

PAPER • OPEN ACCESS

## Attitudes towards physics. A study with high school students from the Colombian context

To cite this article: C A Hernández-Suarez *et al* 2021 *J. Phys.: Conf. Ser.* **2118** 012019

View the [article online](#) for updates and enhancements.

### You may also like

- [Farmers' attitude to standard production method based on Temanggung robusta coffee's geographical indication](#)  
Hanifah Ihsaniyati, Nuning Setyowati and Aditya Phitara Sanjaya
- [High-rate multi-GNSS attitude determination: experiments, comparisons with inertial measurement units and applications of GNSS rotational seismology to the 2011 Tohoku Mw9.0 earthquake](#)  
Peiliang Xu, Yuanming Shu, Xiaoji Niu et al.
- [Spatial priorities for biodiversity and ecosystem services considering theoretical decision-makers' attitudes to risk](#)  
Lijuan Wang, Hua Zheng, Stephen Polasky et al.



The Electrochemical Society  
Advancing solid state & electrochemical science & technology

243rd ECS Meeting with SOFC-XVIII

Boston, MA • May 28 – June 2, 2023

**Abstract Submission Extended  
Deadline: December 16**

[Learn more and submit!](#)

# Attitudes towards physics. A study with high school students from the Colombian context

C A Hernández-Suarez<sup>1</sup>, A A Gamboa-Suárez<sup>1</sup>, and O J Suarez<sup>2</sup>

<sup>1</sup> Facultad de Educación, Artes y Humanidades, Universidad Francisco de Paula Santander, San José de Cúcuta, Colombia

<sup>2</sup> Facultad de Ingeniería, Universidad Autónoma de Colombia, Bogotá, Colombia

E-mail: cesaraugusto@ufps.edu.co

**Abstract.** Science education should promote the development of competent students in science and develop their interest in science; however, although the role and relevance of science within society is evident; the interest towards it is not conscious, being the negative attitudes of the students the main problem in the teaching of physics, which translates into a deficient knowledge and lack of scientific vocation. This report aims to diagnose the attitudes of students in high school physics courses. The study was developed through a non-experimental, descriptive research design, obtained from the application of a Likert scale that evaluates attitudes towards physics, adapted and validated to the context of students in an educational institution in Colombia. The results indicate that the attitudes of the students are slightly favorable, which is an empirical precedent to continue with the studies on attitudes towards physics. This should be considered to enhance the learning processes in these students, especially for those who have their first approach to physical concepts and give importance to attitudes when teaching.

## 1. Introduction

Science is one of the decisive areas for the development of society, which requires people to develop knowledge, skills and attitudes that enable them to solve real problems. However, although its role and relevance are evident, interest in science is not yet widespread in sectors outside the scientific and research spheres. This phenomenon extends to the educational context, especially at the elementary and middle school levels. Several studies have detected that the lack of interest and negative attitudes of students towards science is a problem in science education today, which translates into deficient knowledge of science [1] and a lack of scientific vocation among students in science, technology, engineering, and mathematics (STEM) programs, which are necessary for these disciplines to maintain their activity in progress.

Students' interest in studying science programs has declined in recent years [2]. The factors are diverse, but some studies suggest that students' attitudes towards science may be an important reason [3]. The Programme for International Student Assessment (PISA) has confirmed the deficiency of science education, especially in basic education, and one of its causes is that its affective component has been ignored [4-7]; therefore, it is necessary to promote positive attitudes towards science and science learning [8].

It has been shown that attitudes towards science impact and are impacted by educational experiences, with traditional teaching having the most negative impact on attitudes towards physics [9,10]. The educational value and importance of science, especially physics, in educational processes is the essence



and central reason for its incorporation into academic programs. The formation and development of students' scientific attitudes is fundamental; because, faced with certain apparently complex contents, students begin to show an unfavorable attitude, as they feel incapable of overcoming the challenges inherent to the academic demands of physics. The development of the cognitive, affective, and behavioral components as pedagogical dimensions of attitudes towards physics in students leads to a better attitude to overcome their own deficiencies in learning and to obtain better achievements during their education.

