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Scientific articles

Estrategia didáctica transversal para la enseñanza de la física general a través del deporte

Cross-disciplinary didactic strategy for teaching general physics through sports

Estratégia didática transversal para o ensino de física geral por meio do esporte

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Resumen

La presente investigación constituye una innovación en el ámbito de la tecnología educativa al incorporar el uso del video y una estrategia constructivista para la enseñanza de la física general mediante la integración de prácticas deportivas. La propuesta se llevó a cabo con los alumnos de sexto semestre de bachillerato en la Universidad Autónoma de Querétaro, desde febrero hasta junio de 2023. Para ello, se adoptó un enfoque cuantitativo para evaluar los resultados mediante pruebas pretest y postest para medir los promedios grupales. Durante las clases, se abordaron temas como las leyes de Newton, el equilibrio de la partícula y el tiro parabólico. Para cada uno de estos temas, se emplearon los deportes de voleibol, calistenia y baloncesto, respectivamente. Asimismo, se implementó la estrategia de aprendizaje basado en problemas (ABP) para abordar los ejercicios propuestos durante la propuesta, y el aprendizaje basado en investigación (ABI) se utilizó previamente para la conceptualización teórica de los temas tratados. Al comparar los resultados en las pruebas postest y pretest, se observa una leve mejora en las calificaciones obtenidas de manera grupal. Además, durante la implementación de la propuesta con las prácticas deportivas, los estudiantes mostraron una gran receptividad para

participar en las actividades. Esto abre áreas de oportunidad para investigaciones futuras y la propuesta de esquemas innovadores que fomenten el desarrollo integral de los estudiantes, como lo establece el nuevo Marco Curricular Común de la Escuela Media Superior de México (MCCEMS).

Palabras clave: interdisciplinariedad, constructivismo, enseñanza de la física.

Abstract

This represents an innovation in the field of educational technology by implementing the use of video and a constructivist strategy for teaching general physics through sports practices. The proposal was carried out with sixth-semester high school students at the Autonomous University of Querétaro from February 2023 to June 2023. A quantitative approach was used to measure the students' results with a pretest and posttest, measuring group averages. The topics covered during the classes included Newton's Laws, Particle Equilibrium, and Projectile Motion, with volleyball, calisthenics, and basketball being used for each respective topic. A problem-based learning (PBL) strategy was employed to solve exercises presented during the proposal, and inquiry-based learning (IBL) was used beforehand for the theoretical conceptualization of the topics addressed.

When comparing the results in the posttest and pretest, a slight improvement in the group scores is evident. During the implementation of the proposal with sports practices, the students showed a high level of receptivity to participate in the activities, opening up areas of opportunity for future research and proposing innovative schemes that promote the comprehensive development of students, as established by the new Common Curriculum Framework for Upper Secondary Education in Mexico (MCCEMS).

Keywords: Interdisciplinarity, Constructivism, Physics Education.

Resumo

A presente pesquisa constitui uma inovação no campo da tecnologia educacional ao incorporar o uso do vídeo e uma estratégia construtivista para o ensino de física geral por meio da integração de práticas esportivas. A proposta foi realizada com alunos do sexto semestre do ensino médio da Universidade Autônoma de Querétaro, no período de fevereiro a junho de 2023. Para tanto, foi adotada uma abordagem quantitativa para avaliar os resultados por meio de testes de pré e pós-teste para medir as médias dos grupos. Durante as aulas foram abordados temas como leis de Newton, equilíbrio de partículas e disparo parabólico. Para cada um desses temas foram utilizadas as modalidades voleibol, calistenia e basquetebol, respetivamente. Da

mesma forma, a estratégia de aprendizagem baseada em problemas (PBL) foi implementada para abordar os exercícios propostos durante a proposta, e a aprendizagem baseada em pesquisa (ABI) foi previamente utilizada para a conceituação teórica dos temas abordados. Ao comparar os resultados do pós-teste e do pré-teste, observa-se uma ligeira melhora nas pontuações obtidas coletivamente. Além disso, durante a implementação da proposta com práticas esportivas, os alunos demonstraram grande receptividade para participar das atividades. Isto abre áreas de oportunidade para pesquisas futuras e a proposta de esquemas inovadores que promovam o desenvolvimento integral dos alunos, conforme estabelecido pelo novo Quadro Curricular Comum da Escola Secundária Superior Mexicana (MCCEMS).

