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ORIGINAL ARTICLE

Development and User Satisfaction Assessment of the VJR RTtech Mobile Application in Patient Positioning for Radiological Technology Students

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ABSTRACT

Objectives: Mastering radiographic positioning to produce high-quality diagnostic images requires comprehensive spatial awareness, anatomical knowledge, and technical precision. Radiological technology students encounter major challenges in learning various positioning protocols across different anatomical regions. This present study developed a mobile-based instructional application called VJR RTtech to facilitate radiographic positioning instruction organized by anatomical regions and evaluated user satisfaction.

Materials and Methods: VJR RTtech was developed using the Thunkable platform, which incorporated routine and specialized positioning techniques by anatomical regions. Each technique included positioning protocols, visual demonstrations, central ray angulation, source-to-image distance, and collimation procedures. A total of 52 third- and fourth-year radiological technology students from the Faculty of Medicine Vajira Hospital, Navamindradhiraj University, who completed their clinical practicum, tested the application for 15 days. Satisfaction across three dimensions (interface design, content quality, and system usability) was assessed using a validated 11-item questionnaire using a five-point Likert scale. Content validity was confirmed by three experts using the item-objective congruence index (IOC > 0.5). Descriptive statistics were used to analyze satisfaction levels. Internal consistency reliability was evaluated using Cronbach's alpha, and inferential comparisons between student subgroups were conducted with independent-samples t-tests or Mann–Whitney U tests.

Results: The response rate was 85.2%. Out of 61 students who were invited, 52 completed the questionnaire. The overall satisfaction score was 4.54 ± 0.62 (90.8%), indicating very high satisfaction. All three dimensions reached very high satisfaction levels. The dimension scores were as follows: interface design 4.61 ± 0.58 (92.2%), content quality 4.68 ± 0.53 (93.6%), and system usability 4.24 ± 0.78 (84.8%).

Conclusion: VJR RTtech demonstrated exceptionally high user satisfaction across all dimensions assessed, especially in content quality. These results confirm its effectiveness as a supplemental instructional resource for radiographic positioning in radiological technology programs.

Keywords: diagnostic imaging quality, mobile-based instructional application, radiographic positioning, radiological technology students, user satisfaction

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INTRODUCTION

In medical practice, radiographic imaging is an important diagnostic tool as accurate patient positioning is essential for capturing high-quality images.[1-4] However, radiographic positioning techniques are complex, which arises from the variety of anatomical structures and different imaging protocols needed for various body regions.[4,5] To ensure optimal image quality, mastering these techniques is crucial for radiological technology students, who must develop a comprehensive understanding of positioning techniques, anatomical details, and technical parameters.[6-8]

There are major challenges in acquiring positioning competencies. Students must master several standard and specialized techniques across various anatomical regions while developing the practical skills necessary for clinical practice.[9,10] Traditional learning methods, which mainly rely on textbooks and offer limited clinical exposure, may not adequately prepare students for the diverse positioning scenarios encountered in clinical practice.[11,12] Therefore, developing accessible and interactive instructional resources could bridge the gap between theoretical knowledge and practical learning application.[11-14]

One useful tool for designing and developing mobile applications is the Thunkable platform, a block-based programming environment that is intuitive, easy to use, and well-suited for beginners. Intharaksa et al. developed a learning application on this platform to teach mobile application development in a way accessible even to individuals with no prior programming background. The application provided structured, step-by-step instructional content beginning with fundamental concepts and extending through both theoretical and practical components. The developed application was evaluated by a group of users, mainly Information Technology students and other interested learners. The results showed that the learning application effectively improved users' understanding of application development using Thunkable. Participants were able to follow the instructional procedures, apply the knowledge they gained to create their own projects, and reported high levels of satisfaction with the learning experience. These findings indicate that the applications are effective educational tools for developing foundational skills in mobile application development.[15]

Mobile learning applications have proven effective in medical education, offering benefits such as accessibility, portability, and self-paced learning.[16-18] Although several applications have been specifically developed for radiographic positioning instruction,[19-21] there remain critical gaps remain, including (1) Comprehensive Thai-language applications that cover all anatomical regions with both routine and special positioning techniques, (2) Formal research validation of comprehensive positioning applications through systematic user satisfaction assessments using validated instruments across multiple dimensions, and (3) Evidence demonstrating their effectiveness as supplementary instructional tools in radiological technology curricula.

