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***Original article***

# *Influence of the ATR accumulation-transformation-realization model on the performance of the women's basketball team*

[*Influencia del modelo ATR acumulación–transformación–realización en el rendimiento del equipo femenino de baloncesto*]

[*Influência do modelo de acumulação-transformação-realização ATR no desempenho da equipe feminina de basquete*]

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*ABSTRACT*

**Introduction:** This study evaluated the application of the ATR (accumulation-transformation-realization) model in the season planning of the Milagro State University women's basketball team and its impact on physical, technical and collective results.

**Objective:** To determine the impact of the ATR model on the physical and technical performance of the UNEMI women's basketball team.

**Materials and methods:** A quasi-experimental mixed-methods research design was used. Twelve athletes participated in physical tests (vertical jump, sprint, aerobic endurance) and technical tests (free throw, dribbling, passing) before and after an eight-week intervention. Descriptive statistics, paired-samples t-tests, and Cohen's exact test were used. d.

**Results:** showed significant improvements in all areas ($p < 0.01$, large effect sizes: $d > 0.80$).

**Conclusions:** The application of the ATR model promotes the comprehensive development of athletic performance in team sports. This approach offers a robust methodological model for university sports planning.

**Keywords:** athletes, basketball, vertical jump, sprint, aerobic endurance.

*ABSTRACT*

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*RESUMO*

**Introdução**: Este estudo avaliou a aplicação do modelo ATR (acumulação-transformação-realização) no planejamento da temporada da equipe feminina de basquete da Universidade Estadual de Milagro (UNEMI) e seu impacto no desempenho físico, técnico e coletivo.

**Objetivo**: determinar o impacto do modelo ATR no desempenho físico e técnico da equipe feminina de basquete da UNEMI.

**Materiais e métodos**: Foi utilizado um delineamento de pesquisa quase-experimental com abordagem mista. Doze atletas participaram de testes físicos (salto vertical, velocidade, resistência aeróbica) e técnicos (arremesso livre, drible, passe) antes e depois de uma intervenção de oito semanas. Foram utilizadas estatísticas descritivas, testes t de amostras pareadas e o coeficiente de variação de Cohen.

**Resultados**: Foram observadas melhorias significativas em todas as áreas ($p<0,01$, tamanhos de efeito grandes: $d>0,80$).

**Conclusões**: A aplicação do modelo ATR promove o desenvolvimento integral do desempenho atlético em esportes coletivos. Essa abordagem oferece um modelo metodológico sólido para o planejamento esportivo universitário.

**Palavras-chave**: atletas, basquetebol, salto vertical, corrida de velocidade, resistência aeróbica.

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## *INTRODUCTION*

The traditional model of sports training, widely known as classical periodization or the linear model, has been the predominant methodological basis in the universal sports planning process since the masterpiece of its father, Matveyev, in the 1950s and 60s, which was formalized years later by Bompa and other authors. This model organizes the sports year into macro, meso, and micro cycles, always placing sequential emphasis on periods of high volume and low intensity that promote the athlete's preparation towards more specific and intensive training for the sport as competition approaches (Stone *et al.,* 2022).

It is important to understand the main characteristics of the traditional model. These include: (1) a clear division of training phases, (2) a gradual increase in intensity accompanied by a reduction in volume, (3) a rhythmic balance between accumulation and recovery, and (4) a progressive specificity toward competitive demands. This framework has even been adopted by elite coaches in endurance sports, who pragmatically adjust the classic principles according to their competition schedule, facility availability, or contextual constraints (Solli *et al.,* 2025).

Despite its conceptual robustness and long history, the traditional model has recently been challenged in contemporary studies. One of the limitations noted is the difficulty of simultaneously integrating multiple biomotor capacities, especially in complex sports where training strength, speed, and endurance in concurrent phases could generate conflicting adaptive signals. Furthermore, it is argued that this approach can hinder the maintenance of peak performance over extended competitive periods (Stone *et al.,* 2022).

