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Augmented Reality As A Teaching Strategy To Strengthen The Technical Fundamentals Of Volleyball

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Abstract

Traditionally, physical education has been oriented from the paxis, ignoring the rules and principles that regulate the different sports disciplines. This situation limits athletes' performance and sometimes does not allow them to give their maximum performance. From this perspective, the results of this study are presented, which had the purpose of resignifying the teaching of Volleyball through the use of two learning environments, one of them framed in the traditional education that integrates the use of books, photocopies and conventional didactic material, focused only on sports performance, and the other one directed from the use of augmented reality as a strategy for the theoretical and conceptual appropriation of the technical fundamentals of Volleyball. The research process was conducted through mixed research, descriptive method and quasi-experimental design.

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Based on the didactic intervention mediated by ICT applied to 9th-grade students of the experimental group, belonging to the educational institution of Sora, located in the municipality with the same name, in the department of Boyacá - Colombia, it was concluded that the use of ICT and particularly augmented reality contributes to the dynamization of learning, allowing the appropriation of the conceptual foundations of any sports discipline more easily.

Keywords: Traditional education, Physical education, Pedagogical strategy, Augmented reality, Volleyball.

Introduction

The practice of sports in educational institutions has prevailed over time; however, its teaching has not been innovated because the methods used are framed in traditional education, despite the existence of new resources for the development of the pedagogical process are not used to strengthen the appropriation of knowledge in students, there are scholars of sports disciplines who claim that their learning is only achieved from the practice of sport, other authors from their position indicate that it is essential to practice a sport modality that the athlete or trainee has a minimum knowledge.

Because of these considerations, it is necessary to integrate with the educational scenario pedagogical strategies that contribute to the integral formation of the athlete, that is to say, that link the knowledge of the rules, norms and guidelines that regulate the different disciplines of sport, in order to move on to the practice phase and strengthen the performance of each athlete according to their physical characteristics and their particular situation.

To this end, the integration and use of ICT can be taken as a framework of relationship in the teaching/learning processes since they constitute a possibility of resignification in the teaching of physical education due to their multiple educational advantages. Despite this, they are not used to mediate student learning due to a lack of knowledge and development of digital competencies. Some studies indicate that their integration into sports learning is almost null (Capllonch and Figueras, 2011). Thus, this study is relevant because it seeks to integrate ICT as educational actions that allow students to appropriate the technical fundamentals of Volleyball, particularly augmented reality is integrated as a didactic resource compared to traditional learning.

The research process was carried out with two groups of students in the ninth grade of basic secondary education, with whom two learning environments were questioned, one directed from traditional education and the other through technological innovation, particularly the linkage of augmented reality. The estimation of the study variables was oriented from the mixed research method, on the one hand, the quantification of the level of school performance of students regarding the conceptual appropriation of the fundamentals of Volleyball, and on the other hand, the interpretation of their opinions, arguments and reflections. Likewise, the descriptive research method was integrated to detail aspects raised in the development of the research. Finally, the study's design was directed through the quasi-experimental method to validate the effectiveness of both learning environments. It was concluded that integrating technology, specifically augmented reality, in the school classroom was more effective in the theoretical and conceptual appropriation of the technical fundamentals of Volleyball.

Beginning of Volleyball as a Competitive Sport

Volleyball was recognized in 1896 as a sport discipline. Between 1920 and 1930, modifications began to be made to the rules established for the game of Volleyball and in this way, to improve the nascent sport, in the United States and nearby countries, the initial volleyball regulations were more structured: the rotation of players, the limitation of passes to three, the number of players per team, the dimensions of the field, among others.

Based on the work of Draper (1970), it is documented that in 1922, at the YMCA center in Brooklyn, the first National Volleyball Championship was played in the United States, with the participation of 23 teams from eleven states and Canada, all of them belonging to the YMCA.

In 1928, the "American Volleyball Association" was founded, an entity in charge of organizing volleyball championships. In 1933, the book Volleyball Men's Game was published, in which principles, rules for the game and training guidelines were set out (Callejón Lirola).

Volleyball did not take long to echo in other countries of the world. For example, in Japan, in 1929, the volleyball sports federation was created; in China, in 1951, a federation for the new sport was also created (Callejón Lirola). In European countries, Russia in 1920 adopted the new sport discipline, and in Cuba in 1929, Volleyball was integrated into the sports federations. The sport's expansion in 1955 was linked to the Pan American Games. Undoubtedly, Volleyball as a sport discipline has its origins in the nineteenth century, but it is until 1920 that it begins its heyday, and from then on, it has had a series of changes in the ways of playing, rules and techniques.

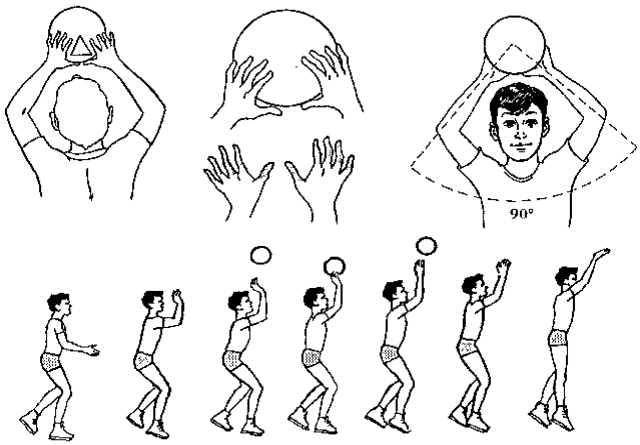
Basic Technical Fundamentals of Volleyball

The implementation of Volleyball as a sport discipline requires the player to recognize each of the plays that can be performed on the playing field; therefore, it is not enough to identify the generalities of the sport, but it is pertinent to identify the technical aspects of each play since five different fundamentals can be put into play in the practice of this sport.

- **Finger Strike**

This foundation refers to a technique in which the player must use his hands to make plays with the ball using only his fingers. Cortina Guzmán (2007) indicates that the purpose of this technical foundation is to execute a placement pass, placing the ball in some area of the net, to be attacked by another player of the team; the basic principles must be precision and control, but above all the correct location before the ball to be able to hit it properly.

Figure 1
Technical fundamentals of the volleyball sport discipline.



Note: The image shows the position of the hands and legs during the technical gesture of a finger strike. Adapted from (Planchart and Domínguez, 2001).

Guidelines for the execution of the finger-tapping technique:

- In the toe strike, the legs should be bent and oriented to the ball's direction.
- Before making contact with the ball, it is necessary to position yourself under the ball and face where it will be thrown.
- When the ball comes into contact with the hands, all fingers must be used to execute the move.
- If a backward finger strike is to be executed, the body must adopt a specific position, the hips must be arranged forward and upward, and the arms will move upward.

The finger strike has several variants, including the forward finger strike and the backward finger strike.