This study is important because it will provide information about students' attitudes, which will allow teachers to guide the physics subject so that they have a greater impact on educational practice. It is relevant because secondary education is strategic within the education system as it is responsible for guaranteeing the appropriate transition to higher education [11]. Given the need to promote better attitudes towards physics in high school students, the question arises: What are the attitudes that students show towards science at high school levels? From this question it follows that the objective of the study was to diagnose the attitudes of high school students towards physics.

## 2. Attitudes towards science

A person's attitude is important in determining their interest, attention, and reaction to related subjects, for example, in the case of students towards science. In the case of Colombia, the science standards aim for students to develop the scientific skills and attitudes required to explore phenomena and to solve problems [12]. One of the difficulties in the study of attitudes is the lack of clarity in the definition of the object of attitude, which leads to inadequate interpretations of the results of research on the subject [13]. It is necessary to differentiate attitudes towards science, its teaching, learning, the teacher, the classroom environment, the didactic strategy, the contents, among others, so it is convenient to make some clarifications in this regard.

In this study, the definition of attitudes towards science was chosen as the dispositions, tendencies, or inclinations to respond to all the elements (actions, people, situations, or ideas) involved in learning science. This definition includes elements such as liking science classes, preference for science careers, science as an institution and specific science topics [4]. The dispositions or tendencies referred to in the definition can be operationally assessed through the cognitive, affective, and behavioral components towards a previously delimited attitudinal object. Attitude measurement instruments are designed, with Likert-scale items, but difficulties have been encountered at the conceptual (validity) and methodological (reliability) levels, due to the definition of the different science-related attitudinal objects that can be measured, so it is necessary to choose instruments backed by rigorous research [14].

## 3. Materials and method

At a general level, it is a descriptive quantitative study; the research subjects were students who study physics in grades 10 and 11 of secondary education who were characterized by attitudes towards physics class by means of a questionnaire that used a Likert scale.

### 3.1. Level and type of study

The study is a descriptive quantitative study, which aims to diagnose the attitudes towards physics of a group of secondary school students. Frequency is characterized by the grouping of responses.

### 3.2. Sample

The sample consisted of 83 students taking the physics course in secondary education (grades 10 and 11) in an educational institution located in the department of Norte de Santander, Colombia, where 43 males participated voluntarily with an average age of  $18.9 \pm 4.71$  years and 40 females with an average age of  $20.2 \pm 4.21$  (mean  $\pm$  SD). The selection of the groups was done using purposive sampling, because the target groups are formed through entry mechanisms outside the control of the teaching staff; by grade the distribution corresponds to 50 (60.2%) students for grade 10 and 33 (39.8%) students for grade 11.

### 3.3. Instrument

The questionnaire used is an adaptation of the Likert-type tests assessing attitudes towards physics class [15] and towards chemistry and physics class [16] with the same 8 dimensions, each with 10 statements, for a total of 80 items with answers ranging from strongly disagree (1) to strongly agree (5); the dimensions are described in Table 1, which is taken from Muñoz and collaborators [17]. For the adaptation to the context, a pilot test was carried out in which Cronbach's alpha for the dimensions fluctuates between 0.79 and 0.85, which gives it an internal consistency, since, for instruments of this type, an approximate value above 0.70 is accepted.

**Table 1.** Dimensions and definition of the Likert scale for assessing students' attitudes towards physics.

Dimension	Definition
Group work	Activities that students carry out as a group to obtain a product
Individual work and homework	Activity to be carried out by the student in a personal, autonomous, and individual way for the development of their learning in physics class
Practical laboratory work	Practical work as any laboratory/experimental activity carried out in all science classes
Interests for your future	Personal linkage of the subject regarding the valuation he/she presents towards science to be considered in future life projects
Teacher's influence about physics	The teacher is understood to be a stimulating factor towards attitudes; therefore, it deals with the teacher-student (individual) linkage and their relationship in terms of classroom didactics and content
Difficulty in learning physics	The content and perceived difficulty of the student's effort to achieve in the subject is covered
Relationship between everyday life and the physics course	The aim is to find the relationship that the student has with the subject based on the link between the subject and the natural/observable world and the contents of the subject
Social importance, importance of science and scientists	It is understood that attitudes are fostered by a positive perception of scientists and science

### 3.4. Procedure

Authorization was requested from the directors of the educational institution to obtain the information, and once obtained, the instrument was placed in digital format on the educational institution's platform during the timetable assigned to each group; both teachers and students were informed of the purpose of the study and expressed their willingness to participate. With the help of the teachers in charge of each of the groups, the students responded voluntarily during the assigned dates, which correspond to the first semester of 2021. Only those students who completed the questionnaire were considered.