Palavras-chave: interdisciplinaridade, construtivismo, ensino de física.

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Introduction

The covid-19 pandemic has had a significant impact on the educational field worldwide, and has highlighted the need to adopt a healthy lifestyle. Plasencia-Urizarri *et al* . (2020) carried out a systematic review on comorbidities associated with covid-19, and found that conditions such as chronic kidney disease, cardiovascular diseases, high blood pressure, and diabetes mellitus are some of the comorbidities that significantly increase the risk of severe clinical presentation in patients with covid-19.

On the other hand, in addition to the fatalities left by the pandemic, education also faced a profound crisis, making it imperative to resort to innovative ways to develop learning strategies that address teaching from a transversal perspective, as specified in the New Common Curricular Framework for Higher Secondary Education (MCCEMS), with the aim of promoting comprehensive training. Therefore, the objective of this proposal is to improve the learning of high school students in the subject of physics and, intrinsically, to promote the physical activation and interest of students in said discipline.

In this sense, the Ministry of Public Education (2022) establishes in the MCCEMS an educational approach that is based on the comprehensive development of students, which arises from the need to educate students so that they can guide their lives towards a satisfactory and healthy future. This implies a strong connection with society, an understanding of the social, economic and political challenges facing the country, as well as an awareness of its immediate environment.

Now, in the specific case of the problem of students achieving basic learning in the subject of physics, it can be stated that this is not a recent phenomenon; in fact, as indicated by Guisasola *et al.* (2019), since the 1980s, studies on physics teaching have consistently shown

that students do not reach expected learning levels. This persistent difficulty highlights the prevailing need to address and improve educational methods in the field of physics.

In this context, educational research has witnessed over the decades the worrying discrepancy between learning expectations and the reality observed in physics classrooms. The relevance of this problem lies in its direct impact on the academic training of students, which affects not only their individual results, but also the general quality of education in the field of physics. These considerations underscore the importance of developing innovative approaches and pedagogical strategies that effectively address persistent challenges in teaching this discipline.

The relationship between sport and science is always implicit, so highlighting this connection is essential in an educational proposal, such as the one used in this study. In a previous work carried out by Arroyo and Royuela (2020) with fourth-year high school students in Valencia, Spain, they sought to demonstrate the interdisciplinarity between physical education and general physics, in addition to the implementation of information and communication technologies. (TIC). This proposal was carried out over four sessions, in each of which various physics concepts were addressed, along with the use of various related applications. The results showed that students were able to use these applications without having previous experience in their use. Specific apps and topics addressed included using the Runtastic app to analyze energy, which measures distances and calories consumed during running sessions. The Wikiloc application was also used to explore concepts of position and kinematics, and GPS technology and fitness bracelets were used to describe movement. In each session, feedback was requested from students and teachers to determine whether the class was motivating, useful, and relevant in relation to the content presented. In this way, it was determined that the proposal effectively fulfilled its function by generating interest in the subject in students.

On the other hand, Méndez and Rodríguez (2014) implemented a pedagogical strategy for teaching physics through the execution of ball throws in sports such as baseball and basketball. The goal of this strategy was to introduce students to the concept of parabolic shooting, which is evident in both sports. Additionally, the Physik Trackers application was used to graphically represent the trajectories of the balls in a Cartesian coordinate system. Students analyzed these representations and compared them with data obtained in real practice, providing them with tools to calculate the position of the ball under specific circumstances.