- **Forearm Strike**

As its name indicates, this technical foundation of Volleyball seeks to perform defensive plays by defying the ball with the forearms. Ortiz (2011) states that in a forearm strike, the player should seek to intercept the ball to make a move that allows him to send it to another team member to continue the play; in receiving the ball, the knees should be bent, the trochus arranged forward and the forearms should be together at waist level, as shown in Figure 2.

Figure 2.

Technical foundation forearm stroke - Volleyball.

Note: The illustration shows the forearm stroke. Adapted from Learning to Play Volleyball (https://es.wikihow.com/Categoría:Voleibol)

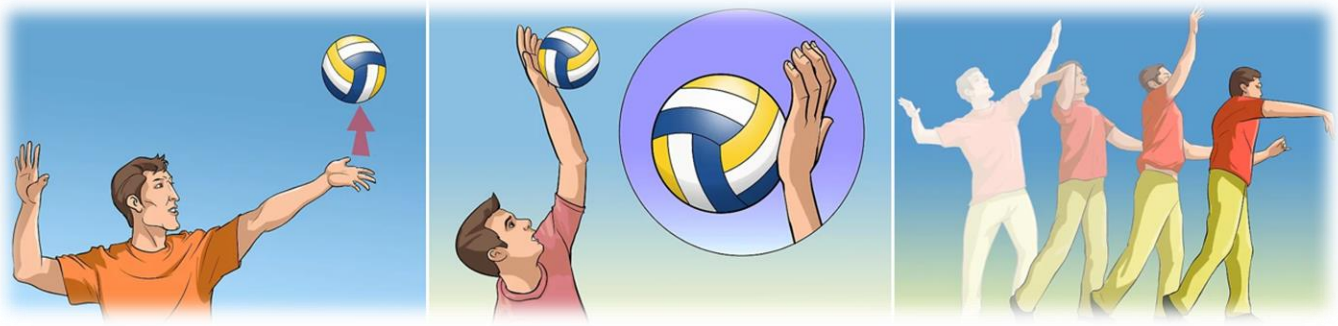
As noted by Ortiz (2011), the down pass is used for the reception of the service, to perform free or low plays, in the phase of setting up new plays or low defense, particularly in the reception of the service, the function of the forearm touch is to counteract the service of the opposing team and initiate the attack. Regarding the free and low balls as moderate-speed plays, the forearm hit is performed to initiate a new play. In the case of the set up can occur when a bad reception is made, and to overcome it, the forearm hit can be used. Also, the forearm hit during the plays is used to respond to direct attacks from the opposing team.

- **Service**

Service is one of the leading technical fundamentals in the volleyball sport. Cortina Guzmán (2007) refers that through the service, the ball is put into play, enabling the team to obtain direct points or hinder the opposing team's plays:

- When throwing the ball, it must be thrown with the utmost precision and accuracy.
- One leg must be brought forward alternately, opposite to the arm with which it is hit, and the body must be stable.
- The body's weight must be placed on the leg that is not forward.

Figure 3.
Technical basis service or serve sport discipline Volleyball.



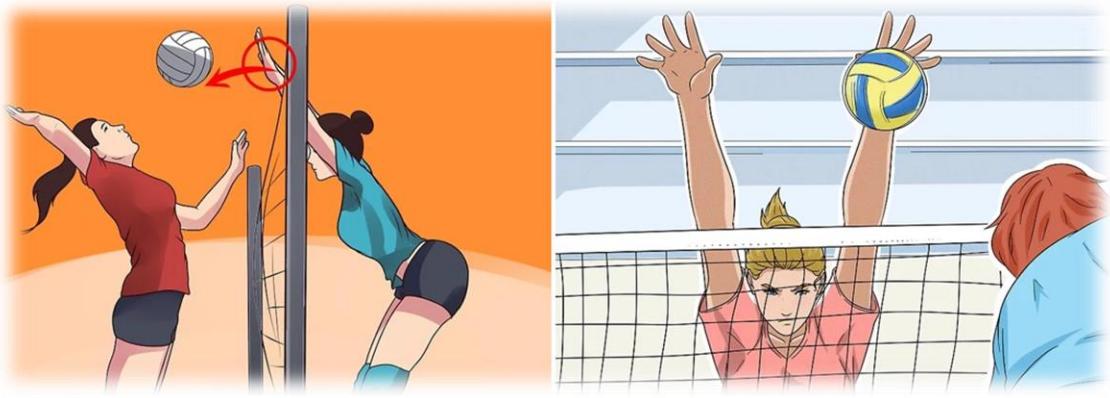
Note: The figure shows the technical foundation of the serve. Adapted from Learning to Play Volleyball (https://es.wikihow.com/Categoría:Voleibol)

In Volleyball, as Cibrian (2000) points out, there are five types of serves, but three of them are usually used: Tennis serve with spin, floating tennis serve and overhead serve with suspension**.**

- **Blocking**

The block is one of the most effective techniques when counteracting the opponent's attack; Bravo (2006) indicates that the block can be considered a strategic move that makes it possible to score points effectively, and its execution is more tactical than technical. For the technical execution of the block, the player should be 50 centimeters away from the net, with the feet in a parallel position and separated at shoulder width, the legs slightly bent, and the trunk slightly forward. The arms bent in front of the body; if the player is very tall, he can keep his arms straight up, and with the palms facing forward, the sight must be focused all the time on the opponent. Once the ball is approaching, the player must jump and try by all means to reduce the opposing team's attack, as shown in figure 4.

Figure 4. Technical foundation blocking sport discipline Volleyball.



Note: The figure shows the technical basis of blocking. Adapted from Learning to Play Volleyball (https://es.wikihow.com/Categoría:Voleibol)

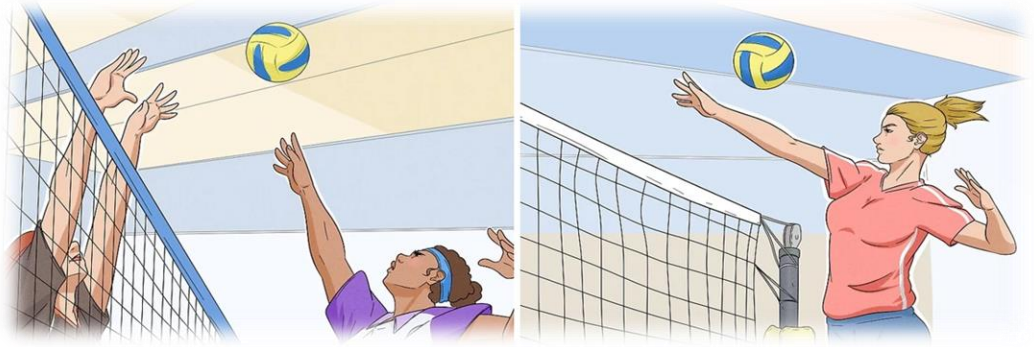
It is advisable that the hands are completely open, which allows a greater space to be occupied when applying the technique and thus proceed to hit the ball, the return of the players should be done in a cushioned manner on the tip of the toes.