### 3.5. Data processing

The arithmetic mean per item and the overall score per test dimension were calculated using the Microsoft Excel spreadsheet. For the interpretation of the numerical scale, it follows the methodological guidelines of the Likert scales [18], which means that scores below 3.0 indicate an unfavorable attitude and, for scores above 3.0, a favorable attitude to physics will be considered as a favorable attitude to physics.

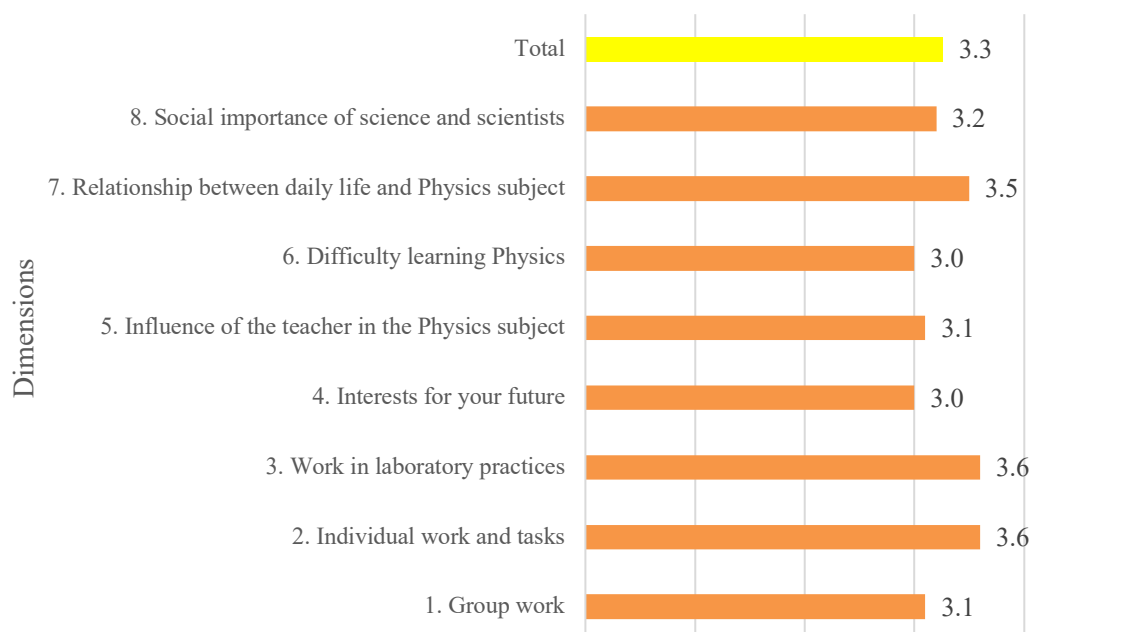
## 4. Results

Next, the results obtained from the application of the test of attitudes towards physics class and its respective dimensions to high school students are presented.

### 4.1. Attitudes towards physics among secondary school students

The overall results of the attitudes expressed by secondary school students and the descriptive comparisons by grade for the dimensions of the instrument are shown in Figure 1; from Figure 1,

students show a favorable attitude towards physics (3.3), especially quite favorable attitudes towards individual work and homework (3.6), work in laboratory practice (3.6) and the relationship between everyday life and the subject of physics (3.5), and less favorable attitudes towards the difficulty of learning physics and interests for the future (3.0).



**Figure 1.** Overall average of scores per dimension of the instrument.

#### 4.2. Attitudes towards physics in students by grade level

In the following, we will explore students' attitudes towards physics by grade and identify possible differences between them. This comparison is made because the aim is to show how attitudes evolve from one grade to the next at the secondary school level; considering the information in Table 2, there is no difference between the average score of grades 10 and 11.

