Enhancing Futsal Referee Competence through Web-Based Tutorial Models: A Sport Pedagogy and Digital Learning Approach

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Abstract. The integration of digital technology in sports education has created new opportunities to improve instructional quality and learner engagement, particularly in skill-based courses such as refereeing. This study aims to develop and evaluate a web-based tutorial model designed to enhance futsal referee competence through a sport pedagogy and digital learning framework. The research employed a Research and Development (R&D) approach, incorporating stages of needs analysis, product design, and effectiveness evaluation. The developed platform integrates multimedia elements, including instructional videos, rule-based simulations, and interactive learning modules accessible via web-based systems. The model was validated by subject-matter experts and tested through student trials to determine its feasibility and effectiveness. Evaluation results indicated that the tutorial model achieved high validity and practicality, while implementation significantly improved learners' understanding of refereeing rules, decision-making accuracy, and procedural skills. The findings suggest that digital tutorial models can provide flexible, learner-centered environments that support both cognitive and practical aspects of referee training. This study highlights the potential of technology-enhanced pedagogy in advancing sports education, particularly in developing officiating competence. Future research is recommended to incorporate advanced features such as real-time feedback and simulation-based assessment to further optimize learning outcomes.

Keywords: Futsal Refereeing; Web-Based Learning; Sport Pedagogy; Digital Learning; Referee Competence; Instructional Technology

1 Introduction

The rapid advancement of digital technology has significantly transformed educational practices, including in the field of sports education. In recent years, the integration of web-based and digital learning platforms has shifted traditional instructional models

I. I. I. Pane and Y. Putri (eds.), *Proceedings of the 2nd International Conference of Sport Science, Sport Coaching Science, and Physical Education, Health and Recreation 2025 (ICOSSCOPER 2025)*, Advances in Social Science, Education and Humanities Research 1022,
https://doi.org/10.2991/978-2-38476-591-1_18

toward more interactive, flexible, and learner-centered environments. In physical education, technology-enhanced learning has been shown to improve student engagement, instructional effectiveness, and skill acquisition through multimedia and data-driven approaches [1]. These developments highlight the growing importance of digital innovation in supporting the teaching and learning of both theoretical knowledge and practical competencies in sport-related disciplines [2].

Within the domain of sport science, referee education represents a critical component that requires not only cognitive understanding of rules but also perceptual, decision-making, and communication skills. Referees must interpret dynamic game situations accurately and make rapid judgments under pressure, which necessitates structured and experiential learning environments. However, conventional teaching approaches in refereeing courses often rely heavily on theoretical explanations and limited practical exposure, which may not adequately prepare learners for real-game scenarios. Recent studies indicate that digital and video-based learning tools can enhance perceptual-cognitive skills and decision-making accuracy by providing repeated exposure to realistic situations and expert demonstrations [3].

From a pedagogical perspective, sport pedagogy emphasizes the alignment between instructional design, learning objectives, and learner engagement. The integration of digital technology into pedagogical practice has been shown to strengthen teaching effectiveness by facilitating interactive learning experiences and promoting active participation among students [4]. Furthermore, frameworks such as Technological Pedagogical Content Knowledge (TPACK) highlight the importance of combining subject matter expertise, pedagogy, and technology to optimize learning outcomes. Empirical evidence suggests that interactive digital content significantly enhances cognitive achievement and skill development in educational settings [5].

In the context of referee training, digital learning platforms—particularly web-based tutorial systems—offer several advantages. These include accessibility across devices, integration of multimedia resources, and opportunities for self-paced learning. Previous research in sports officiating education demonstrates that digital-based training tools can improve referees' understanding of game rules, analytical skills, and performance outcomes compared to traditional instruction [6]. Such platforms also enable the incorporation of observational learning principles, allowing learners to observe, analyze, and internalize expert decision-making processes.

Despite these advancements, the implementation of digital learning in referee education remains limited, particularly in futsal courses within higher education institutions. There is a need for innovative instructional models that integrate sport pedagogy with digital technology to address gaps in learning effectiveness and skill development. Therefore, this study aims to develop and evaluate a web-based tutorial model designed to enhance futsal referee competence by combining multimedia learning, observational practice, and pedagogical alignment.