- **Auction**

Frohner (2004) affirms that it is fundamental in this technical foundation that the player can jump, except for being tall. For the execution of the technical gesture, the following aspects must be taken into account:

- When moving to perform the shot, the player must perform the take-off and movement in a fluid manner taking into account the pass or placement that a teammate has issued.
- The last step must be longer to gain momentum and perform the slam dunk.
- At the moment of the jump to finish off, the feet must be separated at the width of the shoulders.
- The arms should be used for take-off momentum.
- The player's fall should be on both feet so cushioned.
- The arm that will hit the ball must perform a pronation movement when contacting the ball.

Figure 5.
Technical fundamentals of the volleyball sport discipline Volleyball



Note: The figure shows the technical basics of spiking. Adapted from Learning to Play Volleyball (https://es.wikihow.com/Categoría:Voleibol)

Likewise, Frohner (2004) indicates that the technical foundation of the slam shot is carried out in five specific phases: run, swing, jump, hit and fall.

All of them are fundamental to guarantee the correct execution of the technique in such a way that the ball is sent with force to the opponent's field in an attempt to obtain points; the purpose of the shot is to try to outwit the blocking of the opposing team, locating the places that are free to win the play.

In essence, the technical fundamentals of Volleyball guide the game's development; it is not enough that the educational scenarios have the implements to practice this sport discipline. It is useless for students to practice it without appropriating the fundamental concepts for its execution.

The Physical Education Area and the Use of ICT

Technological evolution in the last two decades has impacted the school scenario; virtually all schools use ICT in the development of different academic activities; in this regard, Ferreres Franco (2011) argues that the use of these technologies by teachers and students is aimed at innovating the teaching-learning processes, particularly the application of ICT in the development of physical education classes is an incipient fact, Prat and Camerino (2012) argue that the use of these technologies to guide the area becomes a challenge for educators, while Área (2002) does not see it as a challenge, but as an opportunity that allows teachers to use digital resources to promote sports practice.

On the one hand, some authors find a high potential in their use, as is the case of Generelo Lanaspa (2006), who states that simulators and applications allow people to understand the practice of sports from conceptualization. Consequently, the practice (p.2) against this position are authors such as Capella (2007), who states that sport can only be learned exclusively through praxis.

Lenis Aroca et al. (2011) found that ICTs contribute positively to the teaching of physical education because they allow teachers to use programs to make measurements and calculations for athletes, and build teaching materials for different sports disciplines, and sports scenarios, among other advances.

In addition to the above, information and communication technologies, when used in the area of physical education, allow the teacher to have new channels of communication, interaction and collective construction of knowledge (Lenis Aroca et al., 2011), about the student these digital tools provide different means that allow students to reach the appropriation of knowledge.

Therefore, the role of ICT in appropriating sports knowledge facilitates the inference of the theoretical foundations to the learner. It also provides the opportunity to develop physical activities for people who, in one way or another, have some disability.

Materials and Methods

Based on the proposed objectives, study variables, and integrated research methods, the nature of the study is framed within the mixed methodology, that is, the fusion of quantitative and qualitative methods. Hernández et al. (2006) argue that, in mixed research, qualitative data contribute to support and explain the numerical variables, which is why the authors indicate that both methods are not exclusive but complementary.

Likewise, to detail the development of the research, the descriptive method is integrated, in which, from Danhke's (1989) approaches, the researcher must contextualize the study based on situations, events and phenomena that are subjected to analysis and interpretations framed in the interactions of the subjects under investigation. In other words, collect information on different aspects that make it possible to describe, understand and interpret the object of study. Under these conditions, the descriptive method was used to detail the facts that occurred during the research process development.

Finally, the study's design is framed in the quasi-experimental method, as it sought to validate in two groups whether the traditional teaching methodology or the integration of augmented reality is more effective in the appropriation of the technical fundamentals of Volleyball.

Study participants

The study was conducted in the educational institution of Sora, Boyacá, as a representative sample was selected students of grades 901 and 902 of the basic education school level; the control group (use of the traditional teaching method) consisted of 22 students, and the experimental group (use of augmented reality as a teaching strategy) was composed of 22 students of the referred school grade, as well as the teacher who guides the teaching in the area of physical education. In other words, the sample subjects correspond to 44 students and one teacher, as shown in Table 1.

Table 1.
Study participants

Item	**Characteristic (attribute)**
School level	Grade 9 of basic education
Control group	Women: 10 Men: 12
Experimental group	Women: 13 Men: 9
Teacher	Educator with a background in sports and a Master's degree in ICT
Average age of students	13 to 15 years
School context	Urban / rural
Economic Stratum	1 y 2
Level of access to ICT	Acceptable, since not all students have access to these technologies; however, with the help of the municipal administration, technological infrastructure such as mobile devices were provided for school work in times of social confinement.

Note: The table shows attributes and characteristics of the study unit selected for the research process development.

The unit of analysis in the study sought to estimate the knowledge inherent in the technical fundamentals of Volleyball, both in the control and experimental groups, to determine whether the use of traditional education or the use of augmented reality is more effective in the appropriation of these concepts by students.

Study variables and hypotheses

The variables allow the researcher to estimate aspects related to the object of study. Hernández et al. (2006) affirm that the variables can present changes in the function of the other, depending on the type of study being developed, which is why they can be cataloged as independent and dependent.

Based on these approaches, the variables used in this study are as follows:

- **Independent variables:**
  - Augmented reality

- **Dependent variable:**
  - School performance in physical education: technical fundamentals of Volleyball: finger strokes, forearm strokes, serves, blocks and spikes.

- **Intervening variable**
  - Teaching strategy

Table 2. Operationalization of Variables

VARIABLES	INDICATORS	QUESTIONS	INSTRUMENT
DEPENDENT: School performance in physical education (technical fundamentals of Volleyball: Finger strokes, forearm strokes, serves, blocks and spikes).	Knowledge is inherent to the sports discipline of Volleyball.	What is the knowledge possessed by the students participating in the study regarding the technical fundamentals of Volleyball?	Knowledge pre-test Post Test final knowledge evaluation Observation Participatory
INDEPENDENT: Augmented reality	- Incidence of digital resources in the teaching and knowledge inherent to the five technical fundamentals of Volleyball. - Significant improvements in students' knowledge.	How do students interpret the use of augmented reality in strengthening the learning of volleyball technical fundamentals?	Opinion poll On the use of augmented reality to strengthen the conceptual appropriation of Volleyball.
INTERVINIENT: Didactic Strategy			

Note: The table shows the variables estimated in the study and the techniques and instruments used for data collection.

- Hypothesis

In research, hypotheses are premises submitted to trial to be tested; therefore, they are defined as explanations that attempt to prove situations of the phenomenon or situation under study

(Hernández et al. 2006, p. 130).

In this sense, as this is a quasi-experimental study, it requires the formulation of hypotheses to validate the assumptions that augmented reality contributes to the conceptual appropriation of the technical fundamentals of Volleyball. From this perspective, the null hypothesis Ho is formulated:

Ho: The average school performance in the area of physical education inherent to the technical fundamentals of Volleyball, when teaching and learning are oriented from augmented reality as a didactic strategy, is equal to the average when the traditional teaching method is used.