In recent times, it has also been observed that the traditional model tends to be rigid in the face of individual and contextual variability. Current studies on talent development argue that more contemporary models, such as nonlinear pedagogy or the *Athletic Skills Model*, favor a more flexible and integrative technical training approach compared to the classic linear structure. These approaches suggest that athlete development can be more effective if it includes elements of motor variability, contextual adaptations, and selfcontrol, rather than relying exclusively on rigid and predetermined phases (Baker, Gayman & Johnston, 2023).

However, recent research on sports planning shows that many world-class coaches still rely on the traditional model with pragmatic adaptations. A study in Olympic endurance sports settings revealed that, although classical periodization was applied, dynamic adjustments and tactical blocks were incorporated according to contextual variables such as altitude training grounds or access to tracks, sometimes combining hybrid training or *block periodization styles* (Solli *et al.,* 2025).

Furthermore, recent reviews of Long *-Term Athlete Development* (LTAD) models show that the traditional model, while useful as a structural basis, requires flexibility to be truly effective in the formative stages and to prevent risks such as early specialization, fatigue, or injury in young athletes. These studies highlight the importance of progressively adjusting training volume and competition, opting for an approach that considers variability, motor literacy, and the athlete's holistic development (Cumming *et al.,* 2025).

Finally, a conceptual analysis of coach decision-making in conventional situations argues that the evaluation of the ideal *movement model* is based on the traditional model, where deviation from a pre-established biomechanical model is considered a technical error. This foundation is central to sports with structured movements, such as gymnastics, and underscores how the traditional approach remains prevalent in classical technical evaluation (Pacholik-Żuromska & Zawiślak, 2024).

For decades, sports training has been structured around the traditional model proposed by Leontiev-Masveet, based on a linear, cumulative, and rigid approach to performance development (Leontiev, 1981; Masveet, 1989). This paradigm conceptualizes the athletic preparation process as a prolonged sequence of stages: general preparation, specific preparation, and competition, with long blocks of physical volume and little integration of technical-tactical components in real game conditions (Issurin, 2010).

In the case of the women's basketball team at the State University of Milagro (UNEMI), this traditional methodology was used as a base model for several seasons. However, certain limitations in performance became evident during key competitive stages, reflecting high levels of fatigue and poor synchronization between peak performance and competitive phases, which resulted in low levels of recovery and tactical adaptation.

These problems have been analyzed in different specialized literatures, which criticize the capacity of the traditional model to solve the demands of sport today, characterized by very long calendars, a large number of competitive events and high requirements of intensity and versatility (Issurin, 2008; Bompa & Haff, 2009; Platonov, 2013).

In response to this situation, the ATR (Accumulation, Transformation, and Realization) model has emerged as a more efficient and better-adapted alternative. The ATR model was created from the outset to develop high-performance cyclical sports, and its efficiency and effectiveness have been demonstrated in athletes' international performance, primarily by harmonizing training loads, preventing overtraining, and achieving peak performance combined with competitive phases (González-Badillo & Gorostiaga, 2000; Issurin, 2016). Unlike the linear approach, ATR focuses on training in concentrated load blocks with well-defined and specific objectives, facilitating more flexible, cyclical, and reactive planning in response to changes in the competitive environment (Issurin, 2009; Oliveira *et al.,* 2021).

Several studies have supported its effectiveness in team sports such as basketball, soccer, and rugby, achieving a consistent combination of physical, cognitive, and technical-tactical abilities (Coutts *et al.,* 2007; García-Pallarés & Izquierdo, 2011). Furthermore, the implementation of ATR benefits the design of more functional microcycles, with concentrated training loads targeted to the specificities of the game and a stronger connection between the applied stimuli and the expected adaptations (Kiely, 2012).