Therefore, the present study developed VJR RTtech, a comprehensive mobile application created by using the Thunkable platform. It covers radiographic positioning techniques for all anatomical regions, organized by anatomical regions, for radiographic positioning instruction. Moreover, user satisfaction among senior radiological technology students at Navamindradhiraj University was evaluated using a validated multidimensional questionnaire that assessed interface design, content quality, and system usability. As a result, the research hypothesis was that third- and fourth-year radiological technology students at Navamindradhiraj University show a high overall level of satisfaction with the use of the VJR RTtech application, with a mean satisfaction score indicating a high level.

MATERIALS AND METHODS

This study received approval from the human research ethics committee on February 22, 2023 (project approval number: 001/66 E; certificate of approval number: 041/2566). All ethical guidelines and regulations for research involving human participants were strictly followed.

Standard radiographic textbooks were used to collect radiographic positioning data, including routine and special techniques for various anatomical regions. The VJR RTtech application was created using the block-based programming interface of the Thunkable platform, which provides cross-platform compatibility for iOS, Android, and Web-based access. The architecture of the application included three interconnected screens (**Figure 1**). The home screen acted as the main navigation interface, with a search bar and 10 buttons for anatomical regions (i.e., skull, facial, sinuses, chest, spine, shoulder, abdomen, pelvis, upper limb, and lower limb), along with links to creator information and references. Meanwhile, the region screen displayed

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Figure 1 The VJR RTtech application interface: the home screen (left), the region screen (middle), the position screen (right), and the QR code. The application can be accessed at https://xraypost.labtoreal.com/

categorized lists of available positioning techniques for the selected anatomical area. Finally, the position screen provided detailed Thai-language information for each technique, including photographic demonstrations, positioning protocols, central ray angulation and direction, field of view, source-to-image distance, image receptor size, grid requirements, and additional technical notes. After development, the application was deployed on mobile devices to verify its functionality.

A user satisfaction questionnaire was created to assess the application. To verify the questionnaire's validity, three experts evaluated the content validity using the item-objective congruence (IOC) index.[22] The items were evaluated according to predefined criteria as follows: a score of +1 was given when the expert agreed that the item aligned with the research objectives; a score of 0 was given when the expert was unsure or found the item unclear; and a score of –1 was given when the expert determined that the item did not align with the objectives. These ratings were used to compute the IOC index as a measure of content validity. Items with an IOC ≥ 0.50 were considered acceptable and kept in the final questionnaire, while items with an IOC < 0.50 were revised to improve clarity and better align with the objectives. This process ensured that the questionnaire was valid, appropriate, and comprehensive. All items showed acceptable validity (IOC > 0.5) and were included in the final version. The completed questionnaire comprised 11 items, which were divided into three dimensions: interface design (four items), content quality (four items), and system usability (three items). The questionnaire used a five-point Likert scale[23] (1 = strongly disagree to 5 = strongly agree) to measure user attitudes and satisfaction. It also contained an open-ended section, which allowed participants to share additional comments and suggestions.

Sixty-one third- and fourth-year radiological technology students at Navamindradhiraj University

who completed clinical training in patient positioning were invited to participate in this study. Sample size calculation using the G*Power software[24] (power = 95%, alpha = 0.05, effect size d = 0.5) showed that at least 45 participants are required. Students were included if they volunteered to participate, had clinical experience in radiographic positioning, and owned a functional mobile device (iOS, Android, or Web-based). Meanwhile, those with malfunctioning devices that prevented the use of the application were excluded. The participants were asked to use the application for 15 days. User satisfaction was assessed through a questionnaire that was distributed via Google Forms.

