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Review article

Documentary Review on the GeoGebra software applied to Physical Culture and sports

Revisión documental sobre el software GeoGebra aplicado a la Cultura Física y el deporte

Revisão documental sobre o software GeoGebra aplicado à Cultura Física e ao Esporte

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ABSTRACT

The GeoGebra software is very useful in simulating physical movements because with the help of it the sports professional is able to interpret with mathematical and geometric values the execution of a throw, an action that is very difficult to decipher with the naked eye. However, although this resource is a recurring way to contribute to the development of physical culture and sports, its use in this area of knowledge has not been very widespread. That is why the authors of this research propose as an objective: to carry out a documentary systematization on the Geogebra software focused on Physical culture so that it becomes a reference to be taken into account for future innovations and research on the topic. With a view to achieving this goal, they consulted a group of articles in Scopus and Google Scholar databases and published in the last five years regarding the use of GeoGebra Software and the characteristics of this medium, as well as the various benefits it has offered to users through time were visualized. The articles found were systematized considering the analysis matrix, containing predominant aspects in the number of publications during the year 2021 with 12 publications and a smaller number of publications during 2022. A prototype of 29 articles was studied, in the last five years regarding the use of Educational software that involves GeoGebra.

Keywords: GeoGebra Software, Physical Education, Sports.

RESUMEN

El software GeoGebra es muy útil en las simulaciones de movimientos físicos porque con la ayuda de este el profesional del deporte es capaz de interpretar con valores matemáticos y geométricos la realización de un lanzamiento, una acción que a simple vista es muy difícil descifrar. Sin embargo, a pesar de ser este recurso una vía recurrente para contribuir al desarrollo de la cultura física y el deporte, no ha sido muy generalizado su uso en esta área del conocimiento. Es por ello que los autores de esta investigación se proponen como objetivo: realizar una sistematización documental sobre el software Geogebra enfocado en la cultura Física para que se convierta en un referente a tener en cuenta para futuras innovaciones e investigaciones referente al tema. Con vistas a lograr esta meta consultaron

un grupo de artículos en bases de datos de Scopus y Google Académico y publicados en los últimos cinco años referente al uso del Software GeoGebra y se visualizaron las características de este medio y los diversos beneficios que ha ofrecido a través del tiempo. Los artículos hallados se sistematizaron considerando la matriz de análisis, conteniendo aspectos preponderantes en cantidad de publicaciones durante el año 2021 con 12 publicaciones y menor cantidad de publicaciones durante el 2022. Se estudió un prototipo de 29 artículos, en los últimos cinco años referente al uso del Softwares educativos que implican al GeoGebra.

Palabras clave: Software GeoGebra, Educación Física, Deporte.

RESUMO

O software GeoGebra é muito útil na simulação de movimentos físicos porque com a ajuda dele o profissional do esporte consegue interpretar com valores matemáticos e geométricos a execução de um arremesso, ação muito difícil de decifrar a olho nu. Contudo, apesar deste recurso ser uma forma recorrente de contribuir para o desenvolvimento da cultura física e do desporto, a sua utilização nesta área do conhecimento não tem sido muito difundida. É por isso que os autores desta pesquisa propõem como objetivo: realizar uma sistematização documental sobre o software Geogebra voltado para a Cultura Física para que ele se torne uma referência a ser levada em conta para futuras inovações e pesquisas sobre o tema. do tempo. Os artigos encontrados foram sistematizados considerando a matriz de análise, contendo aspectos predominantes no número de publicações durante o ano de 2021 com 12 publicações e um menor número de publicações durante 2022. Foi estudado um protótipo de 29 artigos, nos últimos cinco anos quanto ao uso de software educacional que envolve o GeoGebra.

Palavras-chave: Software GeoGebra, Educação Física, Esportes.

INTRODUCTION

Every day the application of science and technology is imposed in all areas of knowledge. What was previously believed to be absolute truth, today, the help of new automated and high-precision models and instruments, makes those truths not to be so absolute and does provide a new dimension and a more detailed and broader visualization. Among these instruments is the GeoGebra Software, applied in many areas in order to reflect the characteristics of an object through simulations and which finds in physical activity and sports a context full of environments and particularities that with the help of it can be adequately identified.

The training of Physical Education students in several universities is usually taught with a lack of technology without taking into account that technology is at the service of competition, and which places Physical Education students at a disadvantage compared to those who are trained using technological resources. In other words, it is necessary to conceive technology as a tool to help make these processes more competitive. That is why this research aims to use the GeoGebra software to simulate high-precision physical movements, especially to help calculate physical movements, for example; the angles of initial movement of the projectile in the shot put. In this way, the horizontal reach can be simulated and the athletes efficiently prepared for the Olympic Games, which awards go to the best prepared athletes who have had the support and help of specialists who apply high technologies, mainly through the GeoGebra software.