This research contributes to the growing body of knowledge on digital sport pedagogy by providing an evidence-based approach to integrating technology into referee education. It is expected that the proposed model will not only improve learning outcomes but also support the development of competent, confident, and professionally prepared futsal referees in the digital era.

2 Methods

2.1 Research Design

This study employed a Research and Development (R&D) approach to design, develop, and evaluate a web-based tutorial model aimed at improving futsal referee competence. The R&D framework was adapted from the Borg and Gall model, which emphasizes systematic product development through iterative stages of analysis, design, validation, and testing [7]. This approach is widely used in educational research to produce practical and effective instructional innovations.

2.2 Development Procedure

The development process consisted of three main phases: (1) needs analysis, (2) product development, and (3) evaluation.

In the **needs analysis phase**, data were collected through classroom observations, informal interviews with students and lecturers, and a review of relevant literature. This stage aimed to identify existing challenges in futsal refereeing instruction, particularly the limited use of interactive and technology-based learning media.

In the **product development phase**, a web-based tutorial model was designed and constructed. The development process included preparing instructional flowcharts and storyboards, compiling learning materials (rules, signals, and case-based scenarios), and integrating multimedia elements such as videos, images, and interactive modules. The platform was designed to be accessible via multiple devices, including smartphones and laptops, to support flexible learning environments. The integration of multimedia content in digital learning environments has been shown to enhance cognitive processing and skill acquisition [8].

In the **evaluation phase**, the developed product underwent a series of formative evaluations, including expert validation, small group trials, and field testing. Expert validation involved subject-matter experts and instructional media specialists who assessed the content accuracy, usability, and instructional design of the model. Their feedback was used to revise and improve the product before implementation.

2.3 Participants

The participants in this study consisted of undergraduate students enrolled in the Futsal Refereeing course in the Physical Education, Health, and Recreation (PJKR) program at the Faculty of Sports Science, Universitas Negeri Medan. A purposive sampling technique was applied to select participants who were actively engaged in the course. Additionally, experts in futsal refereeing and educational technology were involved in the validation process to ensure the quality and relevance of the developed model.

2.4 Instruments

Data were collected using several instruments, including:

1. **Expert validation sheets**, used to evaluate the feasibility and quality of the developed model
2. **Student response questionnaires**, used to assess usability and user satisfaction
3. **Knowledge tests (pretest and posttest)**, used to measure learning outcomes before and after using the web-based tutorial

These instruments were designed to capture both quantitative and qualitative data related to the effectiveness of the learning model. The use of multiple instruments helps improve the reliability and validity of educational research findings [9].

2.5 Data Analysis

Quantitative data were analyzed using descriptive and inferential statistics. Pretest and posttest scores were compared using paired sample statistical tests to determine the effectiveness of the developed model. A significance level of $p < 0.05$ was applied to assess statistical differences. Qualitative data obtained from expert feedback and student responses were analyzed using thematic analysis to identify patterns and areas for improvement. Combining quantitative and qualitative approaches provides a more comprehensive understanding of instructional effectiveness [10].

3 Results and Discussion

3.1 Product Feasibility and Validation

The developed web-based futsal refereeing tutorial model was evaluated through expert validation involving material experts, media experts, and refereeing practitioners. The validation results indicate that the product meets the criteria of feasibility and usability for instructional purposes.

Table 1. Expert Validation Results

Expert Category	Score (%)	Criteria
Material Expert	83.33	Very Good
Media Expert	78.33	Good
Refereeing Expert	83.93	Very Good
Average	**81.86**	**Very Good**

The overall validation score (81.86%) indicates that the model is highly feasible. This finding confirms that integrating multimedia and structured instructional design enhances content clarity and usability. Previous studies emphasize that digital instructional tools with strong pedagogical design significantly improve learning effectiveness in sports education [11].

3.2 Student Response and Usability

The practicality of the model was tested through student trials. Results from small group and field trials show high levels of user acceptance.

