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The Role of the Jigsaw Technique in the Basketball Development of Middle School Students: Cognitive, Affective and Psychomotor Domains

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ABSTRACT

We examined the impact of different instructional models on the cognitive, affective, and psychomotor development of 8th-grade middle school students in the context of basketball instruction. The research was conducted with a quasi-experimental pre-test/post-test control group design. For data collection, the Basketball Knowledge Test was used for the cognitive domain, the Attitude Towards Basketball Scale for the affective domain, and the Basketball Fundamental Offensive Skills Graded Scoring Key for the psychomotor domain. We carried out all study procedures at a state school in Mersin province, selected based on suitable physical and environmental conditions, during the fall semester of the 2024-2025 academic year. The study group consisted of two different 8th-grade classes, each with 30 students. The Jigsaw Technique, largely based on the Collaborative Teaching Model (CTM), was applied to the experimental group, whereas the control group received instruction based on the Direct Instruction Model (DIM) (e.g., command, drills). During the eight-week intervention, instruction in the fundamental offensive basketball skills of chest pass, shooting, and layups was provided in physical education lessons within sports curriculum. A Mixed-Design ANOVA was used to analyze the research data; the assumptions of normality and homogeneity of variance were tested prior to the analysis. Comparative tests showed that Jigsaw technique produced significantly greater improvements across three domains, namely cognitive ($\eta^2=.50$), affective ($\eta^2=.68$), and psychomotor ($\eta^2=.83$), as compared to DIM. In conclusion, the Jigsaw Technique, as part of the CTM, is a more effective method for supporting cognitive, affective, and psychomotor development in basketball instruction.

Keywords: Jigsaw, cognitive domain, affective domain, psychomotor domain, collaborative learning, basketball

INTRODUCTION

In our modern information era, a nation's educational accomplishment is considered as a primary indicator of that nation's development. Quality education has been known to spur economic growth by increasing individual productivity and play a decisive role in social advancement, workforce competitiveness, and intellectual progress (Barro, 2001; Hien, 2018). The rapid pace of change shifts the need for continuous learning from an individual pursuit to a societal and collective necessity, driven by the creativity required for sustainable and inclusive progress (Tri et al., 2022; Kabore, 2022).

Integrating innovative methods into curricula can broaden students' awareness and understanding (Jach & Carvajal, 2023), and employing diverse pedagogical approaches strengthens educational quality and efficacy (Zipfel et al., 2023). This is a dynamic that warrants periodical revision of educational models to prepare for future challenges (Abramovskikh et al., 2021).

Physical education and sports training is a key domain that demands such innovative practices. As a fundamental component of schooling designed to support an all-round development of students, the modern physical education scene has become gradually more distinguished by advancements like real-time motion tracking and personalized pedagogical strategies (Chen & Luo, 2023; Wei et al., 2021).

Previous work in literature shows that model-based teaching in physical education and sports instruction can create positive effects on students' motivation, affective characteristics, cognitive development, and physical competencies (Chu et al., 2022; Sang & Chen, 2022; Gusril et al., 2022). Such findings also corroborate that model-based approaches strengthen physical education and sports practices. Although different models are preferred in physical education and sports instruction, the Collaborative Teaching Model (CTM) and Direct Instruction Model (DIM) stand out among frequently chosen approaches. These sorts of models and techniques increase students' intrinsic motivation, support social interaction, and contribute to physical fitness (Liu & Lipowski, 2021; Dyson, 2002).

Collaborative teaching has been reported to boost performance by supporting physical, cognitive, social, and affective development (Rivera-Pérez et al., 2021). It also develops students' problem-solving skills, encourages active learning, and contributes to social skills and academic success (Chiu et al., 2014; Gorucu, 2016). The approach works effectively not just within traditional classroom environments but in online and virtual settings as well (Barreto et al., 2022; Santosa et al., 2022). The Jigsaw Technique is a form of collaborative teaching with students split into expert groups based on some topic headings and students gain an in-depth knowledge of one topic and pass the knowledge to their group (Karacop, 2017).

Students are active in both the learner and teacher roles. Once the students have all presented their topics, then an exam can be administered to assess individual learning. The method is termed "Jigsaw" because, much like a puzzle, each student represents a unique piece, and the entire picture only emerges once every student has mastered and shared their portion. Research shows that the Jigsaw Technique can increase student participation, verbal communication skills, academic achievement, and confidence (Crone & Portillo, 2013; Phillips & Fusco, 2015).

In physical education contexts, recent studies have shown that the Jigsaw method can enhance students' situational interest and moderate-to-vigorous physical activity, with effects varying by the type of sport—supporting its relevance for basketball instruction (Cochon Drouet et al., 2024). It also shows that a Jigsaw Technique can change passive students to active students, allowing them to develop verbal communication skills and creating a positive learning environment for students (Phillips & Fusco, 2015).

The Jigsaw Technique, one of the methods used under the CTM umbrella, has been extensively researched in fields such as educational sciences, medicine, and psychology, and yet its performance in physical education and sports instruction remain rather limited. The technique's effectiveness across different disciplines has been proven (Handayani et al., 2022), and increasing its adoption in physical education and sports instruction appears necessary. This study is unique in that it extends the application of the Jigsaw Technique to the context of physical education and basketball, where research is still limited, thereby addressing a clear gap in the literature (Drouet et al., 2022).

Another model commonly preferred in physical education and sports training, DIM can be considered to be an effective approach for improving learning outcomes. In this model, the teacher performs instruction through techniques such as directing the lesson, providing explanations, skill modeling, and giving feedback (Setiawan et al., 2020). Research shows that DIM plays an important role in skill development in sports like volleyball and basketball and provides positive effects in game-based instruction (Jayantilal & O'Leary, 2017). In this regard, researchers are investigating which of these two models and their associated techniques will contribute more to learning outcomes and the three developmental domains.

One of the sports considered important in skill development, basketball can be described as an area where cooperation and teamwork play a substantial part in physical education and sports instruction. This sort of unity not only helps students gain physical skills but can also provide important contributions from social, psychological, and educational perspectives. Students' participation in collaborative basketball activities can add to the development of essential life skills such as teamwork, communication, and problem-solving.

The Jigsaw Technique, therefore, can offer important opportunities for reinforcing teamwork skills, encouraging active learning, increasing social interaction among students, and developing a sense of responsibility. For Luo (2023), implementing cooperation strategies nurtures students' understanding of collaboration not just in physical competencies but also in social and academic contexts, a process which improves basketball performance while also strengthening students' class participation and game understanding, thus providing countless positive contributions to the educational process (Yang et al., 2021).

Model-based approaches widely preferred in physical education and sports instruction are expected to cover cognitive, affective, and psychomotor domains, yet most applications focus solely on psychomotor development (Cui & Zhang, 2021; Sang & Chen, 2022).

