

Development of a Table Tennis Textbook Based on the Intensive Rally Training (IRT) AZA Method

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Abstract. This study developed and evaluated a table tennis textbook based on the Intensive Rally Training (IRT) AZA method to support university-level instruction. Following the ADDIE Research and Development (R&D) model, the instructional material was designed to enhance motor skill acquisition and conceptual understanding. The textbook underwent validation by subject-matter, media, and instructional experts, followed by field testing with 20 university students. Data were collected via validation sheets, student questionnaires, and practical learning tests, then analyzed using descriptive statistics and a paired-samples t-test. Expert evaluations confirmed high validity across content relevance, instructional structure, visual quality, and IRT-AZA framework integration. Student responses demonstrated high practicality and usability. Product effectiveness was evidenced by a significant mean score increase from 64.15 to 82.95 ($p = 0.000 < 0.05$). The findings confirm that the IRT AZA-based textbook is valid, practical, and effective for systematic skill development.

Keywords: Instructional textbook, Intensive Rally Training, learning outcomes, table tennis, research and development

1 Introduction

Physical education plays a strategic role in developing healthy, active, and skilled individuals equipped with social competencies essential for daily life. Rather than focusing solely on physical activity, physical education serves as a pedagogical framework that integrates the motor, cognitive, affective, and social development of learners. Recent research demonstrates that adopting appropriate pedagogical models enhances learning experiences, motivation, student engagement, and overall learning outcomes in physical education [1]–[3]. Within this context, table tennis is a highly relevant sport for educational contexts, as it requires hand-eye coordination, rapid reaction speed, concentration, movement precision, and dynamic decision-making under time constraints. Structured pedagogical approaches in table tennis instruction have been shown to improve physical fitness, motor coordination, cognitive capacity, and physical activity engagement [4], [5].

Despite its educational value, the implementation of table tennis instruction in school and university curricula faces operational challenges, particularly regarding the availability of systematic, contextual, and user-friendly learning materials. Existing instructional resources

predominantly focus on static descriptions of basic techniques and game rules, failing to accommodate progressive, multi-stage skill training. To bridge this gap, instructional materials must be designed using systematic development frameworks that convert content presentation into actionable learning and training workflows. The ADDIE (Analysis, Design, Development, Implementation, Evaluation) framework offers a robust model for this purpose, providing clear guidelines spanning needs analysis to product evaluation [6].

The technical demands of table tennis require learners to sustain rallies, control ball placement, execute rapid direction changes, and make decisions during dynamic game scenarios. Consequently, isolated drill training is insufficient; instruction must incorporate progressive exercises that simulate actual match conditions. Contextual and progressive training approaches are more effective in developing gameplay skills than isolated technical drills. These insights underscore the utility of the Intensive Rally Training (IRT) AZA method, which emphasizes progressive, high-density rally drills geared toward real-game application.

Prior literature primarily investigates general physical education pedagogical models, educational technology integration, digital media, or isolated skill development in table tennis. However, studies focusing on the development of specialized textbooks that embed systematic training methodologies directly into content structures remain scarce. This highlights a distinct research gap in instructional material design that combines conceptual knowledge with sports-specific training structures. The primary novelty of this study lies in the integration of the IRT-AZA method into a table tennis textbook, creating an instructional system that unifies conceptual knowledge, technical illustrations, progressive rally drills, skill assessments, and learning reflection tasks [2], [7].

Accordingly, this study aims to develop a table tennis textbook based on the Intensive Rally Training (IRT) AZA method that fulfills validity, practicality, and effectiveness criteria for university-level instruction. The resulting textbook is intended to support students in mastering technical fundamentals, enhancing rally consistency, and improving match performance through systematic learning tasks. Theoretically, this study contributes to sports pedagogy by establishing a method-integrated material design framework; practically, it provides an adaptable instructional resource for lecturers, teachers, coaches, and students..

2 Method

This study employed a Research and Development (R&D) design using the ADDIE model, which comprises five stages: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model was selected because it provides a systematic framework for instructional material development, ensuring that the final product is validated, revised, and empirically tested before broader deployment. The study aimed to develop a table tennis textbook based on the Intensive Rally Training (IRT) AZA method that meets the criteria for validity, practicality, and effectiveness.