The overall satisfaction scores were calculated by averaging the ratings of each participant across all 11 items. Descriptive statistics (mean ± standard deviation) were obtained from participants' averaged scores (n = 52). As the standard deviation shows variability in participants' overall satisfaction (not in pooled item-level differences), this method aligns with standard psychometric practices for multi-item satisfaction scales. The internal consistency reliability of the overall questionnaire and each dimension was evaluated using Cronbach's alpha coefficient,[25] with values ≥ 0.70 deemed acceptable. To determine whether satisfaction varied by demographic characteristics, independent-samples t-tests were conducted to compare overall and dimension-specific mean scores between male and female students and between third- and fourth-year students. Where the normality assumption was not satisfied (as assessed by the Shapiro–Wilk test), the non-parametric Mann–Whitney U test was used instead. Statistical significance was set at $\alpha = 0.05$ for all inferential tests.

Satisfaction scores were assessed using a five-point Likert scale[23] and presented as means and standard deviations. The satisfaction levels were classified using class intervals,[26] and the interval width for each level was calculated as follows: where the maximum possible score = 5, the minimum possible score = 1, and the number of levels = 5. This yields an interval width h = 0.80, establishing five satisfaction levels (Table 1).

RESULTS

The response rate was 85.2%, with 52 out of 61 invited students completing the questionnaire. Among the participants, 30.8% (16/52) were male, and 69.2% (36/52) were female. Third-year students made up 51.9% (27/52), whereas fourth-year students accounted for 48.1% (25/52).

The mean satisfaction scores for each dimension and questionnaire item are presented in Table 2. The overall satisfaction score was 4.54 ± 0.62 (90.8%), indicating very high satisfaction. The standard deviation of 0.62 indicates moderate variability among participants, with most rating the application highly across all dimensions. All three dimensions achieved high or very high satisfaction (Figure 2): interface design, 4.61 ± 0.58 (92.2%); content quality, 4.68 ± 0.53 (93.6%); and system usability, 4.24 ± 0.78 (84.8%).

Content quality received the highest overall score (4.68 ± 0.53, 93.6%). As shown in Figure 3, a detailed item-level analysis revealed that content accuracy had the highest score among all items (4.73 ± 0.50), whereas anticipated usage frequency had the lowest score (4.10 ± 0.88), although it still indicated high satisfaction. The interface design achieved very high satisfaction (4.61 ± 0.58, 92.2%), with consistent scores across typography (4.65), layout (4.56), color scheme (4.62), and photographic demonstration (4.60). The system usability received high satisfaction ratings

Table 1 Satisfaction Level Interpretation Criteria

Score Range Formula	Score Range	Satisfaction Level
$(5 - h) + 0.01$ to 5	4.21 - 5.00	Very high level of satisfaction
$(5 - 2h) + 0.01$ to $(5 - h)$	3.41 - 4.20	High level of satisfaction
$(5 - 3h) + 0.01$ to $(5 - 2h)$	2.61 - 3.40	Moderate level of satisfaction
$(5 - 4h) + 0.01$ to $(5 - 3h)$	1.81 - 2.60	Low level of satisfaction
$(5 - 5h)$ to $(5 - 4h)$	1.00 - 1.80	Very low level of satisfaction

An interval width of level, $h = 0.80$

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Table 2 Satisfaction Scores Across All Three Dimensions for Each Questionnaire Item

Questionnaires	Scores (Average ± SD)	Satisfaction Level
1. Interface design		
Font size and style are easy to read.	4.65 ± 0.62	Very high
Layout is appropriate.	4.56 ± 0.57	Very high
Background, button and font colors are suitably matched.	4.62 ± 0.57	Very high
Positioning images are appropriately sized.	4.60 ± 0.57	Very high
Mean	4.61 ± 0.58	Very high
2. Content quality		
The content is useful.	4.67 ± 0.55	Very high
The content is accurate and appropriate.	4.73 ± 0.45	Very high
The content is comprehensive and complete.	4.60 ± 0.53	Very high
The content is clearly understandable.	4.71 ± 0.57	Very high
Mean	4.68 ± 0.53	Very high
3. System usability		
I expect to use this application frequently.	4.10 ± 0.75	High
The application is user-friendly and easy to navigate.	4.42 ± 0.72	Very high
The functions operate efficiently.	4.21 ± 0.85	High
Mean	4.24 ± 0.78	Very high
Average satisfaction scores across all four dimensions	4.54 ± 0.62	Very high

(4.24 ± 0.78, 84.8%), with ease of use having the highest score within this dimension (4.42). All items had a score of at least 4.0.