Likewise, the alternative hypothesis **Ha.**

Ha: The average school performance in the area of physical education inherent to the technical fundamentals of Volleyball, when teaching and learning are oriented from augmented reality as a didactic strategy, is different from the average when the traditional teaching method is used.

Phases of the Research Process

The research process in the study was carried out in four phases that made possible the development of the proposed objectives.

- **First stage**

This stage was aimed at fulfilling the first objective of the proposed study: to analyze the knowledge of ninth-grade students regarding the technical fundamentals of Volleyball.

To meet this objective, a pre-test of knowledge about Volleyball's technical fundamentals was applied, consisting of 15 items. It is a questionnaire validated by Dr. Elena Hernández Hernández, member of the Faculty of Physical Activity and Sport Sciences of the Pablo Olavide University of Seville (Spain), Vice Dean of Strategy, Quality and Mobility of that faculty and José Manuel Palao Andrés, Doctor in Science of Physical Activity and Sport, Director of the Faculty of Sport Sciences at the University of Murcia (Spain).

- **Second stage**

This stage developed the second specific objective proposed: to enable a didactic strategy in two learning environments to strengthen the conceptual appropriation of the technical fundamentals of Volleyball.

As a specific task, a structured techno-pedagogical unit was designed to be applied to the experimental group; the thematic blocks were developed through the integration of augmented reality as a didactic learning strategy in the control group, the same topics were taught, but without the use of conventional didactic elements, the analogical method was integrated as a teaching method articulated with the 21st-century skills learning theory and the integration of collaborative learning.

- **Third stage**

This phase of the study was carried out in response to the third proposed study objective: to validate which of the two learning environments is more effective for students' strengthening and conceptual development.

In order to respond to this objective, among the activities carried out in this phase of the research, a post-test of knowledge inherent to the technical fundamentals of Volleyball was designed, a questionnaire of 15 items was configured, which was also validated by Dr. Elena Hernández Hernández and Dr. José Manuel Palao Andrés already referred to in previous lines. Likewise, to recognize the students' opinions and arguments regarding the educational experience, an opinion survey was administered to the experimental group, which made it possible to interpret the meaning given by them to the integration and use of augmented reality as a learning strategy.

- **Fourth stage**

The final phase of the research process is oriented toward developing the fourth proposed study objective: To reflect on the incidence of using ICT (augmented reality) in sports practice.

Specifically, at this point of the study, it sought to reflect on the educational experience carried out; for this purpose, we took as a reference the results of the school performance of the students of the control and experimental group, the records carried out in the field diaries, and the opinion survey applied to the experimental group, from the analysis of these elements we reflected on the traditional teaching method and the use of augmented reality, and which of these forms of teaching-learning is more effective for students to appropriate the knowledge inherent in the technical fundamentals of Volleyball.

Results

The data analysis and interpretation process is based on the execution of a plan framed in the proposed objectives. For this purpose, descriptive and inferential statistics are used, through which the data emerging from the study are presented through tables, graphs, summary measures and comparative statistics.

- **Results Stage One - Diagnostic**

In the analysis stage, a test of knowledge inherent to the technical fundamentals of Volleyball was developed for the students participating in the study (control group and experimental group), using the test technique and the questionnaire as an instrument.

The diagnosis results were estimated based on the assessment scale established in the educational institution.

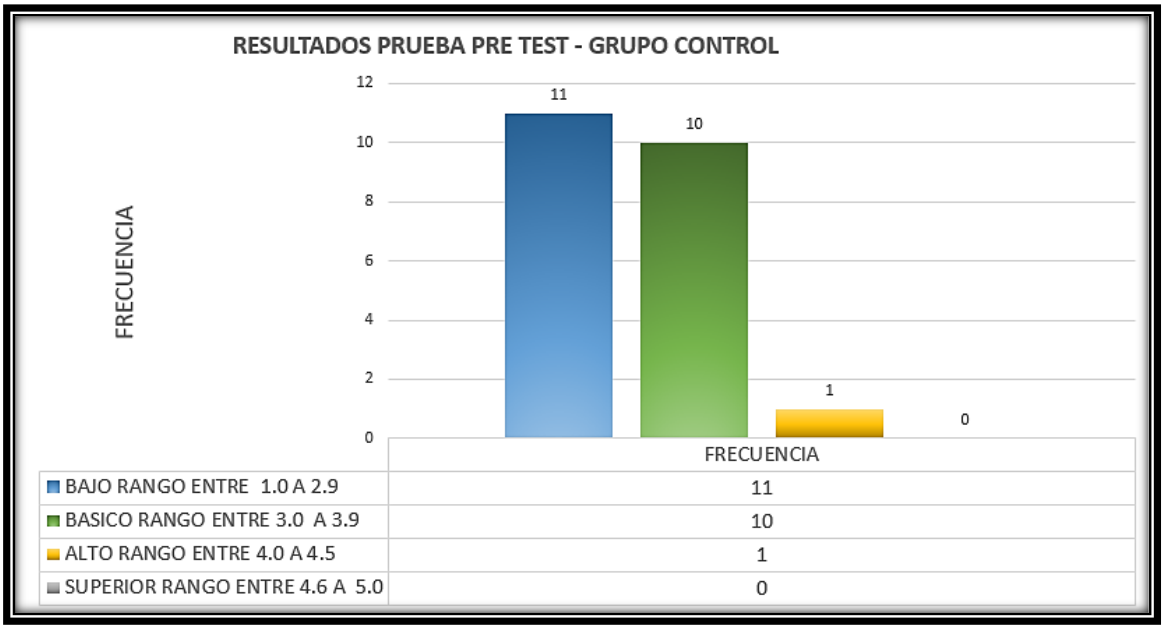
Table 3. School Performance Rating Scale - Sora Educational Institution

Qualitative qualification	Quantitative qualification
Under	1.0 a 2.9
Basic	3.0 a 3.9
High	4.0 a 4.5
Superior	4.6 a 5.0

Note: The rating scale to measure student performance in school
It ranges from 1.0 to 5.0.

The results of the analysis or diagnostic stage in the control and experimental groups are as follows:

Figure 6.
Results of knowledge pre-test control group



Note: The graph shows the results of the dependent study variable in the control group, technical fundamentals of Volleyball: finger stroke, forearm stroke, serve, block and spike.

It was possible to establish that the students who integrated the research control group mainly achieved a predominantly low performance in the pre-test, 11 of them (50%) obtained an average score below 3.0, while 10 students (45.4%) achieved a score ranging from 3.0 to 3.9, only one student of the 22, achieved a score of 4.33, that is, located in the range of high school performance. Based on these results, it can be established that the knowledge of the students regarding the technical fundamentals of Volleyball is low; 15 items that group the five technical fundamentals of Volleyball were evaluated, as shown in Table 4.

