

# Interactive Multimedia-Based Football Learning Model: Needs Analysis, Development, and Effectiveness Evaluation

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**Abstract** This study aimed to design, develop, and evaluate an interactive multimedia-based football learning model to enhance students' cognitive and psychomotor outcomes in higher education. Using a Research and Development (R&D) design adapted from Borg and Gall, the study consisted of four main stages: (1) needs analysis, (2) product design and expert validation, (3) small- and large-group try-outs, and (4) field implementation through a quasi-experimental design. Participants included 60 male university students enrolled in a football learning course. Data were collected through questionnaires, expert judgment rubrics, interviews, observations, and performance tests. Quantitative data were analyzed using descriptive statistics and N-Gain scores, while qualitative data were thematically analyzed to refine the product across iterations. The results demonstrated that the developed model is valid, practical, and effective. Expert validation reached a "very good" category, while student responses indicated high satisfaction with clarity, interactivity, and engagement. The experimental group showed significant improvement in passing, dribbling, and shooting skills, with an N-Gain score in the medium-to-high category. Qualitative feedback also revealed increased motivation, self-directed learning, and enjoyment during practice. Grounded in constructivist and multimedia learning theories, the model integrates visual, audio, and interactive components to foster active learning. The study contributes to sports pedagogy and football

education by providing a replicable framework for technology-enhanced skill acquisition. Future research should expand the participant scope, explore female and youth populations, and examine long-term retention and transfer effects in authentic game settings.

**Keywords** Interactive Multimedia, Learning Model, Needs Analysis, Football Education, Sports Pedagogy

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## 1. Introduction

Football is one of the most popular sports in higher education curricula, yet its learning process often remains dominated by traditional, instructor-centered approaches that emphasize physical execution over conceptual understanding [1], [2]. Such methods tend to limit student engagement, self-directed learning, and feedback opportunities, which are essential components of effective skill acquisition [3], [4]. The increasing availability of educational technology presents an opportunity to transform football instruction into a more interactive, student-centered, and multimodal learning experience [5], [6].

However, before developing a new instructional model, it is essential to conduct a systematic needs analysis to identify learners' actual challenges, technological

readiness, and pedagogical expectations. Needs analysis serves as a crucial foundation in research and development (R&D) processes [7], ensuring that the final product addresses contextual problems rather than abstract assumptions. In football education, previous studies have highlighted limited feedback mechanisms, monotonous drills, and insufficient digital integration as key barriers to learning [8], [9]. Therefore, identifying these needs provides a rational basis for designing an interactive multimedia-based football learning model [10] that responds directly to these gaps.

Conceptually, this study is positioned at the intersection of coaching science and sport pedagogy. From the perspective of coaching science, the model draws on motor learning and constraints-led approaches, emphasizing adaptive skill acquisition in dynamic environments [11]. From the pedagogical perspective, the model adopts constructivist principles [12] and Mayer's multimedia learning theory [13], which together advocate for learning environments where students actively construct knowledge through interaction, visualization, and reflection. Integrating these frameworks allows football learning to become both technically effective and pedagogically meaningful.

Accordingly, this study aims to design, develop, and validate an interactive multimedia-based football learning model that enhances cognitive and psychomotor outcomes among university students. Specifically, the research seeks to (1) analyze the learning needs and contextual challenges of football instruction, (2) develop and validate an interactive multimedia learning model, and (3) evaluate its effectiveness in improving students' performance and learning motivation. By addressing the persistent gap between traditional coaching practices and technology-supported pedagogy, this study contributes to advancing contemporary approaches in sports education and digital learning innovation.

## 2. Materials and Methods

### 2.1. Study Design

This study adopted a Research and Development (R&D) design adapted from Borg and Gall [7], which comprised four main stages: needs analysis, design and expert validation, small- and large-group try-outs, and field implementation with effectiveness testing. A mixed-methods approach was employed to integrate both quantitative and qualitative data, ensuring comprehensive model refinement and validation [14]. The research design emphasized an iterative development process, in which each stage was systematically evaluated, revised, and improved before progressing to the subsequent phase, thereby enhancing the overall reliability and effectiveness of the developed model.