As shown in **Figure 4**, response distribution analysis revealed a strong concentration of responses at scores of 4-5 across all items. The content accuracy and clarity showed the strongest ceiling effects, with 73% and 77% of participants rating the maximum score, respectively. System usability items showed more variability, with 23% providing neutral responses regarding usage frequency, indicating that the application's role is more of a reference tool than for everyday use. Minimal negative responses (four at score 2 and none at score 1) Confirm genuine high satisfaction. The participants' willingness to use the full-scale range suggests the absence of response bias.

The overall questionnaire showed excellent internal consistency (Cronbach's $\alpha = 0.882$). Cronbach's alpha for each dimension was as follows: interface design $\alpha = 0.843$, content quality $\alpha = 0.744$, and system usability $\alpha = 0.825$, all indicating acceptable to excellent reliability. Because normality was not met in the female and fourth-year subgroups (Shapiro–Wilk, $p < 0.05$), Mann–Whitney U tests were used for both comparisons. There was no statistically significant difference in overall satisfaction between male (mean = 4.44 ± 0.43) and female (mean = 4.57 ± 0.42) students ($U = 232.0$, $p = 0.267$), or between third-year (mean = 4.48 ± 0.40) and fourth-year (mean = 4.60 ± 0.44) students ($U = 268.0$, $p = 0.203$). These

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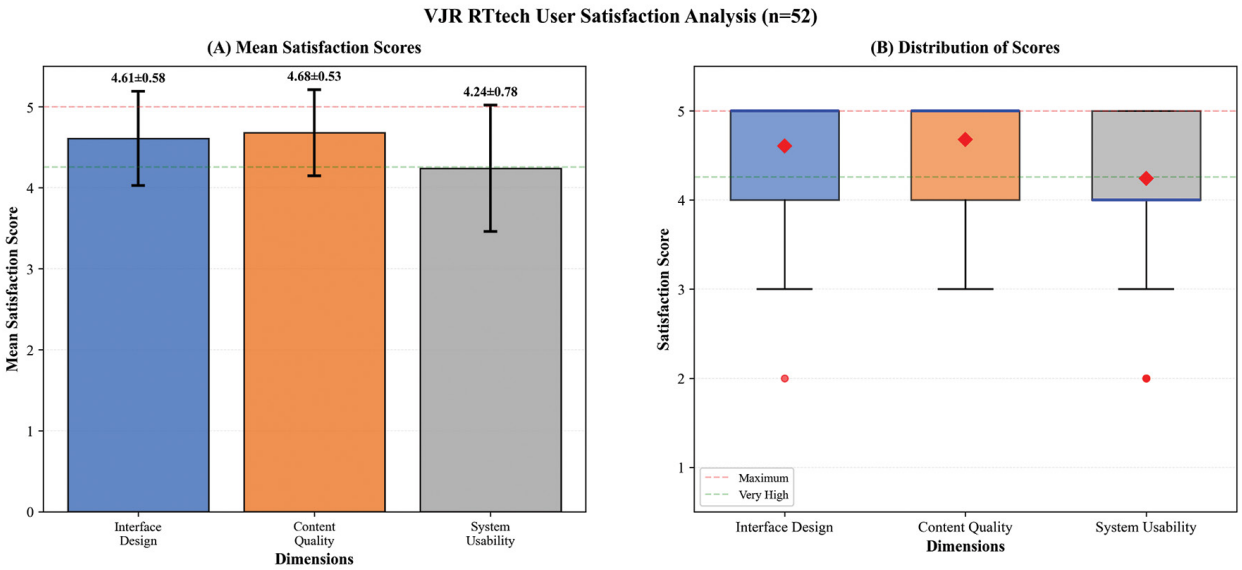


Figure 2 User satisfaction across interface design, content quality, and system usability (n = 52). (A) Mean satisfaction scores (mean ± SD) for each evaluation dimension. The red dashed line indicates the maximum score (5.0), and the green dashed line represents the threshold for very high satisfaction (≥ 4.26). (B) Box plots showing score distributions across dimensions, demonstrating high to very high satisfaction, with content quality showing the highest median score.