The purpose of this innovative teaching strategy was to create an engaging learning environment for students. The results of the research carried out by Méndez and Rodríguez (2014) indicated that students showed a higher level of motivation when applications such as

Physik Trackers were used. Furthermore, it was observed that learning the concept of parabolic shot was more effective when relating it to practical and palpable situations, such as ball throwing in the aforementioned sports, in contrast to the traditional teaching approach based on pure theory.

For his part, Sesma (2016) proposed an educational strategy focused on problem solving, which involved designing problems around everyday situations that students were familiar with, as well as situations related to various sports such as golf, soccer , etc. tennis, artistic gymnastics, javelin throwing, parkour and archery. The results of the evaluations carried out by Sesma (2016) indicated that the application of physics problems based on everyday and sports situations turned out to be effective for students. In fact, 75% of the students managed to pass the course and, in general, demonstrated their willingness and motivation to independently tackle the proposed activities.

According to García Arias and Quevedo Arnaiz (2021), the research-based learning approach seeks to promote the generation of knowledge and provide the opportunity to develop research competencies, skills, and attitudes throughout the entire curricular structure.

For his part, Briceño (July 20, 2021) establishes that the research-based learning (IBL) approach focuses on interweaving classroom lessons with practices and research, providing students with the skills and competencies necessary to express their arguments and reflect critically. In this educational strategy, we seek to establish a link between the contents of the academic programs and the information that students collect both theoretically and practically, which makes them active participants in the construction of their own knowledge.

Based on all of the above, it can be stated that the teacher plays a crucial role in this process and that his or her responsibility goes beyond the mere transmission of knowledge; Consequently, it must provide continuous feedback, closely supervise activities and procedures, and guarantee compliance with the objectives set for the development of learning. In this context, student participation becomes a fundamental element for enriching their understanding and constructing their own learning, which reflects the importance of the interaction between theory and practice in this educational approach.

Duarte *et al* . (2022) describe a didactic strategy to teach physics based on simulation and problem solving. According to the authors, this methodology begins by taking advantage of students' prior knowledge about the topic under study. They are then guided in understanding the theories, laws and principles of physics to cover areas such as mechanics, electricity, waves and sound, as well as heat and thermodynamics. In a subsequent stage, students apply this theoretical knowledge by developing learning guides, using simulators to experiment with various phenomena and consolidate learning. The proposal by Duarte *et al* . (2022)

demonstrated positive results, reflected in the data collected during implementation, since before putting the strategy into practice, only six of the 23 students managed to pass an initial evaluation. However, after it was applied, only one student did not pass the exam, which shows an evident improvement in the academic performance of the participants.

In this context, for Benítez-Vargas (2023), the pedagogical current of constructivism, conceived by Piaget and Vygotsky, is based on the constructivist theory of knowledge. This perspective highlights the importance of providing students with the necessary tools to develop their own approaches when addressing problem situations. In essence, it involves a constant adaptation of their ideas to provide them with the opportunity to continue learning in an active and participatory way.

Of course, constructivism is not reduced to simply being an educational method, since it is also presented as a philosophy that recognizes the crucial role of the student in the active construction of their own knowledge. This approach promotes learning that transcends the mere acquisition of information, which is intended to be meaningful and lasting. According to this approach, the student is not a passive recipient, but rather an active agent in building their understanding, which contributes to cultivating a deeper and more sustainable educational process.

With the previously mentioned strategies, the aim is to promote the development of competencies and skills in students to carry out an accurate analysis of any problem that is presented to them, regardless of the nature of the topic. For example, the ability to interpret a problem in a free-body diagram is acquired when the student has a clear command of theoretical concepts and applies them effectively in problematic situations, using the logical reasoning that is cultivated. Therefore, the implementation of a problem-based or research-based learning approach contributes to the development of these competencies and skills, as it allows the student to interpret and reflect effectively on the case presented.