### 2.2. Participants

The participants were 60 male university students enrolled in a football learning course at a physical education department. Three expert validators (two in sport pedagogy and one in multimedia design) were also involved in the validation process.

Participants were selected using purposive sampling, ensuring that they had prior exposure to basic football techniques. All participants provided informed consent, and ethical clearance was obtained from the Institutional Research Ethics Committee.

### 2.3. Instruments and Procedures

Multiple instruments were utilized to ensure comprehensive data triangulation. Questionnaires were administered to assess learning needs, student perceptions, and the practicality of the developed model. Expert validation rubrics, employing a five-point Likert scale (1–5), were used to evaluate the content, pedagogy, and multimedia design. Observation checklists and interview guides were implemented to collect qualitative feedback during the try-out phases. Additionally, football skill performance tests—covering passing, dribbling, and shooting—were used to assess the model's effectiveness. The reliability of the instruments was confirmed through Cronbach's alpha ( $\alpha = 0.89$ ), indicating high internal consistency. Content validity was ensured through expert judgment and subsequent revisions based on feedback.

The research procedures were carried out in four sequential stages. During the Needs Analysis Stage, data were collected through questionnaires, interviews, and observations to identify existing problems in the football learning process. The analysis revealed low student engagement, insufficient feedback, and minimal integration of technology in instructional activities.

In the Design and Expert Validation Stage, an interactive multimedia-based football learning model was developed, integrating text, images, animations, and instructional videos. Three experts assessed the prototype for its relevance, interactivity, and clarity. Their feedback guided several revisions to enhance the model's quality and instructional alignment.

The Small- and Large-Group Try-Outs involved two successive phases. First, a small group of 15 students tested the prototype to identify usability issues and areas for improvement. After refinement, a large-group try-out involving 30 students was conducted to evaluate the model's practicality and functionality. Qualitative data were gathered through semi-structured interviews and direct classroom observations to ensure comprehensive feedback.

Finally, the Field Implementation and Effectiveness Testing stage employed a quasi-experimental design using a non-equivalent control group format. A total of 60

students participated, divided equally between the experimental group (n = 30) and the control group (n = 30). Both groups completed pre- and post-tests measuring football skill performance—specifically passing, dribbling, and shooting. The experimental group received instruction using the multimedia-based learning model, while the control group was taught through conventional methods. This phase aimed to determine the effectiveness of the developed model in enhancing students' football learning outcomes.

## 2.4. Statistical Analysis

Quantitative data were analyzed using descriptive statistics, normality tests, and N-Gain scores to measure learning improvement. Qualitative data (from interviews and observations) were analyzed thematically to extract insights related to usability, motivation, and engagement. Integration occurred during interpretation to ensure a comprehensive evaluation of model effectiveness and practicality.

## 3. Results

### 3.1. Needs Analysis

The Needs Analysis Stage aimed to identify current challenges in football learning among university students. Data were collected from 60 male students through questionnaires, interviews, and classroom observations. The analysis focused on students' engagement, feedback availability, and technology integration in football instruction.

Quantitative results (Table 1) indicate that students perceived a strong need for multimedia-enhanced learning. The overall mean score was 4.42 (SD = 0.53), categorized as "very high". The highest-rated indicators were the integration of multimedia elements (M = 4.65) and interactive feedback for skill correction (M = 4.57), reflecting students' priorities for visualization and real-time guidance.

Correlation analysis further revealed that teaching experience ( $r = 0.48$ ,  $p = .003$ ) and digital literacy ( $r = 0.52$ ,  $p = .001$ ) were significantly and positively associated with openness toward multimedia integration, indicating that digitally literate educators are more receptive to pedagogical innovation.