Table 4.
Distribution of items evaluated in the diagnostic test or pre-test

Items	**Description**
1,2 y 3	These items were oriented to evaluate the knowledge of the technical fundamentals of finger tapping.
4, 5 y 6	The items assessed the knowledge of the technical foundation of the forearm strike.
7, 8 y 9	Each of these items assessed the knowledge of the technical-service foundation.

10, 11 y 12	These items were oriented to evaluate the knowledge of the technical fundamentals of blocking.
13, 14 y 15	Finally, each of these items was oriented to evaluate the knowledge of the technical basis of the auction.

Note: the table shows in detail the description of the items evaluated in the knowledge pre-test.

Figure 7.

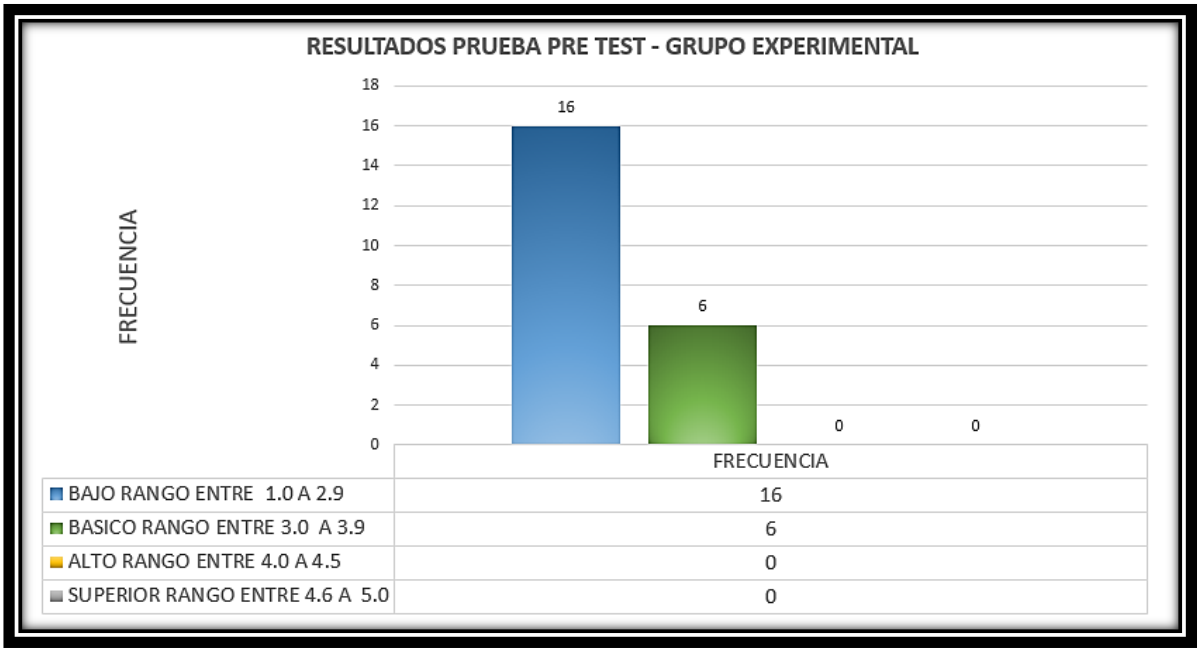
Students in the control and experimental group taking the pre-test

Note: The image shows the detail of the application of the pre-test in both study groups. Source: Property of the author

Broadly speaking, it was possible to establish that in the research control group, students have difficulties in identifying each of the technical fundamentals of Volleyball; one of the causes is the teaching methodology used, since in general, this sport discipline is oriented only to practice, leaving aside any knowledge or conceptual foundation.

In the experimental group, the performance achieved by the students is at a low level, as shown in Figure 8.

Figure 8.
Results of the pre-test of knowledge of the experimental group.



Note: The graph shows in detail the results of the dependent variable in the experimental group, technical fundamentals of Volleyball: finger stroke, forearm stroke, serve, block and spike.

Based on the analysis of the information, it can be inferred that 73% of the students in the experimental group obtained a low performance, with an average score of 2.69 points on a scale ranging from 1.0 to 5.0. Twenty-seven percent were at the basic performance level, with an average score of 3.33 points.

- **Stage Two Results - Design and Intervention**

Taking as a reference the results of the analysis or diagnostic stage in which the dependent variable was estimated, it is established that the school performance inherent to the technical fundamentals of Volleyball is located at a low level, which is why as a strategy to improve the problematic situation a didactic strategy was designed and implemented that integrates augmented reality as an innovation in the pedagogical process in the area of physical education.

Five didactic units aimed at strengthening each of the technical fundamentals of Volleyball were planned, for which school activities were oriented in two learning environments, one focused on the traditional teaching method developed with the students of the control group, in which students used conventional learning elements such as books, consultations, development of exhibitions and billboards as shown in Figure 9.

Figure 9.

Development of activities inherent to the technical fundamentals of Volleyball - Control group.

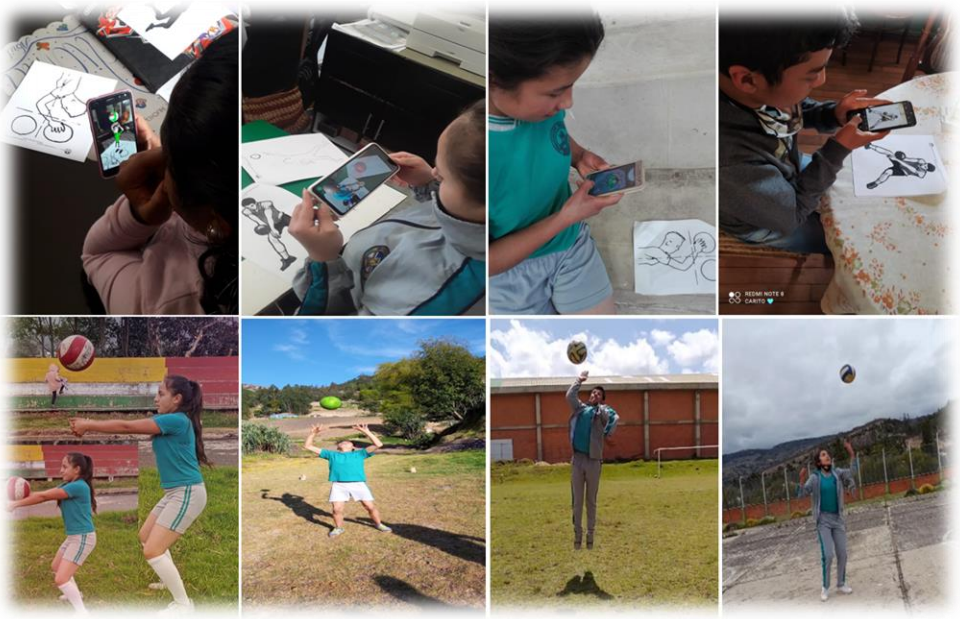
Note: The graph shows the development of work assigned to the control study group.