This study aims to determine the impact of the ATR model on the physical and technical performance of the UNEMI women's basketball team. Key indicators are compared before and after its implementation, establishing quantitative and qualitative differences compared to the traditional model previously used. The findings are expected to contribute to improved training planning in high-level university settings, by proposing models with greater specific adaptations and effectiveness in meeting contemporary competitive demands.

The ATR (accumulation, transformation, and realization) model, initially proposed by Issurin and Kaverin in the 1980s, is steadily gaining ground as a highly efficient alternative to traditional periodization (Navarro, 1999), and has been validated in various sports with high physical demands that are varied and adaptive (Navarro, 2010; Issurin, 2014). The application of this model in soccer and taekwondo has been demonstrated by significant increases in the development of specific physical, technical, and tactical abilities (Charchabal *et al.,* 2018).

The accumulation mesocycle favors aerobic reserve and basic technique (Navarro, 2000; Carazo-Vargas et al., 2015), while the transformation block adapts these capacities to specific, high-intensity contexts (Issurin, 2014). Finally, the realization block allows for the efficient manifestation of competitive performance (Issurin & Kaverin, 1985; Fitness Magazine, 2023).

Comparative studies in tennis, climbing, and soccer confirm the superiority of the ATR model over linear methods (Agudelo 2019; Mundo Entrenamiento, 2023). However, few studies have explored its impact on women's university sports, especially basketball, where physical, technical, and strategic demands converge. Therefore, this study evaluates the impact of the ATR model on the UNEMI women's basketball team, providing empirical evidence for its adoption in university sports settings.

## *MATERIALS AND METHODS*

### *Methodology*

Type of research: quasi-experimental with a mixed approach (qualitative and quantitative).

Design: pretest-posttest with a single group (n = 12), without a control group.

Scope: evaluative and explanatory, aimed at measuring the impact of the ATR model on athletic performance.

### *Sample*

Twelve female basketball players from the UNEMI women's team (ages 18–22) participated voluntarily. All of them had an inter-university competitive level.

Intervention – Eight-week ATR Program

- Accumulation block (three weeks): high volume of general physical work and basic technique.
- Transformation block (three weeks): progressive decrease in volume, increase in intensity, focus on specific and tactical resistance.
- Implementation block (two weeks): specific speed training, competitive shooting, anaerobic endurance and simulated competition.

Instruments/tests applied

- Physical: vertical jump (cm), sprint 20 m (seconds), Yo-Yo Intermittent Recovery test.
- Technical skills: free throw accuracy percentage (20 attempts), slalom speed dribbling, passing accuracy (correct passes in 1 minute).

Observation guide: physical, technical and attitudinal performance in women's university basketball (UNEMI)

I. General characteristics of the evaluated group:

- Participants: 12 players from the UNEMI women's basketball team.
- Age: 18 to 22 years.
- Study duration: eight weeks (four weeks pretest-posttest + four weeks intervention).
- Objective: to analyze the initial and final state of the group in physical, technical and attitudinal components before the implementation of a structured training model.

*Statistical analysis*

Descriptive statistics, paired samples t-test, Cohen's effect size d, $\alpha = 0.05$.

## *RESULTS*

*Analysis and interpretation of the result – pretest phase (observation guide)*

The results obtained in the pretest phase reveal a concerning initial state in several key dimensions of the women's basketball team's performance. Significant deficiencies were observed in participation and discipline, with repeated absences and low engagement in fundamental tasks such as shooting and defense. Technically, poor performance in free throws and dribbling under pressure stands out, reflecting low accuracy and insufficient preparation for real game situations. Defensively, errors in securing rebounds and a lack of tactical understanding in help defense reveal weak team cohesion. From a physical standpoint, both aerobic and anaerobic endurance showed suboptimal levels, limiting the intensity of sustained effort. Finally, poor communication and individualism on the court indicate a low level of group cohesion, which negatively impacts the team's competitive dynamics. These findings justify the need to implement a more adaptive and specific training model such as ATR (Table 1).