**Table 2.** Overall comparison of means between 10th and 11th grades.

Grade	Arithmetic mean
10	3.2
11	3.2

Considering the values presented in Table 3, it can be indicated that there are no differences for the dimensions: interests for their future, relationship between everyday life and the physics course, and social importance of science and scientists, which indicates that there are no differences for these dimensions between grades 10 and 11; however, in the dimensions: group work, individual work and tasks, work in laboratory practices, teacher influence on the physics course, and difficulty in learning physics, differences are observed. From the previous result, the difference between students in grades 10 and 11 for the dimension difficulty in learning physics stands out, since students in grade 11 show a favorable predisposition, while the attitude of students in grade 10 is below the favorable one.

High school students show a slightly favorable predisposition towards Physics class, with a value higher than 3, which is corroborated in various studies [19-22], but which contrasts with a study that agrees that the predispositions that students manifest towards physics are negative, especially in those with low academic performance [23]. The favorable predisposition of the students in this study indicates that there is a basis on which to enhance students' general interest in physics, which could be achieved with innovative strategies such as active learning [24].

This study constitutes an empirical background for further research on attitudes towards physics in students, other levels, and grades, as well as their relationship with other variables such as motivation [20], academic performance [23], gains in learning physical concepts [25].

**Table 3.** Comparison between 10th and 11th grade by dimension.

Dimension	Grade			
	10		11	
	Average	Sd	Average	Sd
Group work	3.2	0.77	3.0	0.66
Individual work and homework	3.6	0.71	3.5	0.69
Practical laboratory work	3.6	0.65	3.7	0.67
Interests for your future	3.0	0.82	3.0	0.84
Teacher's influence on the physics course	3.1	0.51	3.2	0.53
Difficulty in learning physics	2.8	0.87	3.1	0.78
Relationship between everyday life and the physics course	3.5	0.70	3.5	0.69
Social importance, importance of science and scientists	3.2	0.53	3.2	0.49

## 5. Conclusions

Studies of attitudes towards learning physics are relevant, as it is considered a difficult subject for students to learn. The results of this study suggest that secondary school students have a slightly favorable attitude towards physics. As for the comparison between the attitudes of Grade 10 and 11 students, no differences were found overall. There are only differences in the dimension of difficulty in learning physics, where an unfavorable attitude was observed in Grade 10 students, possibly due to the degree of satisfaction experienced by these students as it is their first approach to the subject of physics. This should be considered to enhance the learning processes in these students, especially for those who have their first approach to physical concepts and to give importance to attitudes when teaching. Finally, future studies on attitudes towards physics should include other variables such as academic performance, motivation, innovative strategies, the teacher, and preconceptions of physics, among others. In addition, it could be extended to university students of basic sciences and engineering, or in other types of populations, these being fields of study for future research.

## References

- [1] Matus M 2013 Actitud hacia la ciencia en estudiantes de una universidad estatal de Valparaíso *Revista de Psicología* **2(4)** 57
- [2] Organización para la Cooperación y el Desarrollo Económico 2008 *Informe PISA 2006. Competencias Científicas para el Mundo del Mañana* (Madrid: Santillana)
- [3] Organización para la Cooperación y el Desarrollo Económico 2006 *Evaluación de la Competencia Científica, Lectora y Matemática: Un Marco Teórico para PISA 2006* (Madrid: INECSE/MEC)
- [4] García-Ruiz M, Sánchez B 2006 Las actitudes relacionadas con las ciencias naturales y sus repercusiones en la práctica docente de profesores de primaria *Perfiles Educativos* **28(114)** 61
- [5] Garriz A 2009 La afectividad en la enseñanza de la ciencia *Educación Química* **20(Supl. 1)** 212
- [6] Ojeda E, Delgado C, Ascanio A, Pérez M E 2011 Emociones: su impacto en la modificación de concepciones de docentes en formación en educación integral del Instituto Pedagógico de Caracas *Revista de Investigación* **35(74)** 139
- [7] Cervantes R D, Reséndiz E, Correa S 2019 Análisis de los componentes actitudinales hacia la ciencia en maestros participantes en el programa de enseñanza de la ciencia *Innovación en Enfoques de Contextos Escolarizados* ed Reséndiz E, Cappello H M, García H M (Ciudad de México: Colofón)
- [8] Ruiz F J 2007 Modelos didácticos para la enseñanza de las ciencias naturales *Revista Latinoamericana de Estudios Educativos* **3(2)** 41
- [9] Solbes J, Montserrat R, Furió C 2007 Desinterés del alumnado hacia el aprendizaje de la ciencia: implicaciones en su enseñanza *Didáctica de las Ciencias Experimentales y Sociales* **(21)** 91
- [10] Torres M 2010 La enseñanza tradicional de las ciencias versus las nuevas tendencias educativas *Revista Electrónica Educare* **14(1)** 131