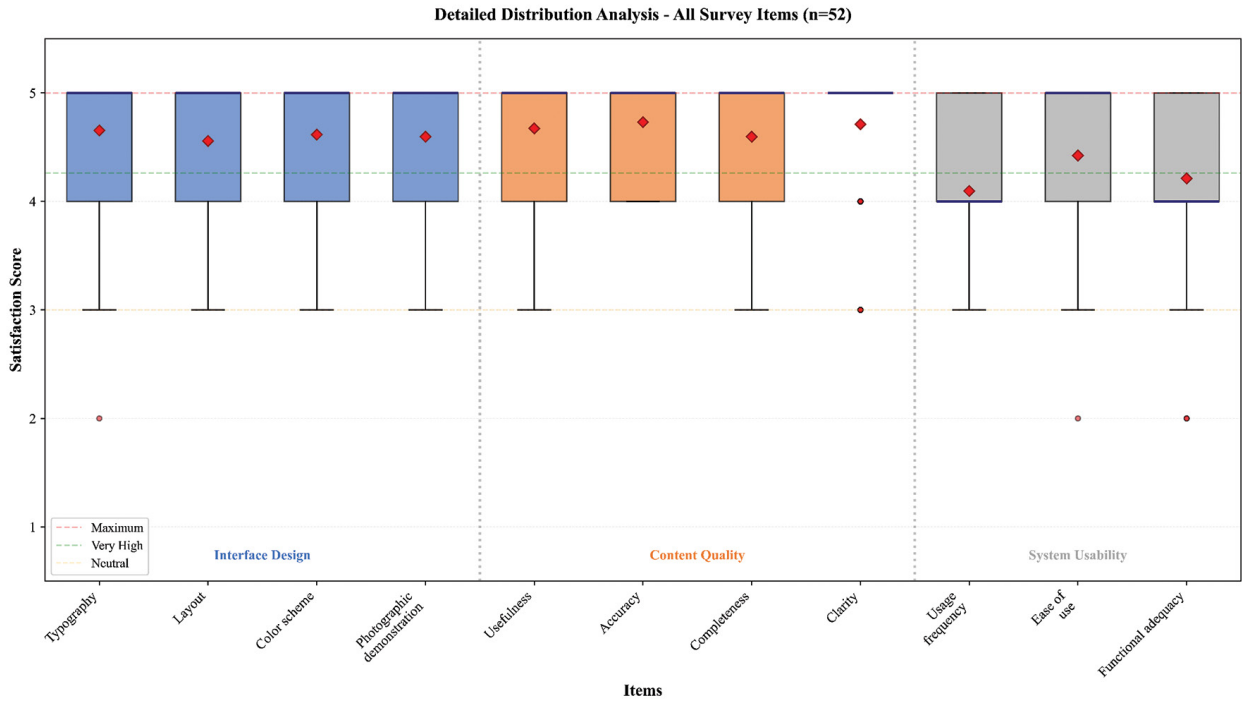


Figure 3 Distribution of satisfaction scores for the 11 questionnaire items across three dimensions: interface design, content quality, and system usability (n = 52). Box plots illustrate score distributions for each item, including the median, mean, interquartile range, and overall score range. Dashed lines indicate the maximum score (5.0), the very high satisfaction threshold (≥ 4.26), and the neutral level (3.0). All items showed high satisfaction, with content accuracy having the highest mean score and usage frequency the lowest.