In fact, Physical Education students should know how the GeoGebra software works and the simulation of such a movement, because the maximum range depends, among other factors, on the throw angle of the initial movement; consequently, the difficulty on preparing Physical Education students without said technologies generates a postponement and delay in the quality that the coaches and experts should reach, limiting the capacity to train said competing athletes.

Therefore, the lack of technological resources means that students only develop memorization of content with minimal applications to problematic situations; consequently, it is urgent that the forms of learning match the demands required by current competitors. To achieve this goal, it is essential to provide Physical Education students with tools for the skills development that help them compete in sports activities and be successful, because contested activities are increasingly more competitive; the GeoGebra software allows the student to gain greater speed in learning and practices of Physical Education. This skill can be promoted by applying technologies for the acquisition and application of learning to practical situations, which involve measurements and mathematical calculations. This can be achieved with the use of technologies according to real situations that involve sports practices and competitions in which the future Physical Education professional will operate, and will have to do so efficiently.

Physical Education students must get used to using computer resources that provide them with accurate information, so that they have more time and concentration on improving other Physical Education skills. This situation predominated in post-covid-19 times; consequently, the initial problem comes from the situation in which they are not provided with the necessary resources to develop software application skills.

This problem is not foreign to study centers in Peru and other developing countries, as seen in progress reports or evaluation minutes. In the context of COVID-19, Physical Education students began their educational work with difficulties regarding access to optimal use of technological tools. At that stage, many students were unaware of this situation to work on the contents of the learning experiences, thus postponing the development of competence.

In the post-covid-19 scenario, some students overcame the mishaps, giving way to the management of technological equipment either with tools obtained individually or provided by the academic school to access learning in person.

Educational software as designs present structures based on processes of inputs and outputs as teaching resources. Likewise, it involves carrying out various activities immersed in processes and tasks that must be carried out to achieve objectives Roalcaba , J. & Soplapuco , J. (2021).

In this article, the use of GeoGebra software is proposed because it is suitable and provides benefits that several universities are unaware of. The knowledge and application of said software will considerably facilitate and make the learning of some sports competitions addressed in the Physical Education programs more attractive and precise. These involve measurements, graphs, simulations and other events that help calculate physical movements, such as: the angles of initial movement of the projectile in the shot put to maximize horizontal range with the use of GeoGebra software with the intention of helping to the student.

Taking into account this limited availability of systematized literature regarding the topic, the authors of this research propose the objective: to carry out a documentary systematization on the Geogebra software focused on Physical culture so that it becomes a reference to be taken into account for future innovations and research.

DEVELOPMENT

Usefulness of Geogebra software in Physical Education

The utility of the Geogebra Software is used by Physical Education students in different exercises on the analysis of the movement of the human body. Its implementation stands out in the calculation of heights used in simulations of shot put, conventional high jump and pirouette, in which cases the students perceive the center of gravity of the athletes in motion. Instead of doing it manually or with other equipment that requires specific installation; that is, it will avoid the use of manual activities subject to certain inaccuracies, which should be known to the Physical Education students. This will allow them to determine the throw angles corresponding to mathematical processes included in the shot put and other movements or events using GeoGebra.

Benefits of the versatility of Geogebra software in sports

Geogebra software allows to be installed on any portable Smartphone device using an Android mobile or another similar application; that is to say, Physical Education students

during post-covid-19 will be able to acquire the expertise to use the Geogebra Software in all situations they consider relevant. To understand by analogy three-dimensional images what it means from the perspective of stakeholder engagement Aziz, N., Haron, H., & Harun, A. (2020). Learning through GeoGebra Software in this context plays an important role, as it pursues interaction with students through technological means and responds to the difficulties presented; in educational practice, virtual environments or classrooms are being equipped to meet the technological need according to Kaplar. *et al.,* (2021).

In this sense, the development of Physical Education classes at the university may include teaching the use of GeoGebra, in an innovative way where it attracts the student's attention and motivates him to receive the knowledge in an attractive way. This process is developed based on practicing the profession, as perceived in similar situations mentioned by Toro Ibacache M. (2010); the application of GeoGebra in the understanding of fractal geometry applied in the distribution of athletes or sportsmen in presentation prior to a sporting event can be also seen. Here colorful images are formed in multiforms such as choreographies, which can be seen from an aerial view, that is, application situations as pointed out by Velasco A *et al.* (2015). In this way, Physical Education students can draw, among other diagrams, a fractal tree with Geogebra to understand various anatomical structures that should also be known to Physical Education students.