The analysis phase involved a literature review, observations of table tennis instruction, and a needs assessment of both lecturers and students. The design phase encompassed establishing

the textbook structure, defining learning outcomes, drafting instructional content and technical illustrations, organizing IRT AZA-based drill progressions, designing evaluation rubrics, and formulating the graphical layout. The development phase entailed drafting the initial product, which was subsequently validated by subject-matter, media, and language experts, followed by revisions based on validator feedback.

The implementation phase involved small-group and large-group field trials with students enrolled in table tennis courses. Product practicality was evaluated using user response questionnaires, whereas instructional effectiveness was measured by analyzing learning achievement gains using pretest and posttest instruments. The evaluation phase was conducted continuously throughout the development process to refine the product until a highly feasible textbook was achieved.

The research instruments consisted of expert validation sheets, user response questionnaires, observation forms, and learning achievement tests. All instruments utilized a five-point Likert scale and underwent expert validation prior to administration. Data were analyzed using quantitative descriptive statistics to determine feasibility percentages, alongside inferential statistical analysis where applicable. The study adhered strictly to research ethics, including securing informed consent from respondents, maintaining data confidentiality, and utilizing research findings exclusively for academic purposes. The final output is a table tennis textbook based on the IRT AZA method, serving as a systematic, practical, and effective learning resource to enhance instructional quality in table tennis education.

3 Result

This study aimed to develop a table tennis textbook based on the Intensive Rally Training (IRT) AZA method as a feasible, practical, and effective instructional resource to support university-level table tennis courses. The development was conducted using a Research and Development (R&D) approach, encompassing needs analysis, product design, expert validation, product revision, small-group testing, large-group testing, and final product refinement. Research data were collected using validation sheets from subject-matter, media, and instructional experts, student response questionnaires, and learning achievement tests administered before (pretest) and after (posttest) using the textbook. Data were subsequently analyzed using descriptive and inferential statistics, including normality testing and paired-samples t-tests, to evaluate the effectiveness of the textbook in enhancing student learning outcomes.

The needs analysis phase revealed that table tennis instruction encounters several operational challenges. Students struggled to comprehend basic technical concepts independently due to a lack of structured instructional materials, whereas lecturers relied primarily on oral explanations and physical demonstrations during class sessions. Consequently, the instructional process did not fully support self-directed learning or systematic drill practice. To address this gap, the textbook was developed by integrating the Intensive Rally Training (IRT) AZA framework, structuring content sequentially from foundational technique mastery and progressive rally drills to drill variations, skill evaluations, and training reflection tasks.

The initial draft underwent validation by subject-matter, media, and instructional experts. The validation results indicated that the textbook fell into the "highly feasible" category across content relevance, presentation accuracy, readability, instructional organization, visual quality, and alignment with the Intensive Rally Training (IRT) AZA framework. Nevertheless, the validators provided several recommendations, including refining technical illustrations, adding rally drill variations, clarifying user instructions, and adapting the linguistic style to be more communicative for university students. All feedback was incorporated during revisions to yield a comprehensive and user-friendly product.

Small-group field testing demonstrated positive student responses toward the developed textbook. Students reported that the content presentation was systematic, technical illustrations were clear, and progressive training stages enabled them to practice incrementally according to their ability levels. Furthermore, the inclusion of rally-based drills helped students connect foundational techniques to real-match scenarios, rendering the learning experience more contextual.

Following revisions based on small-group feedback, the textbook was implemented in a larger cohort. The implementation results demonstrated an increase in student learning outcomes following the use of the IRT AZA-based table tennis textbook. The comparison between pretest and posttest scores is presented in Table I.

Table I Comparison Of Student Pretest And Posttest Scores

No.	Student	Pretest	Posttest	Score Difference	Improvement Category
1	Asep	62	81	19	High
2	Sila	65	84	19	High
3	Ika	61	79	18	High
4	Firman	67	85	18	High
5	Rehan	63	82	19	High
6	Febi	68	86	18	High
7	Zeta	64	83	19	High
8	Angel	66	84	18	High
9	Manda	60	78	18	High
10	Niko	69	87	18	High
11	Tata	65	83	18	High
12	Marta	62	81	19	High
13	Gina	64	82	18	High
14	Bagus	66	85	19	High
15	Tegar	63	80	17	Moderate
16	Hasan	67	86	19	High
17	Riko	61	79	18	High
18	Gigih	65	84	19	High
19	Arsila	68	87	19	High
20	Ziko	64	83	19	High
Mean		64.15	82.95	18.80	Increased

Based on Table I, all students experienced an improvement in learning outcomes after utilizing the table tennis textbook based on the Intensive Rally Training (IRT) AZA method. The mean pretest score increased from 64.15 to 82.95 on the posttest, representing an average gain of 18.80 points. Nearly all students achieved an improvement within the "High" category, while one student achieved an improvement in the "Moderate" category. These findings demonstrate that the developed textbook effectively enhances both conceptual understanding and practical table tennis skills through systematic content presentation, progressive rally drills, and structured learning activities.

