learning activities [7].

According to studies in medical sciences, several reports have confirmed the positive effects of educational games on enhancing students' learning experiences, particularly in clinical settings [8-13]. However, in the field of speech therapy, only one game software has been developed (for voice disorders), and the importance of using educational games in teaching has been investigated [12].

During their studies, speech therapy students become familiar with various speech and language disorders, each with its own unique characteristics and therefore requiring distinct methods of diagnosis, evaluation, and treatment. Dysarthria is a speech disorder of neurological origin, and its diagnosis, evaluation, and treatment fall within the responsibilities of speech therapists. Diagnosing dysarthria requires examining clinical characteristics across five speech sub-systems (respiration, phonation, resonance, articulation, and prosody) using both perceptual–auditory assessment and evaluation of the motor characteristics and oral reflexes of the speech organs.

Currently, instruction on this disorder is predominantly lecture-based. However, qualitative clinical scores and surveys of speech therapy graduates and students indicate that this method is ineffective. Consequently, a need has been identified to modify the teaching approach to enhance students' clinical diagnostic skills for dysarthria.

A review of Persian-language speech therapy literature reveals only one existing audio-based game, designed for voice disorders [12], and no similar software is available in other languages. Given that the nature of dysarthria and its diagnosis depend heavily on accurately identifying perceptual–auditory symptoms of the speech subsystems, as well as assessing the range of motion, speed, strength, and steadiness of the speech organs and oral reflexes, the Nava Game Multimedia application could serve as a valuable tool for developing dysarthria diagnostic skills in speech therapy students. Therefore, this study evaluated students' knowledge and attitudes regarding the use of the Nava software to determine its effectiveness.

Methods

This manuscript, a non-experimental descriptive-analytical study, was derived from an educational process presented at the Shahid Motahari Festival. The project was approved by the Ethics Committee of the National Center for Strategic Research in Medical Education, Ministry of Health and Medical Education, Tehran, Iran. In addition, the game's content was reviewed and approved by the faculty members of the Speech Therapy Department.

The present study is a descriptive-analytical investigation conducted on two groups of incoming students from 2014 and 2016.

Designing and producing the content of Nava's educational game

This multimedia educational game software is the first of its kind, designed for use in speech therapy. The client-side of the Nava software is developed for Android (version 4.4 and above) using Java and Kotlin. The server side is built with the Django framework using the Python programming language. An SQLite database is utilized on both the server and client sides.

This multimedia software consists of three components:

A) *Text Questions*, which include a classified set of multiple-choice questions related to dysarthria, compiled from the question bank of instructors who have taught this course in previous years.

B) *The Audio and Educational Video Section*, which presents the auditory symptoms of speech subsystems and the motor impairments characteristic of dysarthria. To prepare this content, videos and audio recordings of patients with dysarthria were produced according to the following protocol: the audio and educational videos included the pronunciation of the vowel /a/, continuous speech tasks (such as telling a memory, narrating a story, and describing a picture), and evaluation of oral organs and reflexes based on established references [14].

Speech therapists from various regions of Iran were invited to provide videos and audio recordings of patients who had granted written consent. They were assured that patients' faces would not be filmed during video recording.

Voice recordings were captured in an environment with a noise level below 19 dB using a Shure unidirectional AKG C1000S dynamic cardioid on-desk microphone connected to a laptop [15]. The microphone was positioned 10 centimeters from the subject's mouth at a 45-degree angle [16].

After collecting 50 audio and video samples, a panel of three speech therapists—each a faculty member with over 10 years of experience—reviewed the materials to diagnose dysarthria. They carefully examined the samples and classified 40 recordings into different dysarthria types. This classification was performed according to diagnostic protocols that assess all speech sub-systems (respiration, phonation, resonance,

articulation, and prosody) as well as the motor symptoms of the speech organs [14].

The software includes a comprehensive PDF that guides clinical judgment in dysarthria. This file was prepared by speech therapy instructors based on Duffy's diagnostic protocol [14].

How to run software

At the first level, multiple-choice questions are presented in a classified, randomized order. After answering each question correctly, the student receives a coin as a reward. If the student answers five questions correctly and earns five coins, they will advance to the second level, which involves playing an audio or educational video based on the package the student selected. After the playback, a question related to the audio or video is presented. If the student answers correctly, they earn a coin; otherwise, a coin is deducted from their total.

After completing one round of the game and accumulating 25 coins, the student enters the final stage and receives the final reward. It is important to note that the academic staff approved the game's overall content.

Software evaluation in the target group

Forty-two speech therapy students from Ahvaz Jundishapur University of Medical Sciences and ten instructors from the speech therapy department were selected based on the following inclusion criteria:

1. Final-year speech therapy students who had completed the Clinical Internship course and the Dysarthria topic within the Aphasia course.
2. Clinical training instructors with a minimum of three years of internship teaching experience.

The students were divided into two groups. The first group consisted of 21 incoming speech therapy students in 2014 who learned the topic of clinical judgment of dysarthria symptoms through the lecture-based method. The second group consisted of 21 incoming speech therapy students in 2016 who learned the topic using a combined approach (lecture supplemented with the Nava Multimedia Educational Game Software). It should be noted that the theoretical instruction on dysarthria symptoms and clinical judgment was delivered by the same faculty member using the same approach for both groups, and the clinical trainees were also identical for both groups.

To assess students' knowledge of dysarthria diagnosis, 20 questions were selected from the question bank and designed by the professor as the final exam for both groups at the end of the semester. The final exam scores were then compared between the two groups.