Geogebra as an approach to knowledge of the respiratory system

The application of Geogebra in the Characterization of the fractal geometry of the bronchial tree in mammals shown by Canales M. *et al.* (1998) can also be seen; to facilitate knowledge of the respiratory system by Physical Education students to have knowledge of its conformation and functioning.

The PE content learning environment has changed over the years, but the long-standing problem with mathematics education sees students often adopting traditional thinking, with teachers hoping to develop better understanding, create connections complex conceptual concepts and solve Kaplar problems *et al.* (2021).

The substantial change in education is to leave a traditional, routine study to ask why they learn and how it serves them in their lives. The work and commitment of the teacher is latent in improving academic performance using GeoGebra software.

Procedures carried out

The current research was of a basic type, Hermeneutics was used in its review, where scientific information was compiled from the database available on the Internet through the search engine Google Scholar, and Scopus, in this exploration it *is intended* to *respond* to the problem of knowledge assimilation due to limited management of technological resources. This is the case of educational software, so the strategies regarding the use of educational software for Physical Education students during post-covid-19 were considered, because there are difficulties in achieving their skills.

The composition "Technological tools" AND/OR "mathematics learning" AND/OR "interactive learning" AND/OR "educational software" was used, after using the filters and discernments, determining only open access articles, for a total of N= 29 of the 65 downloaded from the database and published between 2018 and 2022. These studies were thoroughly inspected, extracting the main conclusions from all of them and placing them in the results. Some select sources are shown in this table with the articles chosen from the study: the number of articles in each year is shown in table 2 of the Results chapter (Table 1).

Table 1. - Status of the articles and most relevant intention

Article status	**Intention**
Registration qualification	Have a universal idea of your content
Temporality	Consider studies from the last 5 years
Article type	Estimate the review of scientific articles
Research scope	Understand the universe where the research was deployed
Journal	Understand as a reference note
Indexing	Indexed in Scopus
Revised theme	Know the part of the study where the quote is located
Revised quote(s)	Detail the quote that will be estimated in the study

Dimensioning	Decipher the mention with the researcher's opinions
Use in the study to be transcribed	Arrange in which paragraph of the article in composition can reflect the extracted knowledge
Documentary sources (APA)	Arranged in literature
DOI or Link	Review the access link and/or make the study argument visible

According to the information, it was admitted to infer theoretical conceptions that have the exploration of the literature of the study in question, where it is recognized the use of GeoGebra for the learning of mathematics in Physical Education students during post-covid-19 is recognized.

Systematization of information

The results of this review indicate a significance in the application of digital resources as post-Covid-19 educational software, showing themselves as a potential in face-to-face and comprehensive virtual education, the need to design and provide accessible educational platforms and resources with their medium was emphasized. In the reviewed articles, those published in 2020 and 2021 are shown with a greater contribution, the latter being the one with the greatest contribution in the 12 publications analyzed.

The information was systematized considering the analysis matrix (reporting of scientific sections), and according to its structure, basing the title, year, journal, place, references, purpose of the research, the results and findings of each article considering the affinity with the theme, objective that guided the review, is seen below (Table 2).

Table 2. - Number of columns studied according to year of proclamation

Database	Publication date				Total articles
	2018-19	2020	2021	2022	
Scopus https://www.scopus.com/	3	4	5	1	13
Google scholar https://scholar.google.com/	4	4	7	1	16
Total	7	8	12	2	29

This planning led us to choose the precise files for review and study of the topic, involving us in understanding the estimation of technological instruments and educational software for learning mathematics in Physical Education students during post-covid-19. The investigation found from these articles was systematized considering the state of the art and analysis matrix, containing predominant aspects in the number of publications during the year 2021 with 12 publications and the smallest number of publications during the year 2022 considering the Scopus Databases.

Of the selected articles, it was proceeded to examine them, rescuing the most substantial contributions, which are specified below and are consistent with the version of the following researchers:

Muñoz Sanabria and Ordoñez (2019) express, the application of educational software, such as GeoGebra, is very important, since they are components that benefit and promote the educational process, in addition, the resources they propose are effectively used, expressing a greater affinity between the individuals who come together to make it happen; motivating Physical Education students because they will be the ones who promote the use of GeoGebra during said studies, because it will be quite useful within their work field.

The use of GeoGebra software as a choice that improves the solving skills of problematic situations related to two-dimensional figures in the area of mathematics for university students, also influences the development of collaborative work, student social adhesion and increases a good climate in the classroom by facilitating the learning process Aldazabal *et al.* (2021) just as later in the work field it will have to be socialized by Physical Education students who even have tasks linked to physical and physiological health, for example in the event that when there are sports training an athlete may be injured. The development of mathematical competencies is more viable given that students appreciate the idea of establishing a mathematical repository consisting of uploading videos, resources, records of workshops and discussion forums, providing examples and comments given the information from the teachers.