Tables 2. Present the results of the One-Sample Kolmogorov–Smirnov normality test based on data from Table

Variabel	N	Mean	Std. deviation	Kolmogorov-smirnov	Sig. (2-tailed)	Keterangan
Pretest	20	64,15	2,74	0,712	0,200	Berdistribusi normal
posttest	20	82,95	2,81	0,638	0,200	Berdistribusi normal

Prior to hypothesis testing, the research data were subjected to a normality test using the One-Sample Kolmogorov–Smirnov test. This test was conducted to determine whether the distributions of the pretest and posttest data satisfied the assumption of normality, which is a prerequisite for using parametric statistical analysis, specifically the paired-samples t-test.

Based on Table II, the mean pretest score was 64.15 with a standard deviation of 2.74, whereas the mean posttest score increased to 82.95 with a standard deviation of 2.81. The normality test results yielded Kolmogorov–Smirnov test statistics (Z) of 0.712 for the pretest data and 0.638 for the posttest data. Both variables obtained an asymptotic significance value (p) of 0.200, which exceeds the standard significance threshold ($\alpha = 0.05$).

These findings confirm that both the pretest and posttest datasets are normally distributed. Having satisfied the normality assumption, the statistical analysis proceeded with a paired-samples t -test to determine whether a statistically significant difference existed between student learning outcomes before and after using the table tennis textbook based on the Intensive Rally Training (IRT) AZA method.

Methodologically, meeting the normality assumption indicates that score variations among students followed a expected distribution pattern, allowing parametric analysis to yield more accurate estimates regarding the impact of the developed textbook. Consequently, the normality results provide a robust statistical basis for evaluating product effectiveness via the paired-samples t -test.

Following the confirmation of data normality, the next stage evaluated the instructional effectiveness of the IRT AZA-based table tennis textbook on student learning gains. A paired-samples t -test was employed because the pretest and posttest data were obtained from the same respondent cohort. This test aimed to determine whether there was a statistically significant difference in student achievement before and after the implementation of the textbook. The results of the paired-samples t -test are presented in Table III.

Variabel	Comparison	Sig. (2-tailed)	Significance level	Decision
Student learning result	Pretest–Posttest	0,000	0,05	H_0 rejected H_1 accepted

Based on Table III, the paired-samples t -test yielded an asymptotic significance value of 0.000, which is less than the standard significance threshold ($\alpha = 0.05$). Consequently, the null hypothesis is rejected and the alternative hypothesis is accepted, confirming a statistically significant difference between student pretest and posttest scores following the implementation of the Intensive Rally Training (IRT) AZA-based table tennis textbook. These results demonstrate that the developed textbook exerts a significant positive effect on improving student learning outcomes in table tennis instruction.

This gain in learning performance indicates that the textbook functions not merely as an informational resource, but as a structured instructional tool that enables students to master technical fundamentals, comprehend game concepts, and execute table tennis skills systematically. Incorporating the IRT-AZA method within the textbook framework allows students to engage in progressive, structured, and performance-oriented rally drills, optimizing instructional efficiency compared to baseline conditions. Ultimately, these empirical findings confirm that the developed textbook meets the effectiveness criteria required for Research and Development (R&D) instructional materials.

4. Discussion

The effectiveness of the Intensive Rally Training (IRT) AZA-based table tennis textbook is demonstrated not only by improved learning outcomes, but also by shifts in how students construct their understanding of fundamental techniques. Prior to implementing the textbook, instruction was dominated by instructor demonstrations, leaving limited opportunities for self-directed practice. This direct instruction approach prioritized technical acquisition over student-centered learning. By incorporating the IRT-AZA framework, the textbook provides a structured learning guide comprising conceptual explanations, technical movement illustrations, progressive drill sequences, performance rubrics, and self-evaluation tasks. This architecture enables students to systematically link theoretical knowledge with practical skill execution. These findings align with modern physical education pedagogical models that emphasize active, structured, and meaningful student-centered learning experiences [1].