Table 2. Student Response Results

Trial Stage	N	Score (%)	Criteria
Small Group	25	82.53	Very Good
Field Trial	50	92.33	Very Good

The increase in response scores from small group to field trials indicates improved usability after revisions. High student engagement suggests that web-based learning environments promote autonomy and motivation, consistent with findings in digital pedagogy research [12].

3.3 Learning Effectiveness (Pretest–Posttest Results)

To measure effectiveness, pretest and posttest assessments were conducted. The results demonstrate a significant improvement in students' refereeing competence.

Table 3. Pretest–Posttest Results

Test Type	Mean Score	Std. Deviation	Significance
Pretest	65.25	6.82	–
Posttest	82.70	5.94	0.000*

*Significant at $p < 0.05$

The results show a substantial increase in mean scores, indicating that the web-based tutorial effectively enhances students' knowledge and decision-making skills. This improvement is consistent with studies showing that technology-supported learning improves cognitive processing and skill acquisition in sports contexts [13].

3.4 Discussion

The findings demonstrate that the web-based tutorial model significantly improves futsal refereeing competence. The increase in posttest scores confirms that integrating digital learning with sport pedagogy enhances both cognitive understanding and applied decision-making skills.

From a sport science perspective, refereeing competence involves perceptual-cognitive abilities such as anticipation, judgment, and situational awareness. The use of video-based and interactive learning environments allows students to simulate real-game scenarios, thereby strengthening these skills. Research indicates that digital simulation and observational learning significantly enhance decision-making accuracy in sports officiating [14].

Furthermore, the high validation and usability scores suggest that the model successfully aligns instructional design with learner needs. The integration of multimedia elements supports dual-channel processing, enabling learners to process visual and verbal information simultaneously, which improves retention and application of knowledge [15].

The results also support the role of digital learning in promoting student-centered education. The flexibility of web-based platforms allows learners to engage in self-paced study, increasing motivation and participation. This aligns with contemporary trends in sport pedagogy that emphasize active learning and technological integration [16].

Despite these positive findings, several limitations should be acknowledged. The study was limited to a specific group of university students and did not measure long-term skill retention or real-game performance. Future research should include longitudinal designs and incorporate advanced technologies such as virtual reality or AI-based feedback systems to further enhance training effectiveness.

4 Conclusion

This study demonstrates that the development and implementation of a web-based tutorial model significantly enhance futsal referee competence within a sport pedagogy framework. The findings confirm that the developed model is both feasible and practical, as evidenced by high validation scores from experts and positive responses from students. Furthermore, the significant improvement in pretest–posttest results indicates that the model effectively strengthens learners' understanding of refereeing rules, decision-making accuracy, and procedural skills.

From a sport science perspective, the integration of digital learning with pedagogical principles provides a structured environment that supports the development of perceptual-cognitive abilities essential for refereeing performance. The use of multimedia content and interactive learning features enables learners to engage in repeated observation, analysis, and application of game scenarios, thereby enhancing both theoretical knowledge and practical competence.

In addition, the web-based format offers flexibility and accessibility, allowing students to learn independently and at their own pace. This aligns with contemporary trends in technology-enhanced learning and supports the shift toward student-centered education in higher education settings.

Overall, the study highlights the potential of digital tutorial models as an innovative solution for improving learning outcomes in sports education. It is recommended that future research incorporate advanced features such as simulation-based learning and real-time feedback systems, as well as broader implementation across different sports and educational contexts to further validate and expand the effectiveness of this approach.

Acknowledgments. The authors would like to express their sincere appreciation to Universitas Negeri Medan (UNIMED), particularly the Faculty of Sports Science, for providing institutional

support and facilitating the implementation of this research. The authors also extend their gratitude to the experts in futsal refereeing and instructional media who contributed valuable feedback during the validation process. Special thanks are given to the students of the Physical Education, Health, and Recreation (PJKR) program who participated in the trials and provided meaningful responses that contributed to the refinement of the developed model.

Disclosure of Interests. The authors declare that there are no competing interests related to this study. This research was conducted independently without any financial or commercial relationships that could be construed as a potential conflict of interest.

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