The correct application of the GeoGebra software has made it possible to overcome many challenges in the training of Physical Education students, being supported by technological tools in the context of education investigated Naidoo (2 021); Ramón and Vílchez (2021); in addition, students have achieved excellent learning results, as well as other collaborative skills, communication and teamwork Alloqmani *et al.* (2021).

In the exploration of results, it was found that the application of the GeoGebra software has a significant consequence in the achievement of mathematical skills, such as its impact on graphing straight lines and conics by students at the higher university level of the San Antonio Abad University of Cusco, generating skills mental, motor, and optimizing learning Ayala (2021) skills that are typical of Physical Education students.

Regarding the application of GeoGebra software, Roalcaba -Caro and Soplapuco -Montalvo (2021) mention that the use of GeoGebra software can be used at all levels of regular basic education up to university; because it is accessible software, in addition to promoting learning in mathematics, it also helps improve critical thinking skills, creating flexible environments, seeking cooperation, and engaging students toward more significant knowledge. The teacher's useful tools such as virtual classrooms, interactive whiteboards, and other digital resources are favorable at present, these lead to an improvement in teaching practice and efficiency when interacting with digital media and the learner.

According to Sümmermann *et al.* (2021), mathematical simulation acts as a framework in creating tests, it indicates the ability to express mathematics in a particular way where the user can interact by making simulations in a meaningful way. Technological interactions and the use of educational software are important because simulations react according to mathematical laws, they can make assumptions and discussions about the behavior of the simulation. Furthermore, this central property of simulation allows it not only to duplicate known results, but also to discover new ones. This is because the foundation of the underlying mathematical rules allows the reader to go beyond the utopia and intention of the simulation designer to achieve the learnings and applications, so that they can do simulation and understand the formation of images through the GeoGebra.

On the other hand, regarding the use of existing educational technological resources specifically on the use of GeoGebra, it is impossible to say that the software is inefficient, but it all depends on the form of its application in each learning session according to the post-Covid-19 context and planning Martin (2021); even more so when the application is made for highly competitive sports, it is appropriate because you can make traces in the field or set goals, which the program can help verify when calculating the areas traveled or the distances reached.

Learning must deploy virtual skills, make adequate planning, use Geogebra software and train athletes. It is important to emphasize digital competencies as a way to seek to change the role of students in the teaching-learning sequence, directing activities as sports coaches. Several teacher training measures come together, trying to find the combination of pedagogical needs, formulating training standards with respect to the skills and knowledge that students should have Morales (2021).

The application of ICTs in Physical Education students shows with greater emphasis on bridging this digital gap, where knowledge transcends throughout the universe, developing industry, medicine, sports, business, engineering and the educational field, promoting creativity, reflection and criticism of the investigator; this is how the GeoGebra program is applied and improves the levels of mathematical learning in high school students of Guayaquil Galarza (2021).

Such software is also applied in students' mathematics learning at school and the ability to interact with learning media using the Visual Basic application in Excel being a great creative thinking process Rohaeti *et al.* (2019).; Moreira, (2020); Rullis *et al.* (2021); also applied in math card games help students learn math formulas better.

That is, technology is a tool in this model to allow teachers to work globally with less effort, and obtaining better results through educational innovation Rivas-Natareno *et al.* (2021); then, virtual inclusive teaching is preferably shown as a force that favors equal opportunities for marginalized and discriminated people García *et al.* (2018); furthermore, the objective of affordable e-learning is to provide all students with full and independent

access to the learning environment, improving their quality of life, according to Crisol *et al.* (2020).

The application of the GeoGebra educational software has a positive effect on the geometric applications developed by Physical Education students, this shows a difference in results that were obtained during the research phases, it demonstrates the impact on the application of the GeoGebra software during the acquisition of knowledge regarding the geometric resolution of the application and study of linear functions or functions that have a direct relationship during sports training. It concluded given the interaction of the students and the use of GeoGebra as a great utility to improve their learning and subsequent performance, they also demonstrated skills and fluency to solve situations on linear programming, they mathematically simulate real-life situations by optimizing the achievement of goals by minimizing progressive efforts. Teaching GeoGebra software in a practical way restores students' overall geometric knowledge and reasoning. Chile and Oruro (2019), in the present study emphasis is placed on Physical Education students in particular.

CONCLUSIONS

A prototype of 29 articles was studied in the last five years regarding the use of educational software for learning mathematics. As an essential effect, a lack of the application of GeoGebra educational software to improve student learning was evident in some cases, reducing accessible training proposals that seek inclusive virtual education. It is concluded: Learning is more significant and comprehensive in Physical Education students, when the GeoGebra educational software is applied in learning experiences.

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***Authors' contribution*:**

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