To do this, it is essential to teach students within a context that is familiar to them, and allow them to find a genuine interest in learning from a constructivist perspective. Furthermore, the student's active participation in activities that demonstrate the implicit presence of the principles of classical physics can serve as a motivating stimulus for them to continue exploring other scientific fields. This approach not only promotes deep understanding of the subject, but also drives the student's curiosity and intrinsic motivation towards learning.

Methodology

A comparative descriptive quantitative analysis was used to measure the results of the proposal, applying a pretest and a posttest in order to compare the results. The proposal was implemented in a group of 34 students in the sixth semester of high school at the Autonomous University of Querétaro, Jalpan de Serra campus, during the 2023-1 semester, which spanned from February to June. Previously, the students had taken the subjects of Physics I and Physics II in semesters four and five, respectively.

Research design

1. The population with which the study was carried out were high school students at the UAQ, Jalpan de Serra campus.
2. The sample was a group of students in the sixth semester of high school from Jalpan de Serra, whose ages range between 17 and 18 years.

Instruments

- A Google Forms survey was used to identify ages, frequency of sports practices, and the sports that students practice most. In this sense, it was considered crucial to use sports related to their tastes to increase the possibility of raising the levels of motivation and enthusiasm for student participation.
- Instrument to identify the knowledge acquired by students before and after applying the proposed strategy (pretest and posttest).
- Video tutorials on selected sports.
- Honey -Alonso CHAEA learning styles electronic questionnaire .

Materials

- Computer equipment
- Sports equipment (basketball, volleyball)
- Measuring tape
- Projector
- Speaker
- Chronometer

Proposal management

The topics of Newton's laws, parabolic throw and particle balance were selected to be part of the intervention, since they align with the objectives of the institutional program of the subject. These concepts are fundamental in the study of physics because they provide students with a solid understanding of the fundamental principles that govern the movement and interaction of particles. The study of these topics will allow students to acquire essential skills and knowledge for success in their future studies and careers related to physics and engineering.

By applying surveys through Google Forms in the group to evaluate the participation of students in physical activities and using the Likert scale to identify sports preferences, it was found that the most prominent sports, according to the survey, were basketball and volleyball. This led to their selection as part of the intervention, ensuring greater relevance for their participation. In addition, the practice of calisthenics was incorporated due to its suitability with the educational environment of the campus and its adaptation to the topic of particle balance. This decision was made considering both the educational context and the specific conditions of the topic in question.

On the other hand, video tutorials on the selected sports were used to carry out the intervention with the group and for the students to demonstrate the relationship between sports and science (in this case, physics).

The proposal adopted a constructivist approach, since it sought to use the context of the students' lives to make them notice the presence of science in everyday situations. In this way, the aim is to generate truly meaningful learning, at the same time that the proposal is developed in a playful way and is of interest to the students.

In addition, problem-based learning (PBL) was implemented to structure the classes, with problems that incorporated the variables associated with the sports practices seen in the video tutorials, as well as in the sports practices carried out. Finally, inquiry-based learning (IBL) was used to ask students for readings prior to the start of each class.

Development of the proposal

Pretest

The survey was applied in Google Forms for the analysis of population and preferences about sports, as well as the Honey -Alonso electronic questionnaire on CHAEA learning styles.

The planning of the sessions followed the sequence of addressing the topics as follows: first, particle balance was explored, using calisthenics as the selected sport. Secondly, parabolic shooting was addressed, using basketball as a context, and finally, Newton's laws were

examined, using volleyball as a reference. The three sessions were carried out under the same methodology:

- Previous research on the topic was requested.
- A discussion was held on the topic and the sport that was selected.
- The tutorial on sports was shown and the relationship between physics principles became evident to the group.
- Group practice for each sport was held at the campus facilities.
- Problems were designed with the variables associated with each sports practice.
- The problems were resolved.
- Feedback.

Particle Balance

During the class, the video tutorial on calisthenics was shown so that the group could demonstrate the relationship between particle balance and said sport. The design of the problem consisted of a concurrent vector system in the plane, where the athlete holds his mass with his arms, and said arms take part as tensioners.