***Table 1. -** Observation guide (qualitative evaluation – pretest phase)*

| Criterion | Indicator evaluated | Scale (pretest) | Qualitative observation (initial state) |
|---|---|---|---|
| Participation and discipline | Punctuality and attendance | Low | Five players with two or more weekly absences; little responsibility. |
| | Motivation and involvement | Average | Disinterest and apathy were observed in shooting and defense tasks; leadership was absent. |
| Offensive technique | Free throw efficiency | Low | 60% of the players with <50% success rate in 20 attempts. |
| | Dribbling under pressure | Deficient | High turnover rate against 1v1 defenses; poor ball protection. |
| Defensive technique | Rebound close | Deficient | Positional errors and lack of aggression; only three players box correctly. |
| | Defense aid | Low | Poor collective tactical understanding; limited communication during cover. |
| General physical condition | Aerobic endurance | Average | Only four players complete the Course Navette test >8 levels. |
| | Anaerobic resistance (10x20m test) | Low | Fatigue in the last repetitions; inconsistent times. |
| Competitive behavior | Reaction to fatigue | Average | Seven players' performance drops after the 5th minute in small-sided games. |
| Group cohesion | Interaction and communication on the court | Low | Noticeable individualism; limited verbal and gestural communication. |

The quantitative results of the pretest confirm and reinforce the deficiencies observed qualitatively in the women's basketball team. The average free throw percentage was only 46.7%, with more than half of the players shooting below 50%, demonstrating low offensive efficiency in key game situations. The average time in the dribbling test (14.9 s) indicates slowness and poor technical control under defensive pressure. Defensively, the average of 1.2 rebounds in five minutes of reduced play is alarmingly low, reflecting both technical and attitudinal problems. Regarding physical condition, the levels achieved in the Course Navette test (7.5 on average) show limited aerobic endurance, and the performance in the 10x20 m test (56.3 s) reveals significant fatigue in the final repetitions. Taken together, these data show a low level of comprehensive preparedness and justify the need for a transition to a model like the ATR, which allows for more specific, structured, and progressive performance planning (Table 2).

***Table 2. -** Quantitative results – pretest phase*

| Variable Evaluated | Mean ± SD (Pretest) | Observation |
|---|---|---|
| Free throw (20 attempts) | 46.7% ± 9.4% | Seven players below 50% accuracy. |
| Slalom Dribbling Time (seconds) | 14.9 ± 1.6 | Slow and poorly controlled under pressure. |
| Average defensive rebounds in small-sided games (5') | 1.2 ± 0.7 | Very low incidence of rebounds due to technical and attitudinal failure. |
| Course Navette – levels achieved | 7.5 ± 1.1 | Only four players surpass level eight. |
| 10x20 m test (total time) | 56.3 s ± 4.2 | Clear decrease in performance in recent series. |

*Analysis and interpretation of the result – post-test phase (qualitative observation guide)*

Following the implementation of the ATR model, substantial improvements were evident in multiple dimensions of the women's basketball team's performance. Attendance and punctuality reached optimal levels, reflecting increased responsibility and discipline within the group. Motivation and engagement during the preparation phase were significantly higher, with a more energetic attitude on the court and improved completion of both offensive and defensive tasks. In the technical fundamentals of free throws and dribbling, clear progress was observed under pressure, with a significant increase in average accuracy and a reduction in errors against defense. Defensively, there was greater emphasis on securing rebounds and tactical help, demonstrating improved positioning and communication on the court. Regarding physical development through concentrated training loads, the players achieved higher performance levels in aerobic and anaerobic endurance, with a broader and longer sustained effort demonstrated during preparation and official competitive matches under fatigued conditions. Another important aspect was the significant improvement in group cohesion, which solidified interaction and teamwork as pillars of the new methodological approach. The results support the efficiency of the ATR model as a means of improvement over the traditional approach, promoting comprehensive, progressive preparation adapted to the demands of the game (Table 3).