- [11] Jurado F 2019 Retos para la transición entre la educación media, la educación posmedia y la educación superior *Ruta Maestra* **27** 136
- [12] Ministerio de Educación Nacional 2004 *Estándares Básicos de Competencias en Ciencias Naturales y Ciencias Sociales* (Bogotá: Ministerio de Educación Nacional)
- [13] Parra H, Santos R 2014 *Actitud de los Estudiantes Hacia el Aprendizaje de la Física en el Tercer Año de Educación Media General. Caso: Unidad Educativa Casa Don Bosco del Municipio Naguanagua. Año Escolar 2013-2014* (Naguanagua: Universidad de Carabobo)
- [14] Tecpan S, Zavala G 2015 Actitudes de profesores de Física de secundaria sobre ciencia, tecnología y sociedad *Lat. Am. J. Phys. Educ.* **9(1)** S1202:1
- [15] Gómez A G 2011 *Las Actitudes Hacia la Clase de Física del Estudiantado de Secundaria; un Estudio Exploratorio Descriptivo en Instituciones Educativas de Santiago y Concepción* (Concepción: Universidad de Concepción)
- [16] Boixaderas N, De la Vila J, Sanmartí N 1990 *Test de Actitudes Relacionadas con la Asignatura de Física y Química* (Barcelona: Universidad Autónoma de Barcelona)
- [17] Muñoz D, Quintanilla M R, Manzanilla M A 2019 Construcción y validación preliminar de un instrumento de evaluación de actitudes hacia la clase de química para estudiantes de educación secundaria *Educación Química* **30(1)** 121
- [18] Hernández R, Fernández, C Baptista M P 2010 *Metodología de la Investigación* (México; Mc Graw Hill)
- [19] Pinto F 2015 Un estudio de las actitudes hacia la física de los estudiantes cursantes del quinto año de educación media general mención ciencias de los liceos públicos y privados municipio Naguanagua *ARJÉ Revista de Postgrado FACE-UC* **9(16)** 103
- [20] Arandía E, Zuza K, Guisasaola J 2016 Actitudes y motivaciones de los estudiantes de ciencias en Bachillerato y Universidad hacia el aprendizaje de la Física *Revista Eureka Sobre Enseñanza y Divulgación de las Ciencias* **13(3)** 558
- [21] Guevara J C 2018 Actitudes de los estudiantes universitarios hacia el aprendizaje de la física *Anales Científicos* **79(1)** 1
- [22] Torres N, Bolívar A, Solbes J, Parada M 2018 Percepciones de estudiantes universitarios sobre su formación en física en educación secundaria *Revista U.D.C.A Actualidad & Divulgación Científica* **21(2)** 599
- [23] Zeballos R M A 2019 *Estudio de las Actitudes Hacia la Física y su Relación con el Rendimiento Académico de los Estudiantes de las Escuelas Profesionales de Ingenierías, Física y Facultad de Educación de la UNSA, 2017* (Arequipa: Universidad Nacional de San Agustín)
- [24] Prada R, Hernández C A, Gamboa A A 2021 Active learning, and knowledge in physics: a reading from classroom work *Journal of Physics: Conference Series* **1981(1)** 012007:1
- [25] Santana J L 2018 Ganancia en el aprendizaje del concepto de fuerza y cambio en las actitudes hacia la física en estudiantes de la escuela preparatoria de Tonalá *Ciencia UAT* **13(1)** 65