For this reason, expanding instructional activities to encompass all three developmental domains appears important. Cognitive development, one of these developmental domains in physical education and sports instruction, has critical importance in supporting students' mental skills such as attention, memory, establishing cause-and-effect relationships, and problem-solving (Zeng et al., 2017). Structured physical activities develop not only physical fitness but also cognitive skills that support information processing capacity, academic achievement, and lifelong learning (Diamond, 2015; Egger et al., 2019). This development is directly related to cognitive processes such as understanding game rules, generating strategies, setting goals, and self-regulation (Gallahue & Ozmun, 2006; Zimmerman, 2002).

Within this frame of reference, not overlooking cognitive components in physical education instruction is necessary for both students' mental and holistic development. The affective development domain in physical education and sports instruction plays a fundamental role in increasing students' intrinsic motivation, developing positive attitudes, and strengthening social interaction skills (Chu et al., 2022; Pujianto et al., 2020).

Team sports like basketball are known to support the development of affective skills such as empathy, taking responsibility, and sense of belonging (Baena-Morales et al., 2023). In that regard, an instructional environment that supports students' attitudes and emotional responses transforms sport's educational function into a holistic developmental process. The psychomotor development domain is accepted as a multifaceted area that supports both motor skills and cognitive processes through developing an individual's mind-muscle coordination (Jiang et al., 2022). As such, skills included in team sports units such as passing, dribbling, and shooting can provide an effective tool for developing students' hand-eye coordination, motor control, and physical agility.

Structured teaching methods like Jigsaw contribute to students developing both their psychomotor skills and higher-order skills such as decision-making and problem-solving within teams (Isa et al., 2019).

Eighth-grade middle school students are in a critical developmental stage, open to learning due to their transition from concrete operations to abstract thinking according to Piaget's Cognitive Development Theory (Piaget, 1977).

Students at the Identity Achievement versus Role Confusion stage in Vygotsky's Social Constructivism Theory and Erikson's Psychosocial Development Theory can benefit highly from collaborative learning environments in terms of social interaction and identity development (Vygotsky, 1978; Erikson, 1968).

On the other hand, Deci and Ryan's Self-Determination Theory emphasizes that students at this level have intensified needs for autonomy and social belonging, whereas Schmidt's Motor Learning Approach mentions that this period is favorable for acquiring psychomotor skills (Deci & Ryan, 2008; Schmidt & Tim, 2019).

In light of these theoretical foundations, selecting eighth-grade students as the study group appears scientifically meaningful for their cognitive, social-emotional, and psychomotor development. The Jigsaw technique, belonging to the CTM framework, supports the cognitive, affective, and psychomotor dimensions of learning simultaneously by increasing social interaction among students. Bandura's (1986)

Social Cognitive Theory, Vygotsky's (1978) Constructivist Approach, and Gardner's (2011) Multiple Intelligence Theory form the theoretical foundation for explaining this process. The aforementioned theories emphasize that learning is not just individual but it involves social and multidimensional aspects, which suggests that the Jigsaw Technique can contribute to multifaceted development. With this knowledge and rationale, we aimed to measure the effectiveness of CTM-based Jigsaw technique versus methods derived from DIM in basketball training.

In relation to this purpose, the research hypothesis (H1) and sub-hypotheses (H2, H3, H4) were formulated as follows:

H1: The fundamental offensive basketball skills of middle school students taught via the Jigsaw Technique will differ significantly from those of students taught via DIM.

H2: The cognitive development of students concerning fundamental offensive basketball skills will differ significantly between the group taught via the Jigsaw Technique and the group taught with DIM.

H3: Student attitudes (affective development) towards fundamental offensive basketball skills will differ significantly between the group taught via the Jigsaw Technique and the group taught with DIM.

H4: The psychomotor development of students in relation to fundamental offensive basketball skills will differ significantly between the group taught via the Jigsaw Technique and the group taught with DIM.

METHOD

Research Design

In our study, we used a descriptive survey model to describe the current situation and a "pre-test post-test control group quasi-experimental design" during the experimental process. Although students could not be assigned randomly, existing classes were matched to form experimental and control groups.

The inability to make completely random assignments in Ministry of National Education schools influenced the choice of quasi-experimental design (Karasar, 2005; Corbetta, 2003; Matthews & Ross, 2010). This design was therefore considered the most suitable option for educational field research, where full randomization is often impractical, but valid comparisons between groups can still be achieved through pre-test and post-test applications (Karasar, 2005; Matthews & Ross, 2010).

Measurement structures for this quasi-experimental design are detailed in Table 1.

Table 1. Pre-test/Post-test Control Group Experimental Design for the Basketball Unit

Groups	Pre-test	Intervention	Post-test
Experimental	Basketball Knowledge Test	Collaborative Teaching Model-based Jigsaw Technique	Basketball Knowledge Test
	Basketball Fundamental Offensive Skills Graded Scoring Key		Basketball Fundamental Offensive Skills Graded Scoring Key
	Attitude Towards Basketball Scale		Attitude Towards Basketball Scale
Control	Basketball Knowledge Test	Direct Instruction Model	Basketball Knowledge Test
	Basketball Fundamental Offensive Skills Graded Scoring Key		Basketball Fundamental Offensive Skills Graded Scoring Key
	Attitude Towards Basketball Scale		Attitude Towards Basketball Scale

During the intervention process, the Jigsaw Technique under the CTM framework was employed in the experimental group class, while lessons were organized via techniques under the DIM framework (question-answer, command, direct instruction, demonstration) in the control group class. Before implementation, normality tests were run and two sections that produced the closest values were selected. In the first lesson of each group, the researcher and the class teacher divided the class into five groups of six students each. The experimental group class would operate lessons according to the Jigsaw Technique, and the sub-topics of units with group and group names were formed as presented in Table 2. Each group was formed as heterogeneously as possible in terms of academic achievement and gender. Before we started lessons and activities, group leaders and group names were determined together with the group. Whereas the main groups were coded as basketball group 1, basketball group 2, etc. (BG1, BG2, and so on), experts for each sub-topic were coded as Expert Group 1, Expert Group 2, etc. (UG1, UG2, and so on) and each student in the group was assigned a letter (A, B, C, D, or E). Students from the main group who would work on the same sub-topic formed the expert groups. Expert groups contained 5 students each and were asked to manage the subtopics of the basketball unit in both expert and main formats. The described organizational framework for group formations is presented in Table 2.

Table 2. Subtopics and Group Names for the Basketball Unit

Subtopics	Main Groups	Group Names	Expert Groups
1. Shooting Skill			UG1 (A1, B1, C1, D1, E1)
2. Free Throw Shot	BG1 (A1, A2, A3, A4, A5, A6)	Lions	UG2 (A2, B2, C2, D2, E2)
3. Chest Pass	BG2 (B1, B2, B3, B4, B5, B6)	Sky	UG3 (A3, B3, C3, D3, E3)
4. Bounce Pass	BG3 (C1, C2, C3, C4, C5, C6)	The Blues	UG4 (A4, B4, C4, D4, E4)
5. Right-hand Layup	BG4 (D1, D2, D3, D4, D5, D6)	Champions	UG5 (A5, B5, C5, D5, E5)
6. Left-hand Layup	BG5 (E1, E2, E3, E4, E5, E6)	Mersin Power	UG6 (A6, B6, C6, D6, E6)

Study Group

We carried out the study in a public middle school in Mersin province, which was chosen based on an evaluation of suitable physical, environmental, and practical conditions, during the fall semester of the 2024-2025 academic year. The research group consisted of 60 students total from two different 8th-grade sections, with 30 students in each section. Before the research, convenience sampling was preferred in determining study groups, which included individuals who volunteered for the sampling process (Ural & Kılıç, 2005). This method was considered appropriate because it allowed easy access to the target group in a school setting and ensured the voluntary participation of students, which is often recommended for educational field studies (Ural & Kılıç, 2005).