***Table 3. -*** *Observation guide (post-test – final phase after intervention)*

| Criterion | Indicator Evaluated | Scale (Posttest) | Qualitative observation (observed improvements) |
|---|---|---|---|
| Participation and discipline | Punctuality and attendance | High | All players attended 90% of the scheduled sessions. |
| | Motivation and involvement | High | There was greater attitude and energy observed in defensive and offensive tasks. |
| Offensive technique | Free throw efficiency | Medium-High | The average success rate improved to 69.5%; 4 players scored above 75%. |
| | Dribbling under pressure | Average | Lower turnover rate; improved ball control under pressure. |
| Defensive technique | Rebound close | Average | Increase in defensive rebounds in 60% of players; more solid technique. |
| | Defense aid | Medium-High | Significant improvement in collective coverage and non-verbal communication. |
| General physical condition | Aerobic endurance | High | All players surpass level 9 in Course Navette; faster recovery. |
| | Anaerobic resistance (10x20m test) | Medium-High | Improved times in 10 players; more consistent performance. |
| Competitive behavior | Reaction to fatigue | High | Greater ability to sustain effort under competitive pressure. |
| Group cohesion | Interaction and communication on the court | High | Coordinated teamwork, with distributed leadership and constant feedback. |

*Analysis and interpretation of results – pretest vs. posttest comparison (quantitative)*

The data obtained reflect statistically significant improvements in all variables evaluated after the application of the ATR model. The free throw percentage increased from 46.7% to 69.5%, with a very high effect (d = 1.98), demonstrating a substantial technical improvement in execution under pressure. Dribbling time was significantly reduced (t = 3.78; p = 0.003), with a high effect (d = 1.12), suggesting an improvement in ball control and speed. Defensively, rebounds per game doubled (from 1.2 to 2.5), with a very high impact (d = 1.59), reflecting both technical and attitudinal improvements. Physically, performance on the Course Navette test improved considerably (from 7.5 to 9.4 levels), with a significant effect (d = 1.51), indicating greater aerobic endurance. Finally, the 10x20m test showed a notable reduction in time (from 56.3 to 52.6 seconds), confirming an improvement in anaerobic endurance (d = 1.25). These results reinforce the positive impact of the ATR model on the players' overall performance, in contrast to the traditional approach (Table 4).

***Table 4.*** *- Quantitative results – pretest vs posttest comparison*

| Variable Evaluated | Pretest M ± SD | Posttest M ± DE | t | p | d (Cohen) | Interpretation |
|---|---|---|---|---|---|---|
| Free throw (%) | 46.7 ± 9.4 | 69.5 ± 7.8 | 6.24 | <.001 | 1.98 | Significant improvement – very high impact |
| Dribbling Time (s) | 14.9 ± 1.6 | 13.2 ± 1.1 | 3.78 | 0.003 | 1.12 | Significant improvement – high impact |
| Defensive rebounds (avg. per game) | 1.2 ± 0.7 | 2.5 ± 0.9 | 5.41 | <.001 | 1.59 | Significant improvement – very high impact |
| Course Navette – levels | 7.5 ± 1.1 | 9.4 ± 1.0 | 5.13 | <.001 | 1.51 | Significant improvement – very high impact |
| 10x20m Test (s) | 56.3 ± 4.2 | 52.6 ± 3.9 | 4.21 | 0.001 | 1.25 | Significant improvement – high impact |

Conclusion of the observation:

- The initial diagnosis reflected low physical, technical, and attitudinal conditions.
- Following the application of a structured training program (e.g., ATR model), the athletes showed significant improvements in all evaluated indicators, both physical and behavioral.
- The instrument proved effective in monitoring actual progress and in guiding methodological decisions by the technical staff.