After the video was shown, a brief practice was held on the goal bars of the soccer *field* . One student volunteer held on in the same way as the athlete in the projected video did, and the rest of his classmates measured the angles their arms formed when holding on. Using the student's weight, the tension in both arms was calculated. The exercise was repeated with the student using different arm openings. The students were able to corroborate the results between the different tensions that resulted from the variations in the grip angles.

Parabolic shot

A video tutorial on free throws in basketball was shown to the students, where the athlete provided advice on how to take certain positions and perform breathing exercises to simulate a situation similar to a real game. Students were shown evidence of the parabolic throw in the trajectory of the ball from the player's throw to the end zone.

Afterwards, a brief practice was planned on the campus basketball court. A student volunteer took the position of shooter, while other students measured the distance from the shooting zone to the end zone, the height from the ground to the point where the student took the shot, and the height of the basket. Other students measured the travel time of the free throw trajectory to the end zone. With these variables, a problem was posed for the students to calculate the initial velocity and the shooting angle of their partner.

Newton's laws

A video about the volleyball serve was shown, where the athlete explained different techniques to start the game. Feedback was provided on the difference in speed on serves, emphasizing Newton's second law, which states that force equals mass times acceleration.

Then, a free throw practice with a ball was held on the campus volleyball court. A student volunteer was placed in the serving position and asked to perform two serves: one applying little force and another with as much force as possible. Other students measured the time it took for the ball to travel from the service line to the net area. With the mass of the ball previously measured, the students were asked to calculate the serving forces in both cases. The students analytically corroborated that the acceleration of the ball is greater when a greater force is applied, as established by Newton's second law.

It is important to highlight that improving the physical condition of students through education is of great relevance, since it is attributed with the ability to enhance the physical performance of young people and promote a healthy lifestyle. Furthermore, its influence on ethical training and values is significant, since it impacts various areas where these aspects converge. This is because it contributes to the development of essential motor skills, vital skills for daily life, relationships in economic and sporting environments, and in general, to a healthier and more satisfying life (Carrillo-Linares *et al.* , 2020). At the end of the sessions, the post-test was finally administered.

Data Collect

The information was collected through the application of the proposed instruments. As for the surveys in Google Forms and the CHAEA test, these tools immediately provide the results, while in the case of the pretest and posttest, manual review of each test was required.

Analysis of data

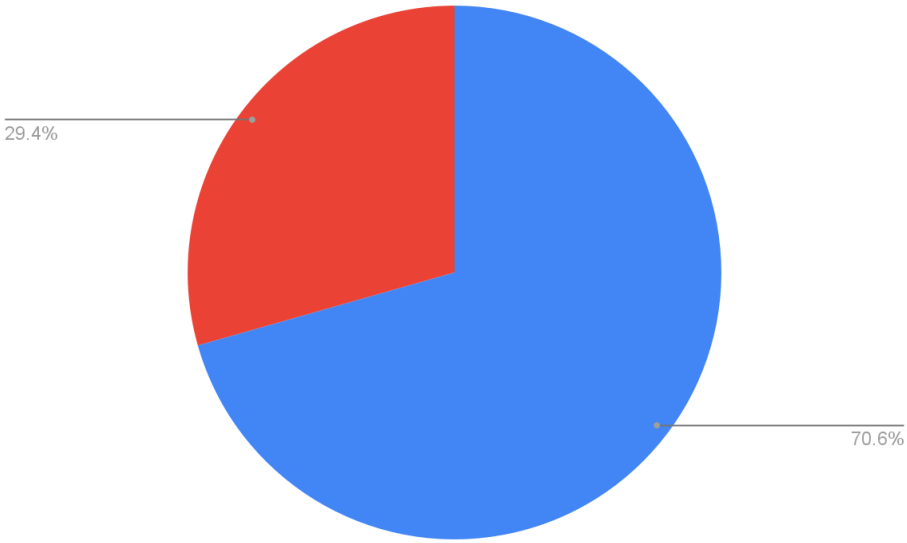
For data analysis, a comparative descriptive analysis was carried out between the post-test and pre-test to determine if there was improvement in the students' learning.

