

## STUDY OF THE LINK BETWEEN PORTUGUESE STUDENTS' ATTITUDES AND PERCEPTIONS ABOUT PHYSICS IN THE CONTEXT OF THE DIGITAL AGE, 21ST CENTURY

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**Abstract:** In the 21st century, we find ourselves immersed in a global social system characterized by complexity, unpredictability and interdependence. This reality presents a series of challenges that must be faced by countries, institutions, organizations and individuals in general. Technological advances are constantly emerging, and being prepared to compete in the digital age requires fluency in the language in which these advances operate. It is the responsibility of the education system to equip individuals with adequate skills to meet these ever-evolving challenges. Curriculum proposals in the area of Physics for basic, secondary and university education must highlight the need to adapt these to the constant need to train citizens capable of keeping up with technological evolution and able to integrate the labor market. It is thought that the “motto” of promoting science in the area of physics is taught using simple language, using the observation of experiments and physical phenomena, combined with everyday examples, so that students have a better perception and understanding of the usefulness and application of this area of knowledge.

In this work, the process of collecting information was carried out using a questionnaire survey, applied to a sample of the Portuguese population (mainland and islands), which took place between March and May 2022. These allow for greater ease in the processing of data, but collect less detailed information. The purpose of this survey is to evaluate, in general, two dimensions related to the study of the scientific area Physics, namely; “students’ attitude towards Physics” and “students’ perceptions of Physics teaching and learning”.

To test the reliability of the survey, Cronbach’s alpha coefficient was used. The coefficient was applied to 4 questions of each of the two dimensions mentioned above. The results

obtained reflect that in the same questionnaire the reliabilities of the dimensions can differ. In order to establish some conclusions about all the items of the questionnaire, statistical techniques were used. In this survey, the population of respondents comprises 145 students, most of whom live in the Autonomous Region of the Azores.

**Keywords:** attitude, perception, teaching, learning, Physics, Portugal.

## INTRODUCTION

In recent decades, there has been an increase in the use of physical methods to study different phenomena [1]. This development was due to physicists who ventured outside their traditional domains of interest, but also due to scientists from other disciplines who throughout the 19th and 20th centuries showed that they can be successful with the use of physical concepts.

According to [2], the skills that students need in the scientific area of Physics are critical thinking, problem solving, innovation, dimensions associated with academic performance and teaching and learning processes. The report [3] suggests that teachers; i) make the contents to work relevant to the students; ii) “bring” the outside world into the classroom; iii) take students out of the classroom; iv) create opportunities for students to interact with each other, with other teachers and adults in meaningful learning experiences. According to the PORDATA data source [4], in Portugal, the resident population aged 15 and over, using the 2021 Census, it appears that the highest level of complete schooling is:

- No schooling – 5.9%
- 1st Cycle of Basic Education – 22.3%
- 2nd Cycle of Basic Education – 9.6%
- 3rd Cycle of Basic Education – 17.8%

- Secondary Education – 23.5%
- High School – 1.2%
- Higher Education – 19.8%

According to [5], a questionnaire was elaborated which consisted of putting a series of questions to a group of 145 students in order to identify attitudes towards Physics and perceptions about the teaching and learning of Physics. After elaborating the questions, the questionnaire was created. using the Google Forms platform, which is available online, using social networks.

The results of the questionnaires applied to the students, which seek to measure and identify their attitudes and perceptions, could be important indicators of how the curriculum and methodologies adopted by Portuguese teachers may or may not be adjusted taking into consideration, the opinion, the suggestion, in short, the “student voice”.