Particularly the students of the control group carried out the activities proposed in the didactic strategy through the traditional teaching method, in which they used information consultation elements such as books, others made expositions through posters, and some drew and colored each of the technical fundamentals of Volleyball to understand what it consists of. The motivation was evident in the development of the work, especially when they put into practice the relevant concepts.

The experimental group also worked on the technical fundamentals of Volleyball using an innovative learning environment, in which augmented reality was integrated as a didactic strategy to allow the use of mobile devices such as cell phones since students like this kind of technology, as shown in Figure 10.

Figure 10.

Development of activities through augmented reality as a didactic strategy - experimental group.



Note: The image shows the appropriation of knowledge for the execution of each one of the following of the technical fundamentals of Volleyball and its practical execution in the experimental group.

Learning through augmented reality occurred autonomously, as each student focused on using the designed app, which allowed them to explore the proposed content and conceptually appropriate each of the technical fundamentals of Volleyball. Furthermore, through the observation technique, it was possible to identify that student's interests and motivation were better in the experimental group than in the control group.

On the other hand, the resignification of the use of the cell phone as a learning tool is evidenced, more so in the social situation of confinement derived from the Covid-19 virus, in which the students, in one way or another have used mobile technologies in most of their school time. The didactic learning strategy in both study groups was carried out in the Blended Learning modality, i.e., half of the work at the home of each student and half in the virtual classroom; during the non-face-to-face class sessions, the students of the control and experimental group carried out activities oriented to the conceptual appropriation of each technical foundation of Volleyball, the students who used augmented reality worked with the application designed for mobile devices. Meanwhile, the control group students addressed the appropriation of knowledge through the development of work guides and elaboration of material such as posters and exhibitions.

In both study groups, the activities were oriented to the appropriation of the fundamentals of Volleyball as a sports discipline in order to reverse the traditional teaching of the physical education area, that is, not to go to practice without first having the theoretical bases that allow students to have better performance or sports performance.

- **Results Stage Three - Comparison of learning environments**

This stage of the study sought to fulfill the third objective of the proposed study: to validate which of the two learning environments is more effective for the strengthening and conceptual development of students.

For this purpose, a post-test of knowledge was applied, consisting of 15 items in both study groups, control and experimental, in order to establish which of the two teaching methods: traditional education or the use of augmented reality as a teaching strategy is more effective in the appropriation of the technical fundamentals of Volleyball by students.

To determine the difference in means, the basic statistics are calculated and shown in Table 5.

Table 5.
Basic statistics post test: dependent variable analysis.
Note: The table shows the basic statistics calculated based on the pre-test applied.

GROUP	**Media**	**Median**	**Standard deviation**	**Range**	**Minimum value**	**Maximum value**
Control Group (without the use of augmented reality)	3.50	3.66	0.64	2.33	2.33	4.66
Experimental Group (Augmented Reality Employment)	4.41	4.66	0.45	1.33	3.66	4.99

Subsequently, the Shapiro-Wilk normality test was applied to the scores obtained in the control and experimental groups in the post-test stage, with a margin of error of 5% and a reliability level of 95%; the results of the normal distribution test are shown in Table 6.

Table 6.
Data normality test results in the post-test stage

POST TEST	
Control group rating (without use of augmented reality)	Experimental group rating (using augmented reality as a teaching strategy)
0.3203	**0.01319**

Note: The table shows the results of the Shapiro Wilk normality test at the final stage or post test.

According to the data normality test, the control group's scores show the normal distribution in the post-test since the p-value > 0.05. On the other hand, the results in the experimental group do not show normal distribution since the p-value is less than 5%.

Based on the Shapiro-Wilk test results, it is impossible to use the student's t-test to establish the difference in means between the two study groups. Therefore, the contrast of means will be made through the nonparametric test equivalent to the student's t-test, which is the Wil-Coxson rank test for related samples.

WILCOXON SIGNED THE RANK TEST

The objective is to verify whether the control and experimental groups present significant differences in the scores obtained in the post-test, according to the teaching method used for appropriating the technical fundamentals of Volleyball (traditional teaching method versus augmented reality as a didactic strategy).

A margin of error of 5% (α=0.05) and a confidence interval of 95% are considered.

Comparison of control group means about the experimental group post-test stage

Data: taken from Excel sheet (Control group and Experimental group).

Hypothesis:

The hypotheses of the research study are taken up again.

Ho: The average school performance in the area of physical education inherent to the technical fundamentals of Volleyball, when teaching and learning are oriented from augmented reality as a didactic strategy, is equal to the average when the traditional teaching method is used.

The alternative hypothesis (Ha) was proposed as a counterpart to the alternative hypothesis.

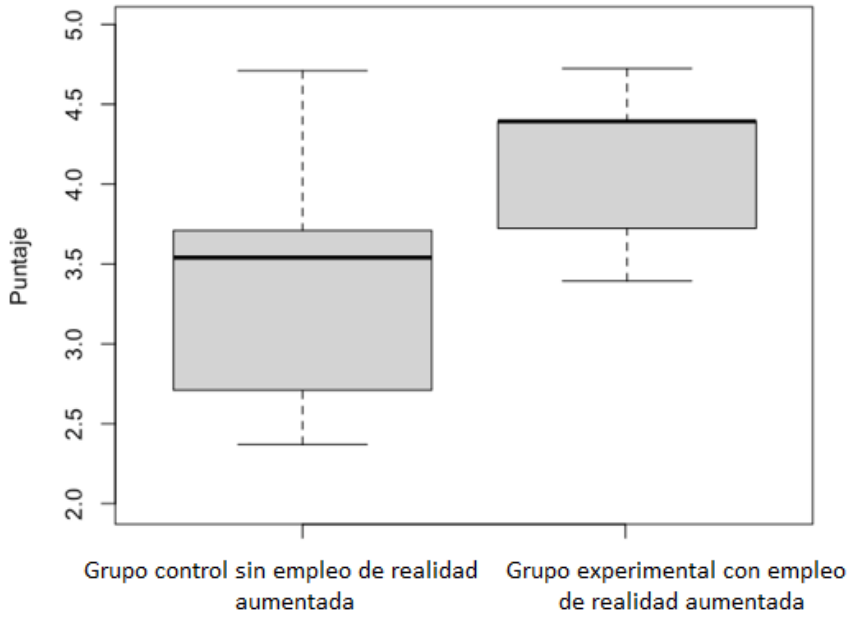
Ha = The average school performance in the area of physical education inherent to the technical fundamentals of Volleyball, when teaching and learning are oriented from augmented reality as a didactic strategy, is different from the average when using the traditional teaching method.

Test statistics:

V = 27,
p-value = 0.001285
Decision: Ho is rejected since (p-value < α; 0.001285 < 0.05).

Conclusion: With a significance level of 5% and a reliability interval of 95%, it is evident that there is sufficient statistical information to determine that the scores obtained in the experimental group using augmented reality are higher than those obtained in the control group in which the appropriation of the technical fundamentals of Volleyball was oriented from the traditional teaching method (Figure 11).