Students' attitudes toward mobile learning were evaluated using a researcher-made questionnaire (Zare et al.) [7]. The reliability coefficient of the questionnaire was estimated at 82% using Cronbach's alpha, and its validity was confirmed through factor analysis [17]. The questionnaire employed a five-level Likert scale with the following scoring: Strongly Agree (5 points), Somewhat Agree (4 points), No Stance (3 points), Somewhat Disagree (2 points), and Strongly Disagree (1 point).

Statistical analysis

SPSS software (version 22) was used for data analysis. The data distribution was assessed using the Kolmogorov–Smirnov test. Differences between the two groups in final exam scores and attitudes toward mobile learning were evaluated using an independent-samples t-test.

Figure 1: Stages of Software

Table 1: Average Age and Standard Deviation for Both student Groups and Trainee Instructors

Variable	Group 1(n=21) Mean± SD	Group 2 (n=21) Mean±SD	Instructors (n=10) Mean±SD
Age	21.32 ± 3.09	21.43 ± 2.68	35.60 ± 5.03

Table 2: Mean and Standard Deviation of Students' Final Exam Scores and Attitudes

Variable	Group 1(n=21) Mean± SD	Group 2(n=21) Mean± SD	P-value
Final exam scores	15.01 ± 1.32	17.86 ± 1.04	p<0.001
Degree of attitude	29.61 ± 14.72	43.14 ± 16.50	p<0.001

Results

This study was conducted on two groups of students and a group of trainee instructors. The first group consisted of 21 incoming students from 2014 (5 males and 16 females), aged 21–24 years. The second group included 21 incoming students from 2016 (6 males and 15 females), aged 21–23 years, with a mean age of 21.43 ± 2.68 years. Additionally, 10 trainee instructors (2 males and eight females) with more than 3 years of experience were included (Table 1).

An independent *t*-test examining the mean and standard deviation of the students' final exam scores revealed a significant difference between the two groups ($p < 0.001$). Similarly, an independent *t*-test conducted on the mean and standard deviation of the students' attitudes toward mobile learning also demonstrated a significant difference ($p < 0.001$) (Table 2).

Discussion

The Nava Multimedia Game Software was designed and developed with the primary aim of enhancing students' knowledge of dysarthria diagnosis. Nava comprises three levels: the first presents text-based questions, the second involves questions about video and audio content, and the third provides the final reward stage. This structure is intended to equip students with skills for diagnosing dysarthria based on symptoms across the speech subsystems, as well as the motor characteristics of the speech organs and oral reflexes.

Existing educational game software in speech therapy, such as the Avazma game [12] is primarily text-based, does not incorporate video or audio, and is not designed for detecting voice disorders. In contrast, Nava emphasizes clinical judgment in dysarthria by integrating video and audio content with text-based questions. Additionally, it provides an objective reward—a comprehensive file detailing differential diagnosis symptoms—which significantly enhances student engagement, motivation, and enthusiasm to learn and continue interacting with the software.

Because the topic of speech paralysis diagnosis is often perceived as challenging and unengaging by students, the use of multimedia and mobile-based games such as Nava appears to facilitate more effective learning. Increased motivation and class participation directly enhance the learning process, as educational games inherently improve students' attention and concentration. Furthermore, the game's flexibility places students in varied, sometimes novel, situations where they must make clinical decisions. These experiences are considered valuable forms of active learning and initiative [12].

Active participation promotes more effective learning and helps ensure that the material is retained in students' memories for a longer period. Various studies on educational games in other fields have consistently demonstrated that games enhance learning outcomes [8-11, 13]. In this study, the use of Nava multimedia software to teach speech paralysis diagnosis resulted in statistically higher scores for students than those who learned through traditional lecture-based methods. These findings are consistent with previous research demonstrating the superiority of game-based learning over conventional lecture methods. Additionally, students who used the game software on mobile devices exhibited more positive attitudes toward mobile learning [18-23].

The findings of this study are consistent with those of Rao et al., Huang et al., Lu et al., and Naderi et al. [7, 24-26]. Mobile learning, a subset of electronic learning, is a relatively new educational approach that is well accepted by medical students and has proven useful in both learning and teaching processes [27].

Several factors may have contributed to the enhanced positive outlook observed in students in the second group. These include: presenting content in small, manageable segments; providing opportunities for practice and repetition with timely intervals and immediate feedback; engaging multiple senses simultaneously; offering unrestricted accessibility via mobile devices, independent of time and location; leveraging the multimedia capabilities of the devices; facilitating easier student–teacher communication compared with traditional educational environments; optimizing time utilization; bridging informal and formal learning environments; and providing greater flexibility than classical learning methods, allowing students to interact with instructors more easily and without pressure [28].

Implementing the software helps students grasp challenging concepts more effectively, leading to better retention of learned material. Consequently, this research underscores the importance of utilizing software to enhance student satisfaction in the educational process. One constraint of the current study was finding a collaborating company for software design. Since this type of software is not yet integrated into speech therapy curricula in many countries, it was necessary to explore and negotiate with multiple companies before identifying a suitable partner for collaboration.

Another limitation of the study was the need to use two different student cohorts. Due to the small number of students entering the field of speech therapy each year, two distinct groups were recruited to increase the research's statistical power. Care was taken to ensure that both cohorts shared the same academic level and were taught by the same instructors.

Conclusion

The use of innovative educational methods, including games, has expanded significantly in medical education. In this study, we developed a multimedia game software called Nava. This Android-compatible software led to improved learning outcomes, enhanced student attitudes toward education, and increased satisfaction among both instructors and students. Consequently, the Nava multimedia educational game software represents a novel and effective teaching method that can be adopted in speech therapy.

Author Contributions

Concept and Design: Negin Moradi
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Reviewing the manuscript for its key ideas: Negin Moradi
Funding Acquisition: Negin Moradi

Copyright of the Picture

The Corresponding Author is the owner of the software and has provided consent for the publication of images illustrating the software's stages in this article.

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