Results

Population analysis

The ages of the group were as follows: 24 students are 17 years old and 10 are 18 years old, which represents 70.6% and 29.4%, respectively.

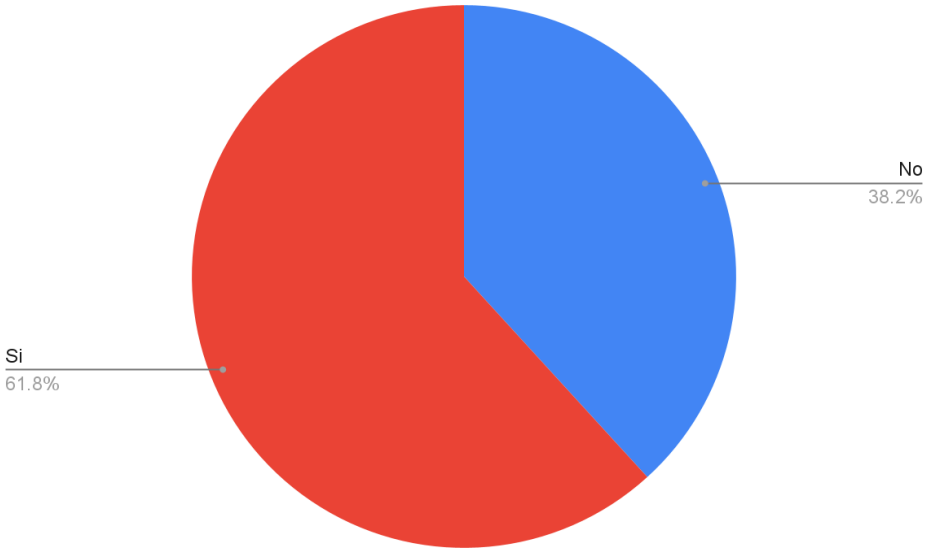
Figure 1. Ages of the group



Source: self made

61.8% of students practice some sport on a recurring basis, while 38.2% do not.

Figure 2 . Recurrence in sports practices



Source: self made

Through a questionnaire applied to the students to find out their sports preferences, using a Likert-type scale, the following responses were recorded, ordered from highest preference to lowest.

Table 1. Results of students' sports preferences

Preference	Sport	Preference	Sport
1	Basketball	13	Climbing
2	Volleyball	14	Athletics
3	Hiking	fifteen	Calisthenics
4	Swimming	16	Taekwondo
5	Running	17	Football
6	box	18	Nailed
7	Cycling	19	Rafting
8	Bodybuilding	twenty	Rugby
9	Archery	twenty-one	Javelin throw
10	Tennis	22	shot put
eleven	Soccer	23	Hammer throw
12	MMA		

Source: self made

As explained above, the hierarchy of sports preferences is displayed in descending order, placing basketball as the most prominent option in terms of voting. In the columns identified as “preference”, the exact position of each sport with respect to the vote is indicated . Likewise, the identification of the students' learning styles was carried out using the CHAEA test by Alonso Gallego and Honey (2000).

Table 2. Preference of learning styles

	ASSET	THOUGHTFUL	THEORETICAL	PRAGMATIC
Student 1	high	Moderate	high	Very high
Student 2	Moderate	Moderate	Moderate	high
Student 3	Low	Moderate	Very high	Moderate
Student 4	Very low	Very high	Very high	Low
Student 5	high	Moderate	high	Very high
Student 6	Moderate	Moderate	Moderate	Moderate
Student 7	Moderate	Moderate	Very high	Moderate
Student 8	Moderate	Low	Moderate	Moderate
Student 9	high	Moderate	Very high	high
Student 10	Moderate	Moderate	Moderate	high
Student 11	high	Moderate	Very high	Very high
Student 12	high	Low	Moderate	high
Student 13	Low	Moderate	Very high	Moderate
Student 14	Moderate	Moderate	high	Moderate
Student 15	Moderate	high	high	Moderate