Figure 11.
Difference between means post-test control and experimental groups



Note: The figure shows the difference in means between the control and experimental groups in the post-test stage.

However, the experimental group with which augmented reality was used as a learning strategy obtained better results in appropriating the technical fundamentals of Volleyball than the control group, with which the same knowledge of the area of physical education was taught but from the use of traditional teaching. Therefore, based on the performance of the students of both groups, the alternative hypothesis of the study is validated: **Ha =** The average school performance in the area of physical education inherent to the technical fundamentals of Volleyball when teaching and learning are oriented from augmented reality as a didactic strategy, is different than when the traditional teaching method is used, since the average school performance of the experimental group was 4.41 points, compared to the control group in which the average performance of the students was 3.50 points.

Discussion

From the research process, it was possible to establish that the teaching of physical education should be reinterpreted; students must appropriate the knowledge of the different sports disciplines so that they can later put it into practice.

From this position, Riera (2005) indicates that in sports practice, the athlete should be oriented towards the development of five skills: Basic, tactical, strategic, technical and interpretative; only from the development of these can allow the athlete to guide the sports practice and make the relevant decisions for its execution. Although Volleyball is a sport that is not complex in its practice, it requires the appropriation of the theoretical and conceptual foundation to achieve the best strategic moves and achieve good results in each game.

From the above, it derives that the knowledge of any sport and its practice must be linked to facilitate the athlete to achieve an optimal level of performance, which is why in educational settings or places where the teaching of different sports modalities is oriented, coaches or sports educators should not lean towards one or the other path in teaching. Instead, it is necessary to combine both elements; on the one hand, knowledge can contribute to preventing accidents because if the athlete ignores how a sport should be executed, he can expose himself physically. However, the practice also contributes to identifying potential risk situations and preventing them.

The appropriation of the technical fundamentals of Volleyball, according to Knapp (1981), should be framed in the development of motor skills for the technical execution on the playing court; therefore, the teacher who guides or orients the training in this sport modality is called to guide spatial location skills in students so that during the development of a game they can perform strategic plays. The situation in teaching the sport is not carried out in this way, sometimes, in schools, the students are given the elements of the game, and without any conceptual and physical preparation, they are referred directly to the practice.

Barquín (2017) states that in teaching any sport modality, the methods used for this purpose must be innovative; it is not enough to use techniques that allow for achieving good results. Instead, it is necessary to resort to using resources that facilitate the athlete to appropriate the knowledge so that he/she can apply it in his/her practice.

Based on these arguments, this study was oriented to integrate ICT, particularly augmented reality, as a didactic resource to strengthen the conceptual appropriation of the technical fundamentals of Volleyball since ninth-grade students of the educational institution of Sora present a low level in the identification of these fundamentals. Therefore, this situation limits their practical performance in this sport modality.

Lopez (2013) argues that the use of this technology for educational purposes allows the student to learn autonomously; he who advances in his learning at his own pace; he also has the opportunity to review the thematic content repeatedly, a situation that favors its appropriation. Likewise, the integration of these technologies allows learning to take place in an interdisciplinary way, that is, integrating different areas of the school curriculum, which allows the student to acquire a comprehensive education.

According to the techno-pedagogical strategy carried out, the statements of López (2013) are corroborated since the experimental group students were motivated and interested in learning the technical fundamentals of Volleyball through the use of mobile devices such as cell phones. Furthermore, it could be observed that they showed pleasure in interacting with these digital media because, due to their age, most of them have access to this kind of technology and find it rewarding to use it in their learning.

The educational experience was innovative for the students since they had no idea of technological resources capable of animating an image on paper. Therefore, for them, it was surprising to focus the cell phone on the illustrations of the technical fundamentals of Volleyball and see how these generated the explanation dynamically and animatedly.

As a result of the research, the teacher-trainer or sports guide should guide the different sports modalities from two main pillars, one of them focused on the athlete learning the conceptual foundation of the sport modality within which the origin of the sport, characteristics, technical and tactical fundamentals, regulations, clothing, among other aspects that are fundamental when putting the sports discipline into practice, should be explained. On the other hand, the praxis should be oriented sequentially, where the learner progresses progressively in the same teaching session. It is not possible that he/she is already an expert in the practice of a particular sport.

Specifically, in Volleyball, learning should be oriented from the basic knowledge, explaining what this sport is, the fundamentals in which it is framed and the rules to apply in its practice. Therefore, it is necessary to work in a personalized way with each athlete since it is a reality that each one has particularities in the execution of the practice, style and pace of learning.

On the other hand, it is necessary to take into account intervening variables in the sports practice, for example, the physical conditions of the athlete, availability of time to practice the sport, and physical and nutritional aspects; the essential thing is to provide the knowledge or fundamentals so that the sports practice can be adapted to each particular situation.

To conclude the academic debate, how the teaching of physical education was traditionally oriented has been redefined with the emergence of information and communication technologies. Currently, many didactic possibilities can guide the knowledge of any sport, specifically for Volleyball; different digital resources have been created that allow the athlete to visualize the technical variants and then be able to replicate them in their practice. The important thing is that the teacher always keeps in mind that the student must first be oriented in the conceptual foundation to be put into practice.

Conclusions

The emerging conclusions of the research process are oriented to the fulfillment of the formulated objectives, in this sense, it is concluded:

- **According to the first objective proposed in the study, it was identified that how teaching in the area of physical education is usually oriented does not allow students to appropriate the fundamentals of the sports discipline of Volleyball.**

In the study conducted, it was possible to establish through the knowledge pre-test applied that the lack of conceptual appropriation of the five technical fundamentals of Volleyball, by the participating students has led them to have limitations in sports practice since they do not recognize the different phases of each technical foundation. This situation sometimes converges in the low school performance in the area of physical education.

Traditionally, sports coaches or teachers who guide the teaching of different sports modalities in schools prioritize the practical part, leaving aside the technical and conceptual foundations essential to achieve the best sports performance. However, Rozengardt (2017) in his study states that the practice of sports disciplines should not focus only on the practical part, but students must appropriate the theoretical-conceptual foundations that can allow athletes to play well and be able to choose the most appropriate game option at all times.

- **It is necessary to redefine the teaching of physical education so that the knowledge-practice binomial allows athletes to achieve the best performance without infringing the principles, rules and norms in which sports practice is framed.**

For the study conducted based on the analysis or diagnostic stage results, it is evident that students do not have the conceptual appropriation of the technical fundamentals of the sports discipline of Volleyball. Therefore, the teacher must integrate strategies that allow the student to learn this sport modality.

This premise is consistent with the study of García, Ruiz and Graupera (2009), who argues that sports knowledge and praxis are not mutually exclusive but are intertwined to allow the student or athlete to achieve high sports performance. The disjointed teaching of Volleyball is not something new, since, in 1980, Singer from his sports studies showed that volleyball players faced difficult situations due to a lack of training and appropriation of knowledge of the sports discipline, which led them not to achieve stability and flexible motor control, which in turn sometimes led them not to achieve the expected sports performance.