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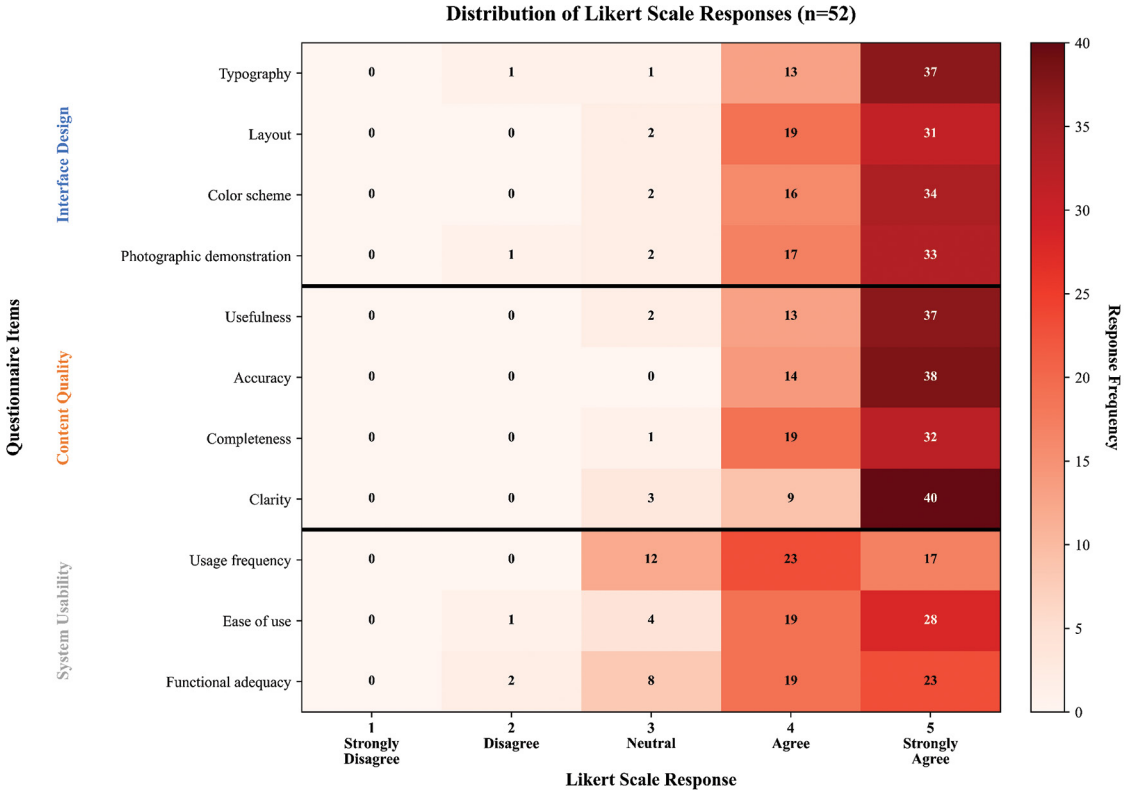


Figure 4 Heatmap distribution of five-point Likert scale responses across questionnaire items (n = 52) evaluating interface design, content quality, and system usability. Most responses clustered at scores 4–5, indicating high user satisfaction, whereas neutral and negative responses were infrequent.

findings show that high satisfaction with VJR RTtech remained consistent across gender and academic year.

DISCUSSION

The VJR RTtech application received very high overall user satisfaction (4.54 ± 0.62, 90.8%) among radiological technology students, indicating strong acceptance and perceived value as an instructional resource. This satisfaction level exceeds that reported in previous studies evaluating mobile applications for radiographic positioning instruction. This satisfaction score slightly surpasses that (4.40 ± 0.60) reported by Pairodsantikul et al. for a Thai skull positioning application using the same five-point Likert methodology.[21] Despite covering all anatomical regions rather than a single region, VJR RTtech maintained higher satisfaction levels while offering broader instructional utility.