Student 16	Low	Moderate	Very high	Moderate
Student 17	high	Moderate	Very high	Moderate
Student 18	Very high	Very low	Moderate	high
Student 19	Moderate	Moderate	Very high	high
Student 20	high	Low	high	high
Student 21	Low	high	Very high	Very high
Student 22	Moderate	Moderate	high	Moderate
Student 23	Moderate	Moderate	high	Moderate
Student 24	Very high	Very low	Low	Moderate
Student 25	high	Moderate	Moderate	Very high
Student 26	Low	Moderate	high	Moderate
Student 27	Moderate	Low	Moderate	high
Student 28	Low	Moderate	high	high
Student 29	Moderate	Low	Moderate	Moderate
Student 30	Moderate	Moderate	high	high

Source: self made

Table 3. Count of learning style preferences

	ASSET	THOUGHTFUL	THEORETICAL	PRAGMATIC
VERY LOW	1	2	0	0
LOW	6	5	1	1
MODERATE	13	twenty	9	14
HIGH	8	2	10	10
VERY HIGH	2	1	10	5

Source: self made

The response count - according to the results obtained from the CHAEA test - indicates that there is a moderate fixation towards all learning styles, although the majority of the group has a biased tendency towards the theoretical and pragmatic style, considering the high and very high.

Pretest results

Due to the absence of some students, the pretest was taken by 25 students on the date it was administered; For the same reason, the posttest was taken by 33 students. The score obtained in the pretest and posttest is on a scale from 0 to 100. The group average was 11.56.

Table 4. Pretest results

	Qualification		Qualification
Student 1	12	Student 14	6
Student 2	0	Student 15	24
Student 3	0	Student 16	6
Student 4	0	Student 17	fifteen
Student 5	6	Student 18	0
Student 6	17	Student 19	fifteen
Student 7	12	Student 20	9
Student 8	fifteen	Student 21	12
Student 9	9	Student 22	fifteen
Student 10	9	Student 23	54
Student 11	fifteen	Student 24	0
Student 12	6	Student 25	8
Student 13	24		

Source: self made

Table 5. Posttest results

	Qualification		Qualification
Student 1	27	Student 18	27
Student 2	38	Student 19	30
Student 3	81	Student 20	30
Student 4	51	Student 21	27
Student 5	51	Student 22	24
Student 6	twenty	Student 23	30
Student 7	27	Student 24	24
Student 8	30	Student 25	30
Student 9	24	Student 26	twenty-one
Student 10	24	Student 27	30
Student 11	twenty-one	Student 28	30
Student 12	27	Student 29	30
Student 13	twenty-one	Student 30	27
Student 14	twenty-one	Student 31	27
Student 15	24	Student 32	30
Student 16	27	Student 33	27
Student 17	30		

Source: self made

The group average in the posttest was 29.93

Discussion

The results show that a good number of students play at least one sport or do physical conditioning activities. Even so, it is of utmost importance to encourage the participation of students who have not yet adopted this as a habit.

Regarding the results of the Alonso Honey test to detect learning styles, the heterogeneity of the group is evident. Altamirano-Pérez and Mesa-Villavicencio (2023) describe the activities that are favorable and those that are not, according to the results of the CHAEA test. In this context, it is crucial to take into account the uniqueness of each student when developing an instructional design that adapts to both group and individual characteristics.