Pre-tests were carried out to determine the basketball knowledge levels, attitudes, and basic offensive skills of students in two eighth-grade sections at the school where the research was implemented. Based on pre-test results, these sections were assigned as experimental and control groups by means of random assignment. In the first week, three measurement tools were applied to students in both groups and videos were recorded. Only the evaluation for the psychomotor domain scoring key was completed instantly by 3 independent raters.

The Jigsaw groups shown in Table 2 were formed with names chosen by students (such as Lions, Sky, and the Blues), and each group consisted of six students. Each student selected a subtopic and joined an expert group. They researched the relevant topic and received support from teachers on the topic whereas other students performed warm-up exercises, then transferred their expertise to their main group.

The intervention process continued for eight weeks under the guidance of the teacher and researcher, with sessions taking place for two class periods each week. In the first week, the Jigsaw Technique was introduced, tasks were explained, and pre-tests were administered. In the following weeks, expert students prepared for their topics and shared information within their groups. In the eighth week, post-tests were administered by independent evaluators.

Data Collection Process

Within the scope of the research, the data collection and the experimental intervention were handled as distinct processes during the 2024-2025 academic year, spanning the period between September 9 and December 15. For the planned procedures, ethical approval was obtained from the Mersin University Faculty of Sports Sciences Ethics Committee (Date: 22.05.2024, Decision No: 032).

Permission from the Ministry of National Education (MEB) was granted by the Mersin Provincial Directorate of National Education on 27.08.2024 following a review of the researcher's documentation for compliance.

Data Collection Tools

Once the collection of parent consent forms had been completed, data were gathered through a demographic information form as well as three researcher-developed tools: the Attitude Towards Basketball Scale, the Basketball Knowledge Test, and the Basketball Fundamental Offensive Skills Graded Scoring Key.

Basketball Knowledge Test: The development of the test began with the identification of learning outcomes for the cognitive domain, which were then linked to the discipline of basketball. Furthermore, recent evidence indicates that the Jigsaw Technique can effectively support learning processes in physical education and sports sciences, reinforcing its applicability in basketball-specific instructional contexts (Cochon Drouet et al., 2024).

In accordance with the opinions of basketball field experts, a table of specifications was created for the sport. This table covered 20 topic areas derived from the learning outcomes for the pilot test: types of passes, shooting, layups, game rules, and fundamental strategies and tactics. According to the table, 12 items were at the knowledge level, 5 at the comprehension level, and 3 at the application level. The test was designed with four answer choices for each question, a format based on the students' age and developmental characteristics. A 60-item multiple-choice test was prepared that corresponded to the 20 topic areas in the table of specifications; this item pool was three times the size of the 20 items intended for the final form.

The prepared test was presented for feedback to a language expert, who reviewed its language and expression; to one academician with experience in knowledge tests; and to three basketball coaches, who reviewed its content integrity. The pilot test form was administered in person to 678 eighth-grade students between September 9-20, 2024.

Student responses were entered into Microsoft Excel, where correct answers were coded as 1 and incorrect, double, or blank answers were coded as 0.

A 60-item matrix was prepared with the coded data, and an item analysis was executed based on the top 27% and bottom 27% of achievers in the pilot group. The test's arithmetic mean was 40.575, the average item difficulty was 0.676, the average discrimination index was 0.372, and the KR-20 (Alpha) was 0.882. For the final 20-item test, which was selected from the item pool, the discrimination values ranged from 0.40 to 0.56, with an average discrimination value of 0.456.

The KR-20 reliability coefficient for the final test was 0.88, and the KR-21 reliability coefficient was 0.86. These results indicate that the Basketball Knowledge Test possesses a near-excellent level of reliability for measuring the basketball knowledge levels of eighth-grade students. In addition to reliability, the Basketball Knowledge Test also demonstrated strong evidence of content and construct validity, as supported by expert evaluations and item analysis procedures commonly recommended in scale development studies (Hayton et al., 2004; Yong & Pearce, 2013)

Attitude Towards Basketball Scale: The researcher developed this scale and administered it across two distinct study groups. The development process began with qualitative steps involving literature review and item pool generation. Eight basketball players participated in focus group interviews alongside four academics specializing in scale development, held at predetermined times to establish the methodological framework.

Athletes (N = 25) contributed compositions about basketball attitudes, which researchers converted into scale items and incorporated into the item pool. The initial 48-item pool was evaluated by experts through an online assessment form distributed to twenty specialists. Experts applied the Lawshe Technique to evaluate content validity, which resulted in removal of thirteen items and addition of three new items, thus reducing the pool to 38 items.

The study group for Exploratory Factor Analysis (EFA) comprised 855 eighth-grade students from whom data were collected between September 9-15, 2024. To provide stronger evidence for the construct validity of the EFA-derived structure, researchers collected data from 612 eighth-grade students between September 22-27, 2024, and performed Confirmatory

Factor Analysis (CFA) on LISREL software. Following assumption testing, validity and reliability analyses constituted the quantitative phase of the study. The scale demonstrates construct validity through a three-factor, 14-item structure that explains approximately 83% of the variance. The instrument employs a 7-point rating scale (7: Strongly Agree ... 1: Strongly Disagree). The subscales and their reliability coefficients are Achievement (6 items, α = .962), Interest (4 items, α = .952), and Desire (4 items, α = .889). The overall scale reliability coefficient is α = .853. Model fit indices demonstrate excellent psychometric properties: (χ^2: 128.75, df: 74) χ^2/df = 1.73, RMSEA = .041, RMR = .026, NFI = .98, IFI = .99, CFI = .99, GFI = .96, AGFI = .94. Scale scores range from 14 to 98 points.

Basketball Fundamental Offensive Skills Graded Scoring Key: The researcher-developed Basketball Fundamental Offensive Skills Graded Scoring Key was analyzed through Generalizability Theory (G-Theory).

Following a literature review, a 21-item form, with 7 items for each of three skills, was sent to experts for their opinions. However, the form was reduced to 6 items per skill based on the expert feedback. The resulting final form was an 18-item key covering 3 skills (passing [chest pass], shooting [free throw], and layups) with 6 items per skill. It used a four-point rating scale: 'Excellent-3 Points', 'Good-2 Points', 'Poor-1 Point', and 'Not Observed-0 Points'. The possible scores obtainable from the form range from 0 to 54.