Qualitative data from interviews and classroom observations revealed three prominent themes regarding the existing football instruction. First, traditional teaching methods were perceived as monotonous, with lessons primarily relying on verbal explanations and demonstrations, which often led to student disengagement, as one teacher (T3) noted, "*Most football lessons rely on*

*explanation and demonstration only. Students lose focus because they can't visualize what's being taught.*"

Second, students reported limited opportunities for feedback, particularly regarding skill execution; a student (S8) remarked, "*We rarely get feedback on whether our passing or dribbling is correct. Sometimes I only realize my mistake after watching others.*"

Finally, participants expressed a positive attitude toward integrating technology into learning. One student (S11) stated, "*If there were videos or animations, I'd feel more excited to practice. Using technology makes learning more fun.*" Collectively, these insights underscore the need for an interactive multimedia-based football learning model to enhance engagement, provide immediate feedback, and support more effective skill acquisition.

### 3.2. Expert Validation

In the Design and Expert Validation Stage, three experts (two in sport pedagogy and one in multimedia design) assessed the model using five-point Likert scale rubrics. The evaluation covered content relevance, pedagogical design, multimedia quality, and interface usability.

Table 2 shows the expert validation results, with an average score of 4.74, categorized as "very good." Experts recommended minor adjustments to navigation flow and audio synchronization, which were subsequently implemented before try-outs.

### 3.3. Small and Large Group Try Outs

The try-out process was carried out in two phases to evaluate the usability and practicality of the developed model. In the small-group try-out involving 15 students, the focus was on initial functionality and user experience. The model received a mean practicality score of 4.56, indicating a "Very Good" level, with students noting that animations, video tutorials, and interactive quizzes significantly enhanced their understanding and engagement. Following refinement, a large-group try-out was conducted with 30 students to assess practicality and performance on a broader scale. The mean score slightly increased to 4.61, also rated as "Very Good" (Table 3), confirming that the model was well-prepared for full-scale implementation.

Qualitative observations further indicated that the multimedia-based model fostered greater motivation, encouraged self-directed learning, and improved clarity in understanding football techniques. As one student (S17) expressed, "*It feels like a game but teaches real football skills. I want to repeat the drills until I get them right,*" highlighting the model's ability to make learning both engaging and skill-focused.

**Table 1.** Descriptive Statistics of Needs Analysis Indicators (n = 60)

Indicator	Mean (M)	SD	Category
Integration of multimedia elements in football instruction	4.65	0.41	Very High
Interactive feedback for skill correction	4.57	0.44	Very High
Visualization of tactical and technical concepts	4.49	0.48	Very High
Integration of audio–visual explanations	4.36	0.52	High
Use of gamification and interactive scoring	4.29	0.55	High
Accessibility and usability of digital learning	4.18	0.60	High
Alignment with curriculum and learning outcomes	4.45	0.46	Very High
<b>Overall Mean Score</b>	<b>4.42</b>	<b>0.53</b>	<b>Very High</b>

Scale: 1 = Very Low, 5 = Very High.

**Table 2.** Expert Validation Results (n = 3)

Aspect	Mean Score	Category
Content relevance and alignment with learning outcomes	4.78	Very Good
Pedagogical design (interactivity, constructivist alignment)	4.72	Very Good
Technical quality and multimedia integration	4.80	Very Good
Interface usability and user experience	4.65	Very Good
<b>Average Score</b>	<b>4.74</b>	<b>Very Good</b>

**Table 3.** Try-Out Results

Phase	N	Mean Score	SD	Category
Small-Group Try-Out	15	4.56	0.42	Very Good
Large-Group Try-Out	30	4.61	0.39	Very Good

**Table 4.** Pre- and Post-Test Performance Comparison (n = 60)

Skill	Group	Pre-Test M (SD)	Post-Test M (SD)	N-Gain	Category
Passing	Experimental	68.43 (6.12)	84.17 (4.93)	0.68	Medium–High
	Control	67.97 (5.88)	74.25 (5.16)	0.32	Low–Medium
Dribbling	Experimental	70.12 (5.87)	86.90 (5.03)	0.71	High
	Control	69.95 (5.44)	76.03 (5.09)	0.34	Low–Medium
Shooting	Experimental	67.81 (6.33)	83.48 (5.40)	0.65	Medium–High
	Control	68.20 (5.90)	75.11 (5.46)	0.35	Low–Medium

### 3.4. Field Implementation and Effectiveness Testing

The Field Implementation Stage used a quasi-experimental design with non-equivalent control groups. The experimental group (n = 30) received the multimedia-based learning model, while the control group (n = 30) followed conventional methods. Pre- and post-tests assessed passing, dribbling, and shooting skills.