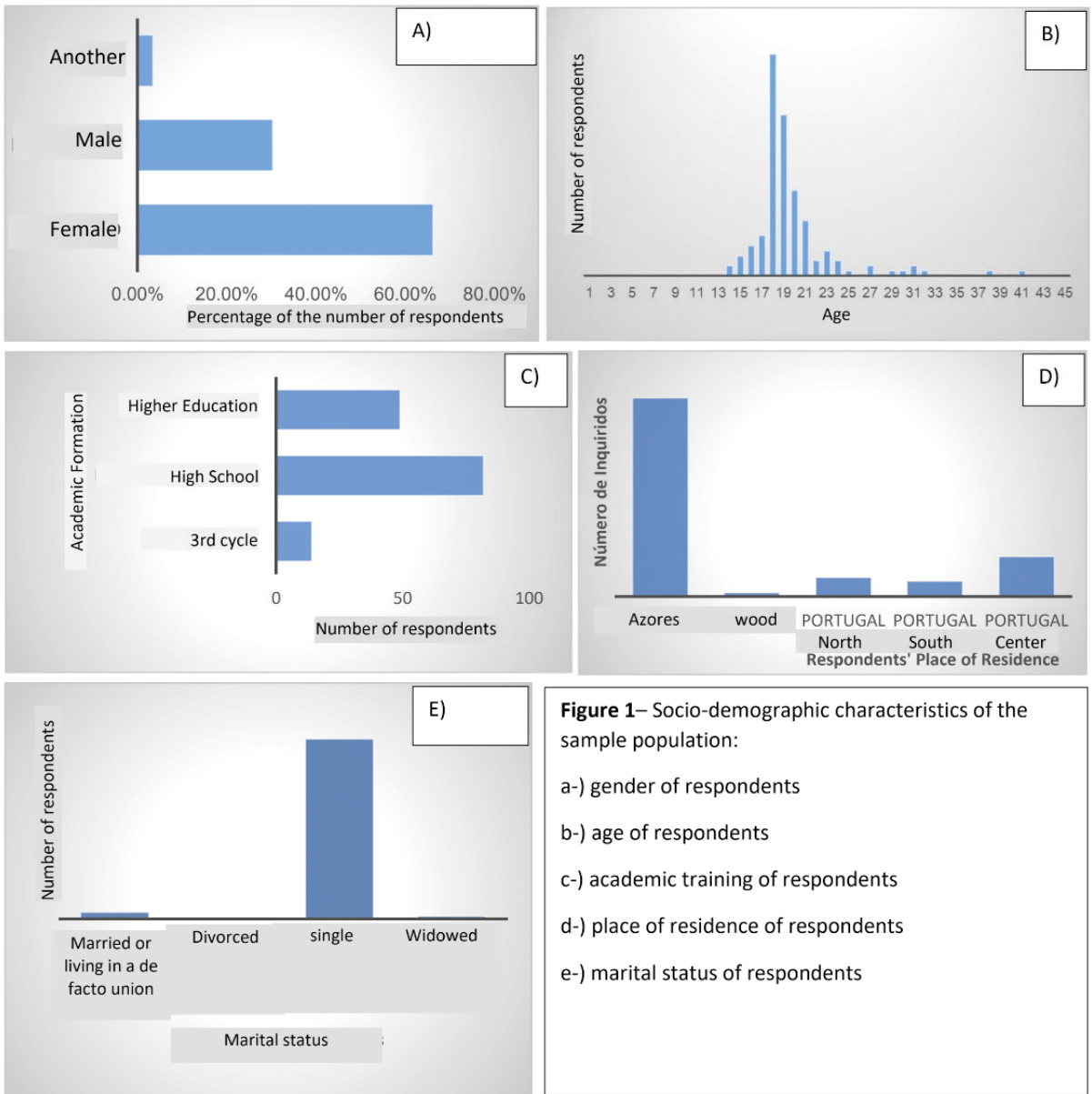
## **RESEARCH METHODOLOGY AND SOCIO-DEMOGRAPHIC CHARACTERIZATION**

Among the data collection methods for analysis, one deserves special attention: the one in which information is collected through questionnaires posted on social networks. Undoubtedly, it is an attractive method, which leads to reliable results, in addition to using procedures that reduce costs. Thus, this questionnaire on “Portuguese Students’ Attitudes and Perceptions in Relation to Physics” was answered by 145 people. The initial objective was to understand the socio-demographic characteristics of the sample population. 65.7% of respondents are female. The most representative age group, in terms of age, was 18 to 20 years old. For ages under 18, only 13.1% of the sample population responded. Respondents over the age of 25 account for 13.8% of the students who answered the questionnaire. As for the level of

training of respondents, it must be noted that 34.3% of the sample of this population attend higher education. While, 57.4% are secondary school students. Continuing with the analysis of the data collected, it appears that 66.9% of respondents reside in the Azores, with 94.5% of the sample of respondents affected by single marital status. Figure 1 shows the socio-demographic characteristics of the sample population.

Considering the definition of attitude in Social Psychology, this can be understood as an acquired and relatively stable tendency or predisposition to act, think or feel in a certain way (positive or negative) towards an object, person, situation, social group, institution, concept or value. And, perception that according to [6], is a process that occurs in the brain and has many stages, involving selection, processing, organization and integration of the information received by the senses, the two dimensions of the questionnaire were elaborated, with 13 items for the dimension – “Students’ Attitude towards the Subject of Physics” and 10 items for the dimension – “Students’ Perceptions about Teaching and Learning the Subject of Physics”, Table 1.