On September 20, 2024, the three skills on the pilot form were voluntarily performed by 40 eighth-grade students at their school; their performances were evaluated and recorded by 3 independent raters. Iteman item analysis, a statistical method used to evaluate the quality of items in a test or survey, was also utilized.

We executed a generalizability study by employing a BxPxG (B: Person/Student, P: Rater, G: Task/Item) design. The scores obtained from (B) the 40 students, on (G) the 18 skill-related tasks, as rated by (P) the three raters, were fully crossed. The BxPxG design has seven sources of variance. The estimated variance component for persons (B) accounted for the highest value (27.0%), and the task (G) component produced the second-highest value (26.2%). The lowest percentage of variance among all main effects was attributed to raters (P) (0.1%). With three raters, the G-coefficient was 0.93, and the Phi coefficient was 0.88.

Based on these observations, a "decision study" was performed for scenarios with 2, 3, 4, 5, 6, and 7 raters. However, because these scenarios produced similar and proximate values, it was determined that optimization was achieved with 3 raters. The scoring key created for the three fundamental offensive skills can adequately discriminate between differences in skill level.

Intervention Process

Procedure for the Experimental Group (Jigsaw): For the students in the experimental group, the Jigsaw interventions during lessons were realized based on the principles of the collaborative learning method. Each week, the students were divided into subgroups of expert and home group members; critical behaviors related to basketball skills were then taught to peers by the designated expert students.

The teacher prepared the expert students in advance by distributing weekly worksheets for the relevant skill; during the class, these students were then responsible for sharing the information and leading the session. At the beginning of the lesson, motivation was fostered through warm-up games. Afterward, the home group members positioned themselves in a semicircle to observe and then repeat the expert student's demonstrations.

Throughout the activities, the teacher circulated around the classroom to provide guidance and offer feedback as needed. The activities were diversified with differentiated tasks that supported intra-group collaboration; at the end of each lesson, a period for self-evaluation and peer feedback was held. The process concluded in the final week with a general review and a practical skills test. The process described is detailed in Table 3.

Table 3. Procedural Steps Followed in the Experimental and Control Groups

Weeks	Common Topic for Both Models	DIM (Control Group)	Jigsaw (Experimental Group)
Week 1	Pre-test and introduction	Pre-test administration and briefing via command and introduction techniques	Jigsaw group formation, expert assignment, pre-test
Week 2	Ball handling and shooting skill	Shooting skill instruction via demonstration-response and command techniques	Transfer of shooting techniques via expert students
Week 3	Free throw shot	Free throw training via practice and repetition-focused demonstration-response	Free throw practice with shared learning within the group
Week 4	Chest pass	Demonstration-response and individual practice drills for chest pass skill	Intra-group teaching and observation of passing techniques
Week 5	Bounce pass	Bounce pass instruction with drills and repetitions	Bounce pass practice: repetition with group guidance
Week 6	Right-hand layup	Right-hand layup practice and correction via demonstration-response	Reinforcement of layup practice through group sessions
Week 7	Left-hand layup	Left-hand layup practice with command and demonstration-response	Left-hand layup: interactive learning within the group
Week 8	Post-test and evaluation	Post-test administration, observation, and feedback-based evaluation	Practical post-test and general evaluation

Procedure for the Control Group (DIM): For students in the control group, lessons were operated based on DIM. Throughout the intervention period, the instructional techniques of "command," "demonstration-response," and "practice drills" were used. Each week, teacher-centered activities were organized in a way that aligned with the designated target behaviors for fundamental offensive basketball skills. First, the relevant technical skill (e.g., shooting, passing, or layups) was demonstrated to the students by the teacher; this was followed by a practice phase. Students, working individually or in small groups, performed technical repetitions by following the teacher's instructions and received immediate feedback. As the weeks progressed, the complexity of the skills increased, and new techniques were added to build upon the skills acquired in previous weeks. The process concluded with a practical skills test administered in the final week.

Data Analysis

The data obtained in the research were tested for normality, and based on the results, a decision was made to use parametric analyses. The significance level was set at .05; the data were analyzed with computer-assisted statistical software. A Mixed-Design ANOVA was applied to address the three sub-problems, and the relevant assumptions for this analysis were tested beforehand.

As required for the use of parametric tests, the assumption of normality was tested first. Because the group size was greater than 50 (N = 60), the Kolmogorov-Smirnov test was chosen. The results showed that the scores for the Basketball Knowledge Test Pre-test (p = .018, p < .05), the Basketball Fundamental Offensive Skills Pre-test (p = .043, p < .05), the Basketball Fundamental Offensive Skills Post-test (p = .000, p < .05), and the Attitude Towards Basketball Scale Post-test (p = .000, p < .05) were not normally distributed (Büyüköztürk, 2018). However, in a second normality analysis that factored in the ratio of the skewness coefficient to its standard error, it was determined that the Z-scores for all measurements fell within the ±3 range, which indicated absence of severe non-normality. Thus, the assumption of normal distribution was considered to be satisfied (Tabachnick & Fidell, 2015).

Homogeneity of variances was measured with the Levene test, and the error variances were found to be equal for all measurement tools (Can, 2014). The null hypothesis, which states that there is no significant difference between the error variances, was accepted (Can, 2014).

The pre-test outcomes confirmed the equality of variances for the Basketball Knowledge Test (F = .958, p > .05), the Basketball Fundamental Offensive Skills Graded Scoring Key (F = .027, p > .05), and the Attitude Towards Basketball Scale (F = 3.587, p > .05).

In light of these results, the assumptions of normality and homogeneity of variance were deemed to be met, and the Mixed-Design ANOVA method was employed for the analyses.

Recent studies in physical education also emphasize that the Jigsaw Technique promotes both cognitive and behavioral engagement, highlighting its relevance for basketball-oriented learning environments (Cochon Drouet et al., 2024).

RESULTS

The intervention was completed with two different groups through two different models, namely CTM and DIM, to determine the extent of differences in students' learning and development across the cognitive, affective, and psychomotor domains. Pre-test and post-test measurements were taken from two distinct groups: an experimental group, where the Jigsaw Technique (a method under the CTM framework) was applied, and a control group, where techniques from the DIM framework were used. The primary hypothesis (H1), which addressed all three developmental domains, was supported. This hypothesis stated: "The fundamental offensive basketball skills of middle school students taught via the Jigsaw Technique will differ significantly from those of students taught via DIM."

Findings Related to the Cognitive Domain

The mean and standard deviation values for the Basketball Knowledge Test for both the experimental and control groups are presented in Table 4.

Table 4. Mean and Standard Deviation Values for the Basketball Knowledge Test

	Pre-test			Post-test		
Group	N	$\bar{X}$	SD	N	$\bar{X}$	SD
Experimental	30	10.26	1.89	30	15.30	2.80
Control	30	6.93	2.50	30	7.93	4.44

Table 4 shows the pre-test and post-test mean ($\bar{X}$) and standard deviation (SD) values on the Basketball Knowledge Test for the experimental and control groups. For the experimental group, the pre-test mean score was $\bar{X}$ = 10.26 (SD = 1.89), and the post-test mean score was $\bar{X}$ = 15.30 (SD = 2.80); for the control group, these values were $\bar{X}$ = 6.93 (SD = 2.50) and $\bar{X}$ = 7.93 (SD = 4.44), respectively. An increase in scores was observed in both groups; the ANOVA results concerning whether this change constitutes a significant difference are presented in Table 5.