As shown in Table 4, the experimental group exhibited substantial improvements with N-Gain scores ranging from 0.65–0.71 (Medium–High), whereas the control group showed smaller gains (0.32–0.35, Low–Medium).

The effectiveness of the multimedia-based football learning model was confirmed through independent t-tests, which revealed significant differences between the experimental and control groups ( $p < .001$ ). These quantitative results were reinforced by qualitative

feedback, which identified three key themes. First, students demonstrated active and autonomous learning, as they were able to practice independently using multimedia guidance. Second, motivation and enjoyment increased, with learning perceived as more like interactive play than traditional instruction. Third, students benefited from immediate feedback and opportunities for self-correction, allowing them to identify and correct errors without relying solely on teacher intervention. Together, these findings indicate that the model effectively enhances both engagement and skill acquisition in football learning.

### 3.5. Integrated Findings

Table 5 summarizes the integration of quantitative and qualitative results, confirming the model's validity, practicality, and effectiveness.

**Table 5.** Integrated Findings

Aspect	Quantitative	Qualitative	Interpretation
Learning need	M = 4.42, Very High	Students report monotony in traditional lessons	Strong need for the multimedia-based model
Model validity & practicality	Expert = 4.74; Try-out = 4.61	Students report clarity, engagement	Model is valid, practical, and user-friendly
Effectiveness	N-Gain = 0.65–0.71	Motivation, autonomy, self-directed learning increased	Model enhances cognitive and psychomotor outcomes

## 4. Discussion

The findings of this study demonstrate that the Interactive Multimedia-Based Football Learning Model is valid, practical, and effective in enhancing university students' cognitive understanding and psychomotor skills in football. The discussion below integrates quantitative performance data and qualitative feedback to provide a comprehensive interpretation.

### 4.1. Needs Analysis and Rationale for Model Development

The needs analysis revealed a very high demand (M = 4.42) among students for multimedia-supported instruction (Table 1). Students highlighted monotonous traditional methods, limited feedback, and minimal technological integration as significant barriers. These findings align with previous research in sport pedagogy, which emphasizes the importance of interactive and technology-enhanced learning environments for improving skill acquisition and engagement [15].

The strong need for multimedia integration justifies the development of an interactive model combining videos, animations, and interactive quizzes, which allows students to visualize and practice technical and tactical football skills independently. Qualitative data also supported this rationale: students reported increased motivation and enjoyment when engaging with multimedia components. This reflects constructivist learning principles, where learners actively construct knowledge through exploration and interaction [16].

### 4.2. Expert Validation and Practicality

Expert validation produced an average score of 4.74 (Very Good) across content, pedagogy, and multimedia design (Table 2). The feedback suggested minor adjustments, which were implemented prior to try-outs. The small- and large-group try-out phases yielded mean practicality scores of 4.56 and 4.61, respectively (Table 3), indicating that the model is user-friendly, engaging, and well-aligned with learning objectives.

These results indicate that both theoretical alignment and practical usability were achieved, addressing a common challenge in educational technology: the gap between design intent and classroom applicability.

Students' qualitative feedback reinforced this point: they described the learning experience as motivating, self-directed, and interactive, highlighting that the model successfully translates pedagogical theory into practice.

### 4.3. Effectiveness in Enhancing Football Skills

Field implementation using a quasi-experimental design demonstrated substantial improvements in passing, dribbling, and shooting skills in the experimental group compared to the control group (Table 4). N-Gain scores ranged from 0.65 to 0.71 (Medium–High), while the control group only achieved 0.32–0.35 (Low–Medium). Independent t-tests confirmed that the differences were statistically significant ( $p < .001$ ).