Table 6. Characterization of activities to learning styles

Activities that favor or disfavor according to learning styles (CHAEA test)				
	Asset	Thoughtful	Theoretical	Pragmatic
Activities that favor	Brainstorming	Discussions	Develop models	Study cases
	Solve problems	Questionnaires	Statistics	Think about how to apply
	Discussions	Feedback	Background	Solves problems
	Competition	Interviews	They apply theories	Discussions
	Puzzle		Inquire	
Activities that do not favor	Passive role	pressure over time	emotional activities	Discontinuous activities
	Independent work	Be a leader	Nothing without theoretical foundations	Activities without purpose
	Theoretical activities	Be spontaneous		unreal activities
		Change activities		

Source: Adapted from Altamirano-Pérez and Mesa-Villavicencio (2023)

As detailed in table 6, the proposal seeks to be plural in terms of the students' learning style preferences. To achieve this, we seek to identify common points by promoting research into the proposed topics, practice inside and outside the classroom, as well as design and

problem solving. This ensures that regardless of the student's learning style preference, the class is interesting and beneficial, whether it has an active, reflective, theoretical or pragmatic approach.

Like the study by Sesma (2016), the proposal indicates a good indication, since the results of the post-test show upward figures compared to the pre-test. During the sports practice classes, the students were very receptive when performing the exercises and taking the necessary measures to design the problems, which resulted in collective work that favored group integration. Therefore, it is considered that the intervention meets an intrinsic objective of promoting the students' interest in the subject of physics and also in sports.

Like Sesma (2016), Arroyo and Royuela (2020) and Méndez and Rodríguez (2014) also recognize that the students were motivated by working from a constructivist approach relating sports to general physics topics. In fact, students carried out practices both inside and outside the classroom, as required for the design and resolution of the proposed problems. Likewise, they were actively incorporated into the dynamics of the class, according to the constructivist approach and in accordance with the description of Benítez-Vargas (2023).

Finally, when making the numerical comparison between the group averages regarding the pretest and posttest tests, a double difference is evident. Although this is a low score, the increase in performance is considerable, as was the case with Duarte *et al* . (2023), who observed a significant improvement in student grades by applying a problem-based strategy for teaching physics.

Conclusion

Highlighting the presence of everyday situations in science constitutes an effective strategy to contextualize students' learning through events familiar to them. The task of those involved in the teaching-learning processes is to find ways to use educational tools that allow students to achieve the learning objectives required by the new standards of the Higher Secondary School in Mexico.

In this sense, the idea of using sports practices and applying biomechanics concepts to specific situations of each sport can be highly motivating for students within the context of a general physics class. This will allow them to experience science in a tangible way, which in turn will make learning more practical and fun from this perspective.

Although the group averages in the tests before and after the intervention are low (11.56 and 29.93, respectively), it is crucial to highlight the significant improvement observed, since a notable double increase in student performance is evident. the exam. This indication suggests

that the intervention has had a positive impact on their learning process, and underlines the effectiveness of the measures implemented to promote academic progress in the group studied.

Finally, when examining the results of the Alonso Honey test to identify learning styles, the notable diversity of styles present in the group stands out. This finding underscores the importance of adapting our pedagogical approaches dynamically and flexibly to address students' varying learning preferences. Heterogeneity in learning styles is an opportunity to enrich the educational experience and promote an inclusive learning environment, where each student has the opportunity to develop optimally. Therefore, the implementation of varied teaching strategies that cover a range of teaching approaches is recommended to ensure effective support for all students in their learning process.

Future lines of research

Based on the conclusion provided and the findings presented in the text, several lines of future research can be identified:

- Qualitative research that seeks to explore students' interest in the subject of physics by carrying out interdisciplinary interventions.
- Qualitative research that seeks to explore the most recurrent difficulties of students in the subject of physics.
- Extrapolate the proposal to other subjects, seeking the interdisciplinarity that can be found between the subject in question and sport.
- Adapt the proposal to apply it in different contexts in which the popularity of sports varies depending on its acceptance or the availability of infrastructure.
- Improving physics teaching and continuing to investigate innovative ways of teaching physics that encourage student engagement and understanding of scientific concepts.

These lines of research can contribute to the development of more effective and motivating educational approaches, as well as a deeper understanding of how contextualization and the diversity of learning styles can influence the educational process.

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