Table 5. ANOVA Results for the Pre-test and Post-test Scores of the Basketball Knowledge Test

Source of Variance	Sum of Squares	df	Mean Square	F	*p*	Partial η^2
Between-Subjects	1372.092	59				
Group (Person/Group)	858.675	1	858.675	97.003	0.000***	.63
Error	513.417	58	8.852			
Within-Subjects	517.499	60				
Measurement (Pre-test-Post-test)	273.008	1	273.008	129.279	0.000***	.69
Group*Measurement	122.008	1	122.008	57.775	0.000***	.50
Error	122.483	58	2.122			
Total	1889.591	119				

****p < .001*

According to Table 5, a significant difference was found between the pre-test and post-test scores of the students in the experimental and control groups, a difference attributed to the interaction effect of the group and measurement factors $F(1,58) = 97.003$, $p < .001$, $\eta^2 = .63$. Regarding the main effect of measurement, a significant difference was found between the pre-test and post-test scores of the students, independent of group $F(1,58) = 129.279$, $p < .001$, $\eta^2 = .69$. The main effect for the different teaching models was found to be significant $F(1,58) = 57.775$, $p < .001$, $\eta^2 = .50$, which indicates that the Jigsaw Technique was more effective than the DIM in increasing knowledge levels. The partial η^2 values obtained ($\eta^2 = .63$ for group effect, $\eta^2 = .69$ for measurement effect, and $\eta^2 = .50$ for interaction effect) indicate large effect sizes according to Cohen's (2013) guidelines, demonstrating the strong impact of the Jigsaw Technique compared to the Direct Instruction Model.

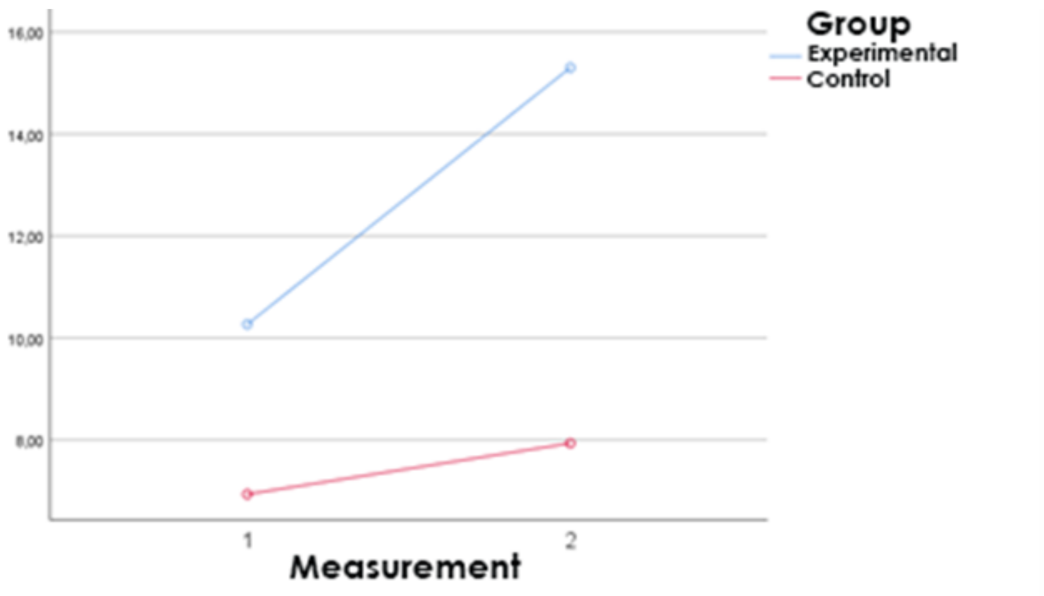

Figure 1. Marginal Means for the Basketball Knowledge Test Measurements

Figure 1 presents a comparative overview of the pre-test and post-test scores for the experimental and control groups; a marked increase in the scores for the experimental group is evident. The effect of the program applied to the experimental group manifested as a greater increase in performance compared to the control group. Although a limited increase was also observed in the control group, the findings indicate that the model applied to the experimental group was more effective. Based on the evaluation of Table 5 and Figure 1, Hypothesis 2 was supported.

Findings Related to the Affective Domain

The Attitude Towards Basketball Scale was administered as a pre-test and post-test to the two different classes involved in the study. The values for the data obtained are presented in Table 6.

Table 6. Mean and Standard Deviation Values for the Attitude Towards Basketball Scale

	Pre-test			Post-test		
Group	*N*	$\bar{X}$	SD	*N*	$\bar{X}$	SD
Experimental	30	50.56	13.23	30	65.43	8.55
Control	30	47.00	17.28	30	48.86	16.38

According to Table 6, the attitude scores of the experimental group, where the Jigsaw Technique was applied, increased from a pre-test mean of $\bar{X}$ = 50.56 (SD = 13.23) to a post-test mean of $\bar{X}$ = 65.43 (SD = 8.55). In the control group, where the DIM was applied, these values were $\bar{X}$ = 47.00 (SD = 17.28) and $\bar{X}$ = 48.86 (SD = 16.38) for the pre-test and post-test, respectively. Although scores increased in both groups, the significance of the difference between the groups, in terms of the direction and magnitude of this change, is evaluated with ANOVA results in Table 7.

Table 7. ANOVA Results for the Pre-test and Post-test Scores of the Attitude Towards Basketball Scale

Source of Variance	Sum of Squares	df	Mean Square	F	*p*	Partial η^2
Between-Subjects	26100.866	59				
Group (Person/Group)	3040.133	1	3040.133	7.646	0.008**	.12
Error	23060.733	58	397.599			
Within-Subjects	3959	60				
Measurement (Pre-test-Post-test)	2100.033	1	2100.033	205.932	0.000***	.780
Group*Measurement	1267.500	1	1267.500	124.293	0.000***	.682
Error	591.467	58	10.198			
Total	30059.866	119				

****p* < .001 ***p* < .01

As shown in Table 7, a significant difference was found between the pre-test and post-test attitude scale scores of the experimental and control groups $F(1,58) = 124.293$, $p < .001$, $\eta^2 = .68$; this result indicates that the students' attitudes changed at different rates depending on the applied model.

In the between-groups comparison, a significant difference was detected between the experimental group, where the Jigsaw Technique was applied, and the control group, where the DIM was applied $F(1,58) = 7.646$, $p < .01$, $\eta^2 = .12$. When the pre-test and post-test means for all students were compared, a significant improvement was found independent of the model $F(1,58) = 205.932$, $p < .001$, $\eta^2 = .78$.