From this perspective, this research aimed to transform physical education teaching by integrating information and communication technologies, particularly augmented reality, as a teaching strategy to enable the conceptual appropriation of the technical fundamentals of Volleyball.

- **Technological didactic resources for teaching physical education allow students to achieve better school performance.**

In the particular case, the use of ICT, augmented reality as a teaching strategy, allowed students in the experimental group to appropriate in greater depth the technical fundamentals of Volleyball, in addition to stimulating their interest and motivation for learning, through the hypothesis test it is established that the school performance in the control group was basic with an average score of 3.5 on the scale of 1.0 to 5.0, the activities carried out were oriented to the consultation of information, development of workshops and guides, on the other hand, the experimental group in which the proposed activities were carried out through the use of augmented reality, the average school performance was 4.41 points.

These results show that the use of augmented reality for educational purposes allows students to maintain a high degree of concentration, which in turn contributes to the appropriation of knowledge and its integration into their cognitive structures. Furthermore, López (2013), in his study, confirms that augmented reality contributes to a personalized education in which the student is autonomous in his or her training process.

Thus, the alternative hypothesis of the study is validated since it is corroborated that the average school performance in the area of physical education inherent to the technical fundamentals of Volleyball, when teaching and learning are oriented from augmented reality as a didactic strategy, is different from the average when the traditional teaching method is used.

Finally, it is concluded that the educational experience carried out is significant. Therefore, it can be replicated and implemented in schools where students have difficulties conceptual appropriation of any sport modality, since augmented reality, by allowing self-directed learning, facilitates the appropriation of knowledge in the student.

References

Área, M. (2002). Manual de tecnología educativa. Tenerife: Universidad de la Laguna.

Barquín, I. (2017). Estudio y Aplicación de Metodologías Orientadas a la Iniciación Deportiva en Voleibol [Tesis de Pre Grado. Facultad ciencias de la Actividad física y del deporte, Universidad de León, España]. https://buleria.unileon.es/bitstream/handle/10612/7613/barqu%c3%8dn%20fournet_ismael%20hugo_julio_2017.pdf?sequence=1

Bravo, C. (2006). Evaluación del Rendimiento Físico. Editorial Kenesis. Armenia Colombia.

Capella, S. (2007) Informática, educaciuón física y ¡las WebQuest! Tándem. Didáctica de la Educación Física. Educación Física y nuevas tecnologías, 25, 42-49.

Capllonch Bujosa, M., y Figueras, S. (2011). Educación Física y Comunidades de Aprendizaje. Estudios pedagógicos (Valdivia). 38. 231-247. 10.4067/S0718-07052012000400013.

Callejón Lirola, D. (2006). Estudio y análisis de la participación técnico-táctica del jugador líbero en el voleibol masculino de alto rendimiento. [Tesis Doctoral. Universidad Politécnica De Madrid.].http://oa.upm.es/146/1/tesis_callejon_lirola.pdf

Cibrián, S. (2000). Manual para el entrenador de voleibol. Sistema de capacitación y certificación para entrenadores deportivos. Área técnico-practica. Nivel 4. México, CONADE.

Cook, T.D. y Campbell, D.T. (1986). The causal assumptions of quasi-experimental practice. Synthese, 68, 141-180.

Cortina Guzmán, C.A. (2007). Voleibol - Fundamentos Técnicos. Universidad Nacional Autónoma De México. Facultad de Estudios Superiores Zaragoza. ISBN: 968-36-6860-7.

Danhke, G. 1. (1989). Investigacion y comunicacion. En C. Fernandez-Collado y G. L. Danhke (Eds.). La comunicadon humana: Cienda sodal (pp. 385-454). Mexico: McGraw-Hill.

Draper, G.O. (1970). "Williams G. Morgan- Inventor of Volleyball". N. Y. American Sports Publishing Company.

Ferreres Franco, C. (2011). La integración de las tecnologías de la información y de la comunicación en el área de la educación física de secundaria: análisis sobre el uso, nivel de conocimientos y actitudes hacia las TIC y de sus posibles aplicaciones educativas. Universitat Rovira i Virgili, Tarragona. http://www.tesisenred. net/handle/10803/52837

Frohner, B. (2004). El voleibol juegos para el entrenamiento. Editorial Stadium. Buenos Aires Argentina.

García, V., Ruiz, L.M. y Graupera, J.L. (2009). Perfiles decisionales de jugadores y jugadoras de voleibol de diferente nivel de pericia. Revista Internacional de Ciencias del Deporte, 14, 123-137.

Generelo Lanaspa, E (2006), Las Nuevas Tecnologías Y Su Aplicación En Educación Física. Universidad de Zaragoza. http://www.ub.edu/Vcongresinternacionaleducacionfisica/userfiles/file/MesasRedondas/MR3Generelo.pdf

Guaraca Ortiz, P.E. (2011). Metodología para el desarrollo del entrenamiento deportivo de voleibol en la categoría inferior (14años) del colegio Manuela Garaicoa de Calderón. [Tesis de Licenciatura. Universidad Politécnica Salesiana. Ecuador]. https://dspace.ups.edu.ec/handle/123456789/1237

Hernández, R., Fernández, C. y Baptista, L. (2006). Metodología de la Investigación. (5ª. ed.). México: McGraw-Hill.

Knapp, B. (1981). La habilidad en el deporte. Valladolid: Miñón.

Lenis Aroca, A. Osorio Correa, D. y Herrera Florez, P.(2011). Estado Del Arte Del Uso De Las TIC En Los Procesos Didácticos De Enseñanza - Aprendizaje De La Educación Física En Las Instituciones Educativas De Educación Básica Secundaria Y Media Oficiales De La Zona Urbana De Santa Rosa De Cabal. Universidad Católica De Pereira. http://ribuc.ucp.edu.co:8080/jspui/bitstream/handle/10785/585/completo.pdf?sequence=1

López, C. (2013). La realidad aumentada desde el aprendizaje por Competencias y el desarrollo de las Inteligencias Múltiples. Blog TACTICAS. http://tacticasc.blogspot.be/2013/11/la-realidad-aumentada-desde-el.html#sthash.EEjSonv8.dpuf.

Planchart, J. y Domínguez, D. (2001) Fundamentos técnicos del voleibol. México: Editorial

Paidós.

Prat, Q., y Camerino, O. (2012). Las tecnologías del aprendizaje y el conocimiento (TAC) en la educación física, la WebQuest como recurso didáctico. Apunts. Educación Física y Deportes (109), 44-53.

Riera, J. (2005). Habilidades en el deporte. Barcelona: Iniciativas del Nuevo Deporte Español.

Rozengardt, R. (2017). Una propuesta de enseñanza para la Educación Física escolar. Las experiencias socio psico motrices de nuestros niños y niñas. EFDeportes.com, Revista Digital. Buenos Aires - Año 16 - Nº 157. https://www.efdeportes.com/efd157/una-propuesta-para-la-educacion-fisica-escolar.htm