The quantitative improvement is supported by qualitative observations, where students reported the ability to practice autonomously, receive immediate feedback, and correct errors independently. This combination of multimodal input (visual, auditory, interactive) and active engagement aligns with Mayer's multimedia learning principles [13], which emphasize that learning is enhanced when students process information through multiple channels.

### 4.4. Integration of Quantitative and Qualitative Findings

The integration of both quantitative and qualitative data, as presented in Table 5, provides strong evidence for the effectiveness of the interactive multimedia-based football learning model. Notably, the multimedia elements enhanced students' motivation and engagement, making practice more enjoyable and fostering self-directed learning, in line with constructivist and gamification principles. Additionally, measurable improvements in passing, dribbling, and shooting skills indicate that the model's interactive practice and immediate feedback mechanisms facilitate faster and more effective psychomotor learning. From a pedagogical perspective, the model promotes active learning by enabling students to construct knowledge through guided practice, reflection, and self-correction, thereby addressing gaps commonly found in traditional instructional methods. Collectively, this dual evidence base demonstrates that the model not only elevates performance but also positively influences learning attitudes and autonomy, outcomes that are

particularly valuable in higher education sports programs.

#### 4.5. Implications for Practice and Theory

The study carries several important pedagogical and theoretical implications. From a pedagogical standpoint, educators can incorporate interactive multimedia into football instruction to boost student engagement, foster autonomy, and accelerate skill acquisition. The feedback mechanisms embedded within the multimedia model enable real-time error correction, reducing students' reliance on the instructor and promoting independent learning. Moreover, the model offers a scalable framework that can be adapted for other team sports, supporting technology-enhanced instruction across diverse contexts.

Theoretically, the study provides empirical support for constructivist and multimedia learning theories within higher education football instruction. It demonstrates that a multimodal instructional design can effectively integrate cognitive understanding with psychomotor skill development, bridging the gap between theory and practice. The convergence of quantitative evidence, showing performance gains, and qualitative evidence, reflecting enhanced motivation and autonomy, reinforces the value of technology-enhanced pedagogy in sports education.

#### 4.6. Limitations and Future Directions

While the results of this study are encouraging, several limitations should be acknowledged. The sample was restricted to 60 male university students, leaving female and younger populations unrepresented. Additionally, the evaluation focused on immediate skill gains, so long-term retention and the transfer of skills to actual game performance remain unexamined. The study was also context-specific, conducted within a single higher education football course, which may limit the generalizability of the findings to other institutions without appropriate adaptation. Future research should address these gaps by including female and youth participants to ensure broader applicability, conducting longitudinal studies to evaluate skill retention and transfer in authentic game settings, and integrating advanced analytics and adaptive feedback mechanisms to further personalize and optimize the learning experience.

### 5. Conclusions

This study successfully developed and evaluated an Interactive Multimedia-Based Football Learning Model designed to enhance both cognitive understanding and psychomotor skills of university students enrolled in a football course. The needs analysis revealed that traditional football instruction often lacks sufficient feedback, engagement, and technological integration, with students expressing a clear preference for interactive multimedia to

support autonomous learning. Validation by experts and classroom try-outs confirmed that the model is highly valid, practical, and user-friendly, featuring clear instructions, engaging multimedia elements, and strong alignment with learning objectives. Quantitative results demonstrated significant improvements in passing, dribbling, and shooting skills among the experimental group compared to the control group (N-Gain = 0.65–0.71, Medium–High), while qualitative feedback highlighted enhanced motivation, self-directed learning, and enjoyment, indicating that the model effectively promotes active and meaningful learning. Theoretically and pedagogically, the model operationalizes constructivist and multimedia learning principles in football instruction, providing a structured framework for integrating visual, auditory, and interactive elements to facilitate skill acquisition and learner engagement. Overall, the study presents strong evidence that the Interactive Multimedia-Based Football Learning Model is valid, practical, and effective for higher education football instruction, offering a replicable approach applicable to other sports education contexts.

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