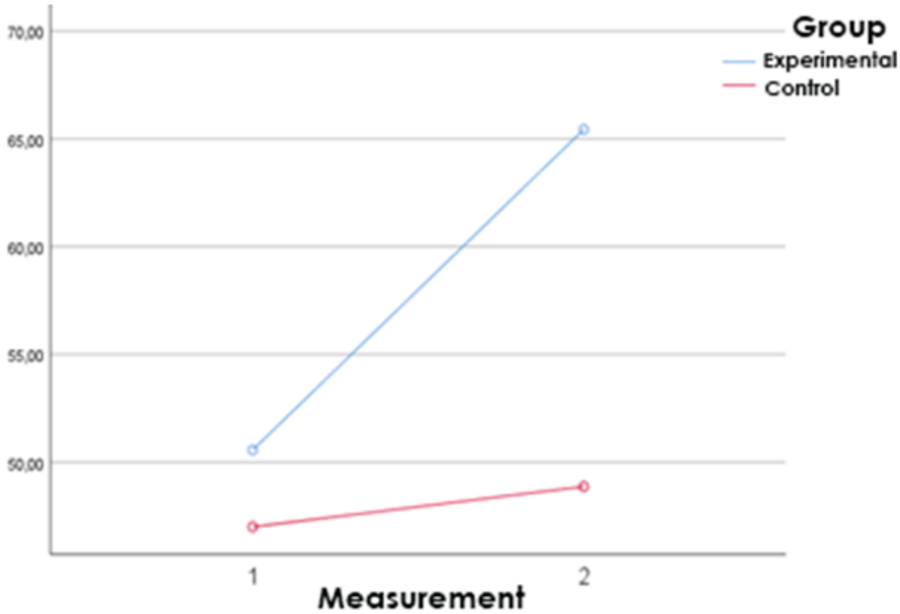

Figure 2. Marginal Means for the Attitude Towards Basketball Scale Measurements

Figure 2 presents a comparative overview of the attitude scores for the experimental and control groups; a distinct increase from pre-test to post-test is observable for the experimental group.

The program based on the Jigsaw Technique appears to have produced a higher level of attitude development compared to the DIM applied in the control group. Although a limited increase occurred in the control group, it was concluded that the experimental group generally showed a more effective performance increase. When Table 7 and Figure 2 are evaluated together, Hypothesis 3 can be said to be supported.

Findings Related to the Psychomotor Domain

Measurements were obtained with the Basketball Fundamental Offensive Skills Graded Scoring Key. The results of the correlation analysis for the independent raters who measured the students' fundamental offensive skills in basketball are provided in Table 8.

Table 8. Results of the Inter-rater Correlation Analysis for the Pre-test

N = 60	1	2	3
Rater 1	1	.795**	.808**
Rater 2		1	.978**
Rater 3			1

**$p < 0.01$

With regard to the students' pre-test scores, high-level, positive, and significant correlations were found among the evaluations of the three independent raters (raters 1 and 2: $r = .795$; raters 2 and 3: $r = .978$;

raters 1 and 3: r = .808, $p < 0.01$). These results seem to show a strong agreement among the raters and demonstrate the reliability of the measurement process. The mean and standard deviation values for the pre-test and post-test scores are presented in Table 9.

Table 9. Mean and Standard Deviation Values for the Basketball Fundamental Offensive Skills Graded Scoring Key

	Pre-test			**Post-test**		
Group	*N*	$\bar{X}$	SD	*N*	$\bar{X}$	SD
Experimental	30	20.84	4.28	30	36.42	3.27
Control	30	15.56	4.23	30	17.41	3.88

According to Table 9, the fundamental offensive skill scores of the experimental group, where the Jigsaw Technique was applied, showed a significant increase from a pre-test mean of $\bar{X}$ = 20.84 (SD = 4.28) to a post-test mean of $\bar{X}$ = 36.42 (SD = 3.27).

The scores for the control group were $\bar{X}$ = 15.56 (SD = 4.23) on the pre-test and $\bar{X}$ = 17.41 (SD = 3.88) on the post-test, with the increase remaining more limited.

Some improvement was observed in both groups, and the results of the statistical evaluation regarding the direction and magnitude of the change are presented in Table 10.

Table 10. ANOVA Results for the Pre-test and Post-test Scores of the Basketball Fundamental Offensive Skills Graded Scoring Key

Source of Variance	Sum of Squares	df	Mean Square	F	*p*	Partial η^2
Between-Subjects	5929.996	59				
Group (Person/Group)	4424.626	1	4424.626	169.462	0.000***	.75
Error	1514.370	58	26.110			
Within-Subjects	3979.889	60				
Measurement (Pre-test-Post-test)	2276.504	1	2276.504	457.111	0.000***	.89
Group*Measurement	1414.533	1	1414.533	284.031	0.000***	.83
Error	288.852	58	4.980			
Total	9909.885	119				

$^{***}p < .001$

The two different models applied for teaching fundamental offensive basketball skills were found to have created a significant difference between pre-test and post-test scores $F(1,58) = 284.031$, $p < 0.001$, $\eta^2 = .83$. The difference between the DIM and the Jigsaw Technique confirms that the choice of model produces different effects; the between-groups difference in effectiveness is also significant $F(1,58) = 169.462$, $p < 0.001$, $\eta^2 = .75$. For all groups, a significant difference was found between pre-test and post-test scores according to the main effect of measurement $F(1,58) = 457.111$, $p < 0.001$, $\eta^2 = .89$, and the differences in increase are presented in Figure 3.

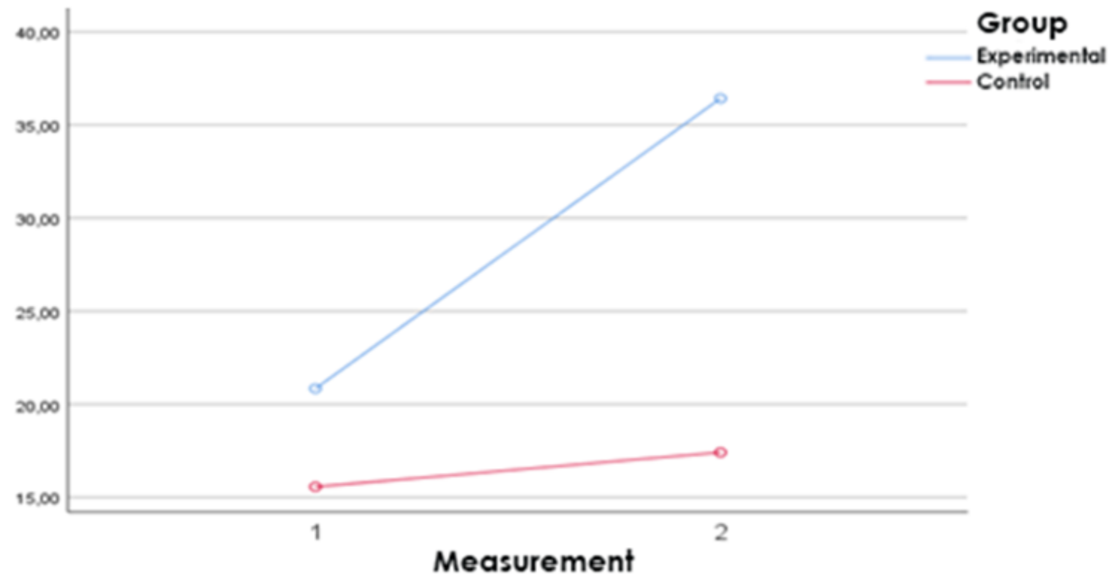

Figure 3. Marginal Means for the Basketball Fundamental Offensive Skills Graded Scoring Key Measurements