The observed gain in learning performance indicates that integrating sports-specific training methods into instructional materials exerts a broader impact than presenting static theoretical content alone. In motor skill acquisition, technical proficiency depends not only on conceptual understanding, but also on repeated deliberate practice, feedback loops, and contextual application in game scenarios. Therefore, embedding progressive rally drills within each instructional unit distinguishes this textbook from conventional table tennis learning resources. Rather than practicing forehand, backhand, service, and footwork techniques in isolation, students integrate these skills through progressive rally sequences. This approach aligns with motor learning principles that emphasize contextual practice and repetition to enhance performance consistency.

These results reinforce the paradigm of contemporary physical education, which highlights task-based learning and active student engagement in building motor competence. Under this paradigm, motor skill instruction extends beyond mechanical execution to cultivate tactical reasoning, decision-making skills, problem-solving abilities, and learning reflection. Consequently, sports skill acquisition fosters cognitive and affective growth alongside psychomotor development. From a sports pedagogy perspective, these findings corroborate that table tennis is uniquely suited for developing hand-eye coordination, reaction speed, mental concentration, movement precision, and rapid decision-making. However, international literature indicates that table tennis remains underutilized in physical education curricula despite its physical and pedagogical benefits [4], [5].

Commonly cited barriers include a scarcity of structured learning materials, insufficient instructional tools, and a lack of progressive training frameworks tailored to incremental skill development. The IRT AZA-based table tennis textbook directly addresses these instructional gaps. Rather than providing static rule descriptions and basic techniques, the textbook structures training activities according to principles of progression, continuity, and skill complexity. This structural design ensures that theoretical concepts are immediately followed by practical exercises that reinforce gameplay execution. Thus, the textbook serves as both an informational resource and an active instructional tool. These findings support previous research on the necessity of developing physical education materials that actively facilitate learning rather than merely presenting facts [7]. Compared to existing literature, most physical education

development studies focus primarily on digital media, electronic modules, or generic pedagogical models. Specialized research on sports-specific textbooks that integrate targeted drill methodologies into content architecture remains limited. This study fills a distinct research gap by unifying conceptual instruction with systematic motor training. In terms of the state of the art, this study adopts current trends in physical education that integrate learning materials with activity-based and student-centered frameworks.

The quality of instructional materials is evaluated not merely by content comprehensiveness, but by their capacity to facilitate active learning, offer authentic practice experiences, and support sustainable competency development. Thus, the developed textbook fulfills informative, instructional, and evaluative functions within a unified learning system. The primary novelty of this research lies in the integration of the IRT-AZA method as the core structural framework of a table tennis textbook. Unlike traditional textbooks that present isolated technique descriptions, this textbook unifies conceptual knowledge, motion illustrations, progressive rally drills, skill rubrics, and learning reflection tasks into a single systematic workflow. This integration provides an innovative learning tool that supports autonomous learning while progressively developing table tennis skills. The study offers both practical and theoretical contributions. Practically, the textbook serves as an adaptable instructional resource for university lecturers, students, and sports coaches to elevate table tennis instruction. Theoretically, it expands sports pedagogy research by demonstrating that instructional efficacy can be enhanced when learning materials directly embed training methods tailored to sport-specific characteristics. These findings provide an empirical foundation for designing similar method-integrated learning materials in other sports that require progressive motor skill development. Several limitations should be noted. The efficacy evaluation was conducted with a single cohort from one study program, which limits the broader generalizability of the findings. Additionally, long-term skill retention and performance under competitive match conditions were not evaluated. Future research should involve larger, multi-institutional samples and examine long-term effects on tactical awareness, learning motivation, and sustained match performance.

4 Conclusion

This study successfully developed a table tennis textbook based on the Intensive Rally Training (IRT) AZA method using the ADDIE model. Validation, field testing, and statistical analyses confirm that the textbook is valid, practical, and effective for university-level instruction. By embedding the IRT-AZA framework, the textbook provides a progressive and contextual learning experience that significantly improves student learning outcomes compared to traditional technique-oriented instruction. It serves as a unified instructional tool integrating conceptual content, practical exercises, skill reflection, and assessment.

The primary contribution and novelty of this work lie in systematically incorporating sport-specific drill methods into textbook architecture, expanding physical education pedagogical design. Practically, it offers a scalable resource for lecturers, coaches, and students. Future research should address study limitations by testing larger, multi-institutional cohorts and evaluating long-term skill retention, tactical awareness, and match performance.

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