All three dimensions exhibited very high satisfaction levels. The interface design (4.61 ± 0.58, 92.2%) showed effective implementation of a user-friendly interface and photographic demonstrations. Moreover, the content quality had the highest score among dimensions (4.68 ± 0.53, 93.6%), indicating that the comprehensive, accurate, and clearly presented coverage of routine and specialized positioning techniques across all anatomical regions effectively addressed gaps in available Thai-language instructional resources. The system usability (4.24 ± 0.78, 84.8%) also received very high satisfaction scores, indicating positive perceptions of ease of use, functionality, and anticipated usage frequency, although with slightly more variability in responses. The 15-day trial period provided participants with enough time to explore the application's features and interface, which likely contributed to the high system usability scores.

These findings are consistent with international evidence. Yousef et al. distributed a self-administered questionnaire to radiological science students covering various medical and radiographic positioning applications, including accessibility, usability, skills development, and clinical integration. The results show that 96-97.3% of radiological science students found them easy to

use and experienced improvements in practical skills.[16] Furthermore, these mobile applications are more suitable and convenient than traditional learning tools, which aligns with the high satisfaction ratings reported by VJR RTtech.

In national studies, Boonchai et al. created and evaluated a mobile application, CUFastTech, for general radiographic imaging that includes instant search and learning features. This application was developed using Genymotion and installed on a smartphone running Android. The radiological technology students rated their satisfaction with the application's content and design as good, as indicated by the system usability scale (SUS). However, the usability assessment fell below the acceptable standard, indicating that the application was perceived as challenging to use and exhibited usability problems.[20] Additionally, compared to the study by Boonchai et al., which developed an application exclusively for the Android platform, the application developed in this study supports a broader range of platforms. Specifically, it can operate on multiple operating systems and is also accessible via a web application.

Similarly, a study by Pairodsantikul et al. focused on the development and evaluation of mobile applications for radiographic education. One such study involved developing the Cranix application, a mobile application designed to assist with patient positioning and radiographic techniques for skull imaging in general radiography, created using the Thunkable platform. The results indicated that radiological technology students reported very high satisfaction with the application. Both the SUS and the Likert-scale usability assessment received very high satisfaction ratings. The results showed that the Cranix application was user-friendly and met the needs of the target users. Nevertheless, some individual usability scores dropped below the acceptable level threshold.[21]

Despite these radiographic positioning applications being Thai-based, they are no longer accessible on platforms such as iOS, Android, or the web. This indicates that developers have currently ceased support or use.[20,21] Based on the information provided, the findings indicate that VJR RTtech is likely to achieve similar usability outcomes, given its comparable satisfaction scores. These consistent findings from quantitative Thai benchmarks[20,21] and qualitative international patterns support the effectiveness of mobile learning in radiological technology instruction, aligning with broader evidence in medical education.[16-18] However, this study evaluates user satisfaction with the developed application. It does not assess the effectiveness or the improvement of clinical skills resulting from its use. Additionally, it is conducted in a single-institution setting, has a small sample size (n = 52), and does not include a SUS assessment, which are limitations of this study. Future research should include SUS evaluation, objective measures of learning outcomes, and clinical performance. Incorporating long-term studies and advanced features, such as augmented reality, interactive assessments, and performance tracking, could enhance instructional value.

CONCLUSION

VJR RTtech demonstrated exceptionally high user satisfaction across all dimensions assessed (interface design, system usability, and especially content quality). These outcomes confirm that this application may help fill the gap in Thai-language resources on patient positioning for radiographic imaging. It provides accessible, structured content covering all anatomical regions, including both routine and specialized positioning techniques. Additionally, the application may serve as a supplemental educational resource in radiological technology curricula.

Conflict of Interest

The authors declare no conflict of interest.

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No AI assistance was used in preparing this project. All content was generated independently by the author.

Author Contributions

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Formal analysis: N.W., T.N.

Funding acquisition: P.P.

Investigation: P.P.

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Project administration: P.P.

Resources: P.P.

Software: P.P., P.C.

Supervision: P.P.

Validation: P.P.

Visualization: N.W., T.N.

Writing – original draft preparation: N.W., P.P.

Writing – review & editing: P.P.

Data Availability Statement

The data supporting this study's findings are available from the corresponding author upon reasonable request. Individual participant data cannot be shared publicly because of ethical restrictions and privacy concerns outlined in the study's ethical approval.

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