Discussion of Cognitive Domain Findings

The experimental group received instruction through the Jigsaw Technique based on CTM, but the control group used methods derived from DIM. Analysis results indicate that both teaching models can produce different effects on students' basketball knowledge. The experimental group's pre-test mean scores ($\bar{X}$ = 10.26) showed significant improvement compared to post-test mean scores ($\bar{X}$ = 15.30). On the other hand, the control group displayed a smaller increase from pre-test mean scores ($\bar{X}$ = 6.93) to post-test mean scores ($\bar{X}$ = 7.93). Statistical analyses showed that the differences in both groups' scores were significant ($F(1\text{-}58) = 57.775$, $p < 0.001$, Partial $\eta 2 = .50$), but the Jigsaw Technique proved more effective than DIM.

The Jigsaw Technique provided more meaningful contributions to cognitive development while increasing students' basketball knowledge. According to Piaget's Cognitive Development Theory, active interaction and assimilation processes enable students to understand what they learn more deeply (Yıldırım, 2016). The Jigsaw Technique actively involves students in the process, facilitating knowledge internalization (Castelli, 2022). Moreover, providing students with continuous feedback plays a critical role in enhancing learning permanence (Hattie & Zierer 2019).

Practices based on Johnson and Johnson's (2018) Collaborative Learning Theory require each student to take responsibility and actively contribute to the learning process. In that vein, the interaction among students can be interpreted as supporting cognitive development and encouraging teamwork. The learning processes delivered under expert students' leadership in Jigsaw interventions allowed students to bear individual responsibility and acquire deeper knowledge. Student-led Jigsaw activities provide the rationale for supporting Hypothesis 2. Recent research in physical education further confirms that the Jigsaw method enhances students' motivation and engagement in sport-specific learning contexts, thereby reinforcing its effectiveness for basketball instruction (Cochon Drouet et al., 2024). However, some researchers have argued that unguided or minimally guided learning approaches may not always be effective, as they can impose a heavy cognitive load on students and limit learning outcomes (Kirschner et, al., 2006).

Field research shows that the Jigsaw Technique is more effective than traditional teaching methods in mathematics and English courses (Tran, 2012; Gömleksiz, 2007). In physical education and sports instruction, the Jigsaw Technique reportedly contributes positively to students' cognitive development in interactive sports like basketball (Drouet et al., 2022). However, this technique's effectiveness may vary according to subject matter, student levels, and implementation methods, making it important for teachers to consider these factors. The Jigsaw Technique emerges as an effective method for enhancing students' cognitive development. Nevertheless, its effectiveness may vary across different sports, and teachers are expected to select appropriate teaching methods by considering the characteristics of the sport-specific unit and students' needs.

Discussion of Affective Domain Findings

In the experimental group, the Jigsaw Technique was applied within the framework of CTM, whereas DIM was employed in the control group. Throughout the process, pre-test and post-test sessions were administered, and student attitude scores, which reflect their affective characteristics towards basketball, were assessed. As a result of the implementation of the Jigsaw Technique, a significant increase was observed in the affective characteristics of the 8th-grade students, similar to the improvement in their learning performance. The literature also emphasizes that this technique encourages cooperation and mutual learning among students and makes positive contributions to individuals' affective characteristics (Aronson & Patnoe, 1997).

The Jigsaw Technique is based on having students learn different sub-sections of a topic and then teach this information to their group members; this process both increases individual responsibility and strengthens interaction among students. In this context, many studies show that integration of Jigsaw methods are effective in enhancing students' affective characteristics along with their critical thinking skills, problem-solving competencies, and academic achievement (Johnson & Johnson, 1999; Slavin, 2018). The research findings indicate that the Jigsaw Technique provided an effective learning environment by significantly increasing students' attitudes towards basketball.

For the 8th-grade middle school students who participated in the study, the pre-test mean score for the experimental group was determined to be $\bar{X}$ = 50.56, and the post-test mean score was $\bar{X}$ = 65.43. The control group's pre-test mean score was $\bar{X}$ = 47.00, and its post-test mean score was $\bar{X}$ = 48.86. Although an increase in scores was observed for both groups, the differences in the proportional distribution of the increases are significant, and a significant difference was found in the comparison of the groups' pre-test and post-test scores ($F(1,58) = 124.293$, $p < .001$, Partial $\eta^2 = .68$).

These results show that there was a significant difference in change between the two groups in terms of attitudes towards basketball. The implementation of Jigsaw Technique in the experimental group produced much more pronounced development as compared to the control group. Although the DIM was applied in the control group and some progress was recorded, this progress was limited in comparison to the experimental group. The DIM, where the teacher assumes a central role, can be effective in ensuring that basic skills are acquired quickly and systematically (Rosenshine, 2008), however this model can be insufficient for helping students develop higher-order skills such as deep learning, motivation, and creative thinking (Kirschner et al., 2006). Indeed, the study's findings indicate that direct instruction is effective only in transferring information and increasing affective characteristics, but that it has limitations in situations that require collaboration.

The analyses confirmed increases in both groups' pre-test and post-test measurements and showed a significant difference between the experimental group that received Jigsaw Technique instruction and the control group that used DIM ($F(1-58) = 7.646$, $p < 0.01$, Partial $\eta^2 = .12$). A significant difference also emerged between pre-test and post-test scores for students in both experimental and control groups ($F(1-58) = 205.932$, $p < 0.001$, Partial $\eta^2 = .78$).

These findings demonstrate that the Jigsaw Technique is more effective than DIM in learning and affective development. The experimental group's higher post-test scores compared to the control group confirm that methods derived from CTM contribute to increasing students' motivation, participation, and learning success (Slavin, 2018). Such learning methods may be effective in developing students' problem-solving and analytical thinking skills by increasing social interaction. The intense interaction among students in Jigsaw practices is thought to be effective in supporting Hypothesis 3.

Observations indicate that Jigsaw Technique interventions in the experimental group provided a much greater improvement in students' attitudes toward basketball techniques. Vygotsky's Social Constructivism Theory emphasizes the importance of social interaction among students in the learning process and explains how these interactions contribute to students' cognitive and affective development (Jing, 2017; Ahioğlu, 2008). Jigsaw methods facilitated the development of positive attitudes such as empathy, trust, and support as students continuously provided feedback to each other in expert and practitioner roles. This social interaction may have improved students' attitudes toward basketball. The Jigsaw Technique emerges as a more effective approach than traditional DIM in terms of developing students' academic and social skills. The findings appear to support the use of CTM-based interventions in applied fields such as physical education and sports.