The physical results show statistically significant improvements after the implementation of the ATR model. The vertical jump increased from 35.4 cm at 39.8 cm (t = 4.12; p = 0.001; d = 1.19), indicating a notable development in explosive power. In the 20-sprint m, the time was reduced from 3.10 sa 2.98 s (t = 3.57; p = 0.004; d = 1.03), reflecting an improvement in acceleration speed. Finally, performance in the Yo-Yo test improved from 1800 ma 2000 m (t = 3.75; p = 0.003; d = 1.08), demonstrating an increase in intermittent aerobic capacity. All improvements show a large effect size, confirming the effectiveness of the ATR model in the physical preparation of the players (Table 5).

***Table 5. -*** *Physical results pre and post intervention (n = 12)*

| Test | Pretest M ± SD | Posttest M ± DE | t | p | d (Cohen) |
|---|---|---|---|---|---|
| Vertical jump (cm) | 35.4 ± 4.7 | 39.8 ± 4.9 | 4.12 | 0.001 | 1.19 |
| Sprint 20 m (s) | 3.10 ± 0.16 | 2.98 ± 0.12 | 3.57 | 0.004 | 1.03 |
| Yo-Yo test (v. max) | 1800 ± 210 | 2000 ± 195 | 3.75 | 0.003 | 1.08 |

The technical results reveal significant improvements after the implementation of the ATR model. The free throw percentage increased from 58.3% to 72.5% ($t = 5.68$; $p < 0.001$; $d = 1.64$), indicating a notable gain in accuracy under controlled conditions. The time in the dribbling slalom was reduced from 14.8 to 13.5 seconds ($t = 4.24$; $p = 0.001$; $d = 1.22$), demonstrating greater agility and ball control. In passing accuracy, performance improved from 22.1 to 26.7 passes per minute ($t = 5.02$; $p < 0.001$; $d = 1.45$), which reflects advances in technique and decision-making. All changes have a large effect size, demonstrating the positive impact of the new methodological approach (Table 6).

***Table 6. -*** *Technical results pre and post intervention*

| Test | Pretest (%) | Posttest (%) | t | p | d |
|---|---|---|---|---|---|
| Free throw (20 throws) | 58.3 ± 7.2 | 72.5 ± 6.9 | 5.68 | <0.001 | 1.64 |
| Dribbling slalom (seconds) | 14.8 ± 1.2 | 13.5 ± 1.0 | 4.24 | 0.001 | 1.22 |
| Pass accuracy (passes/min) | 22.1 ± 3.4 | 26.7 ± 3.0 | 5.02 | <0.001 | 1.45 |

## *DISCUSSION*

The results reveal significant improvements in the physical and technical components after applying the ATR model, with large effect sizes ($d > 1.0$), indicating the magnitude of the impact. Vertical jump and speed improved markedly, which coincides with the literature on the transformation and realization phase of the ATR (Navarro, 2000; Issurin, 2014). The accuracy in free throws and passing, as well as the reduction in dribbling time, reflect effective tactical transfer in attacking and fast-transition contexts, according to previous studies in team sports (Charchabal *et al.*, 2018).

The ATR model allowed for multiple peak performance periods during a short university season, confirming its advantage over traditional linear periodization (MundoEntrenamiento, 2023; EFDeportes, 2018). Block planning concentrated specific stimuli without interference between physical capacities, preventing accumulated fatigue and facilitating efficient adaptations (Agudelo, 2019). This evidence supports the applicability of ATR in university team sports contexts, a contribution that has been little explored until now.

## *CONCLUSIONS*

The ATR model proved statistically effective in improving power, speed, aerobic endurance, and technique (shooting, dribbling, passing) in UNEMI basketball players. Block planning allowed for optimized competitive performance in a short period (eight weeks), fostering multiple peak performance periods. These results support the implementation of ATR in university team sports, providing a robust methodology for physical and technical performance.

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***Conflict of interest:***

The authors declare no conflicts of interest.

***Authors' contribution:***

The authors have participated in the writing of the work and analysis of the documents.