Discussion of Psychomotor Domain Findings

The development of fundamental offensive basketball skills in students from the experimental group, which received a CTM-based program via the Jigsaw Technique, and the control group, where techniques based on the DIM were applied, was evaluated with the Basketball Fundamental Offensive Skills Graded Scoring Key. The experimental group's pre-test mean score was $\bar{X}$ = 20.84 and rose to $\bar{X}$ = 36.42 on the post-test; in contrast, the increase in the control group was more limited, rising from $\bar{X}$ = 15.56 to $\bar{X}$ = 17.41. As a result of the repeated measures ANOVA, the group-by-time interaction was found to be statistically significant ($F(1,58) = 284.031$, $p < .001$, $\eta^2 = .83$). This finding demonstrated that the variation in teaching method had a strong impact on skill development.

Within the framework of Kolb's Experiential Learning Theory, the Jigsaw Technique is understood to be effective because it supports students' learning through concrete experiences and creates more permanent learning environments via active roles and information sharing within the group (Stocker et al., 2014; Claramita et al., 2018). The students' acquisition of skills during the intervention process through peer observation, guidance, and modeling points to the effect of observational learning on motor development, according to Bandura's Social Learning Theory (Bird et al., 2005; Cross et al., 2009). When the effect of the immediate feedback given by expert students in this process is evaluated within the scope of Schmidt's Motor Learning and Control Theory, it is seen that individuals improve their performance by developing their recall and recognition schemas (Czyż, 2010; Lee et al., 2022). In the context of Gardner's Theory of Multiple Intelligences, the hands-on implementation of activities within a group that emphasize bodily-kinesthetic intelligence provides a more holistic development compared to individual-centered instruction (Shearer & Karanian, 2017; White, 2019).

These findings show that in teaching psychomotor skills, not only is structured instruction effective, but approaches based on social interaction and experiential learning are also highly effective. Furthermore, in alignment with our study, findings in the literature, such as the work of Çifçi (2019), also note that alternative and innovative teaching strategies allow for a higher level of skill development compared to traditional methods. Besides this, when students take responsibility in the learning process and are active in the decision-making and application stages, their development in the cognitive and psychomotor domains is supported simultaneously. It is thought that the contribution of the intra-group interactions observed in the Jigsaw sessions to the students' psychomotor skills influenced the confirmation of Hypothesis 4. In line with the obtained results, it was concluded that the Jigsaw Technique is a pedagogically strong and effective teaching model for cognitive and affective aspects as well as for the acquisition of motor skills.

CONCLUSION

Research findings showed that the Jigsaw Technique applied in physical education and sports classes was significantly more effective than DIM-based techniques across students' cognitive, affective, and psychomotor development domains in the basketball unit. In the cognitive domain, the Jigsaw Technique supported by specialization and reciprocal teaching processes strengthened skills in structuring, assimilating, and transferring knowledge (Slavin, 1991; Vygotsky, 1978). At the affective level, motivational increases based on group interaction, social support, face-to-face interaction, and sense of achievement positively influenced students' attitudes toward the course, self-confidence, and communication skills (Johnson et al., 2014). Concerning psychomotor development, students' competencies in learning and applying fundamental basketball techniques reached higher levels through Jigsaw interventions via active participation, peer observation, and immediate feedback mechanisms (Ayan, 2019).

Students who assumed both teacher and student roles in Jigsaw interventions created group synergy (Fusaroli & Tylén, 2015) and acquired fundamental elements such as individual responsibility and focus on common goals. They achieved holistic development by taking the learning process beyond mere knowledge acquisition (Darnis & Lafont, 2013). Jigsaw sessions delivered under teacher guidance facilitated peer learning among students, and learning outcomes deepened through multi-perspective viewpoints (Jeppu et al., 2023).

Structured group dynamics appear to support long-term gains by increasing students' motivation, satisfaction, and physical participation levels (Wu, 2016). Such achievements clearly support Hypotheses 1, 2, 3, and 4. The Jigsaw-Based CTM, which aligns with cognitive theories and social learning approaches, has emerged as a powerful alternative that supports both academic and social development in physical education and sports training settings. In practical terms, physical education teachers can implement the Jigsaw method in basketball lessons by forming small groups of 4–6 students, assigning each group a specific skill or tactical component (e.g., passing, dribbling, shooting, or defensive strategies), and then rotating the groups to share expertise. A lesson time allocation of 10–15 minutes for expert group study, followed by 15–20 minutes of peer teaching, has been recommended to maximize both learning outcomes and student engagement.

LIMITATIONS AND FUTURE DIRECTIONS

The scope of this research, which had an experimental design, can be expanded beyond the specific study group of 8th-grade students and the basketball unit that was implemented. However, how the Jigsaw Technique affects different age groups and various sports disciplines should also be investigated. Detecting the potential differences between interventions in individual versus team sports, in particular, will contribute to the assessment of the method within a broader framework in the domain of sports education. Longitudinal studies are also needed to measure the extent to which the fundamental offensive skills taught via the Jigsaw Technique contribute to students' cognitive, affective, and psychomotor development in the long term. The impact of hybrid models that use different teaching approaches together, such as the DIM and the Jigsaw Technique, should be measured and introduced into sports education as innovative instructional designs.

The research was limited to a single public middle school, so future studies with student groups from different socio-economic and cultural backgrounds are important for evaluating the universal applicability of the Jigsaw Technique. The intervention was implemented in a traditional face-to-face setting, and its transferability to digital or hybrid learning environments is unknown. The study also did not compare the effects of different collaborative groupings, such as heterogeneous versus homogeneous arrangements, on student achievement, participation, and satisfaction levels. Exploring these variables, alongside the potential of hybrid models that integrate DIM and Jigsaw principles, represents a promising avenue for future studies. The Jigsaw Technique could be an effective and innovative approach in physical education and sports instruction; it is therefore recommended that physical education teachers and academic staff in the field of sports sciences incorporate this technique into their lessons and arrange their instructional environments to be suitable for this model.

Author Contributions

M.K: data collection. M.K: data analysis and original draft preparation. M.K; M.Ç.Ç: review and editing. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

Within the scope of the research, the data collection and the experimental intervention were handled as distinct processes during the 2024-2025 academic year, spanning the period between September 9 and December 15. For the planned procedures, ethical approval was obtained from the Mersin University Faculty of Sports Sciences Ethics Committee (Date: 22.05.2024, Decision No: 032). Permission from the Ministry of National Education (MEB) was granted by the Mersin Provincial Directorate of National Education on 27.08.2024 following a review of the researcher's documentation for compliance.

Informed Consent Statement

Informed consent was obtained from all subjects involved in this study.

Data Availability Statement

Datasets are available through the corresponding author upon reason-able request.

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Conflicts of Interest

The authors unequivocally assert that this research was undertaken while devoid of any commercial or financial affiliations that might be perceived as potential conflicts of interest.

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