Cronbach’s alpha coefficient is widely used in research in many fields, including psychology, education, health, and business. It is commonly used to assess the quality of questionnaires and measurement scales before they are used in surveys. Furthermore, it is a useful tool to identify weak items in a scale and thus improve the scale’s validity. The calculation of Cronbach’s alpha coefficient is based on the principle that the more highly correlated the items of a scale, the greater the scale’s internal consistency. [8] states that this coefficient varies from 0 to 1, where a value close to 1 indicates a high internal consistency and a value close to 0 indicates a weak internal consistency. In summary, Cronbach’s alpha coefficient is an important



dimensions



*1. The Students' Attitude towards the Discipline of Physics*

Items:

- 1.1. Is knowledge of Physics useful to you?
- 1.2. On a scale of 0 to 10, with 0 being not at all related and 10 being extremely related, how do you consider most topics in the Physics course related to your life?

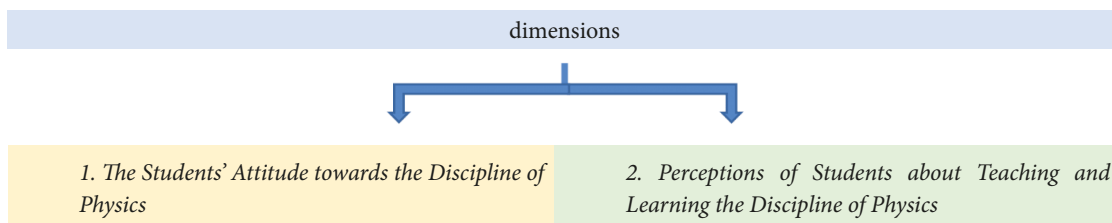
*2. Perceptions of Students about Teaching and Learning the Discipline of Physics*

Items:

- 2.1. Have you had the opportunity to carry out experiments in the laboratory to prove physical concepts?
- 2.2. If you answered the previous question many times, do you think that the practical activities carried out at school helped you to understand Physics concepts more effectively?

- 1.3. Regarding the following statement – “The knowledge acquired from the study of Physics can be used in daily life”, your opinion is: Totally Agree, Agree, Neutral, Disagree and Totally Disagree.
- 1.4. Do you think Physics can improve a person’s life?
- 1.5. Do you think Physics is important for national development?
- 1.6. On a scale of 0 to 10, with 0 not at all likely and 10 extremely likely, how would you rate the probability that the Physics subject will be studied with enthusiasm by all students?
- 1.7. Do you like to keep up with the latest developments in science and technology?
- 1.8. Do you like to learn physical concepts?
- 1.9. Do you love doing physics experiments in the laboratory?
- 1.10. Do you think the Physics course consists of activities or projects that teach students to think critically and creatively?
- 1.11. Regarding the following statement – “The Physics subject consists of activities or projects that encourage students to explore and investigate”, your opinion is: Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree.
- 1.12. On a scale of 0 to 10, with 0 not at all likely and 10 extremely likely, how would you rate the probability that the Physics course will help prepare students to face the challenges of technology in the 21st century?
- 1.13. On a scale of 0 to 10, with 0 being not at all interesting and 10 being extremely interesting, how would you rate the study of Physics?
- 2.3. Do you consider that your professors provide information and advice about careers and opportunities in Physics?
- 2.4. Does your Physics teacher usually use a creative and innovative approach in teaching this subject?
- 2.5. Does your Physics teacher encourage students to research Physics information on the Internet?
- 2.6. Do your Physics teachers usually share Science or Physics articles with the students in the class?
- 2.7. Your Physics teacher has a habit of encouraging you to use the knowledge
  - physical resources to produce some product or idea that can be economically profitable.
- 2.8. Do your Physics teachers conduct Study Tours to places that are associated with the use of scientific technology?
- 2.9. Regarding the following statement – “My Physics teachers have always given me the opportunity to think and give opinions on the concepts covered in the classroom.”, your opinion is: Totally Agree, Agree, Neutral, Disagree and I totally disagree
- 2.10. Regarding the following statement – “My Physics teachers usually encourage me to participate in competitions about innovation in science.”, your opinion is: Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree

**Table 1**– Dimensions and items used in the questionnaire. Adapted from [7]



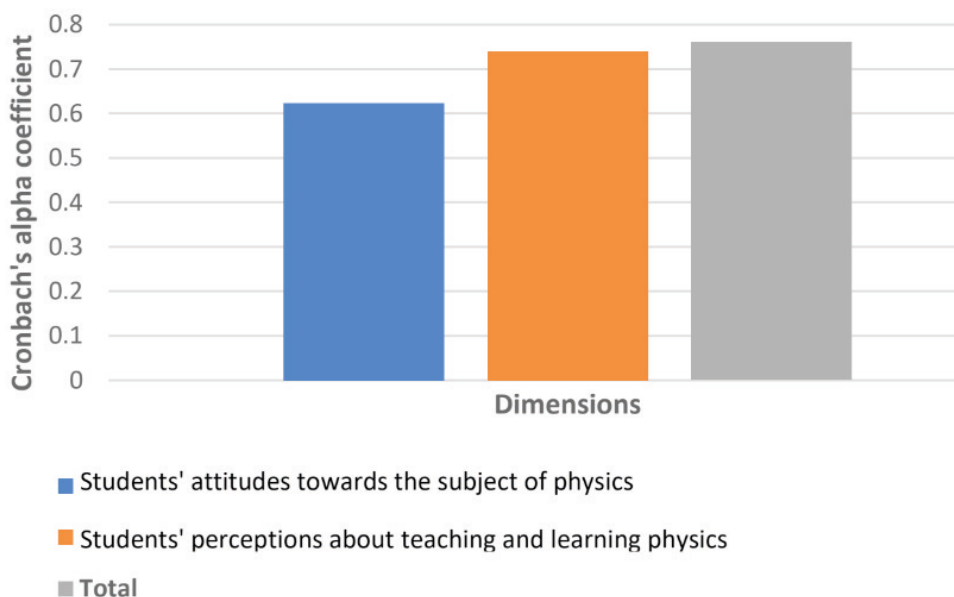
Items:

- 1.7. Do you like to keep up with the latest developments in science and technology?
- 1.8. Do you like to learn physical concepts?
- 1.9. Do you love doing physics experiments in the laboratory?
- 1.10. Do you think the Physics course consists of activities or projects that teach students to think critically and creatively?

Items:

- 2.3. Do you consider that your professors provide information and advice about careers and opportunities in Physics?
- 2.4. Does your Physics teacher usually use a creative and innovative approach in teaching this subject?
- 2.7. Your Physics teacher has the habit of encouraging you to use your physics knowledge to produce some product or idea that can be economically profitable.
- 2.8. Do your Physics teachers conduct Study Tours to places that are associated with the use of scientific technology?

**Table 2**– items from the two dimensions selected for the calculation of Cronbach's alpha coefficient.



**Figure 2**– Cronbach's alpha coefficient for each dimension and total dimension.



measure of reliability in psychometry and is widely used to assess the internal consistency of questionnaires and measurement scales. It is a valuable tool for ensuring the quality and validity of research in many fields.

As a decision method to assess the internal consistency of the various items related to the two dimensions of this study, we calculated Cronbach's alpha coefficient. According to [9], the reliability limits of Cronbach's alpha coefficient are the following:

- $\alpha \leq 0.30$  - Very low
- $0.30 < \alpha \leq 0.60$  - Low
- $0.60 < \alpha \leq 0.75$  - Moderate
- $0.75 < \alpha \leq 0.90$  - High
- $\alpha > 0.90$  - Very high

Based on the presented scale, after calculating this coefficient, one can decide to add some more item to the questionnaire, or remove some item, with the objective of increasing the value of the coefficient and, consequently, the reliability of the questionnaire.

In the present study, Cronbach's alpha coefficient was calculated between four items of each of the two dimensions, Table 2.

## DISCUSSION OF THE RESULTS

We are going to start observing the answers considering dimension 1 – “Students’ Attitude towards Physics”. Analyzing the answers given by the 145 Portuguese students, it appears that, in relation to the question – “Is knowledge of Physics useful to you?”, 53.8% of respondents answered yes. 25.5% answered maybe and 20.7% do not consider the knowledge of Physics useful for the students themselves. When the respondents were confronted with the question – “The knowledge acquired from the study of Physics can be used in daily life”, 64.4% of the students answered I agree or totally agree. Of these, 44.7% responded that Physics

is important for national development. When analyzing the answers of the respondents to the question – “How do you assess the probability of the subject of Physics being studied with enthusiasm by all students?”, we found that 11.03% consider the study of Physics exciting, and 74.5% reflect a moderate enthusiasm for the study of the referred scientific area. Referencing the question – “Do you like to follow the latest developments in science and technology?”, we found that 89.6% follow scientific and technological developments. Of this percentage of students, 98% answered yes to the question – “Do you like to learn physical concepts?”. The experimental component of the Physics scientific area is considered important. To the question - “Do you love doing Physics experiments in the laboratory?”, 67.6% answered affirmatively. Pondering the answers given by respondents to the question – “Do you think that the Physics discipline consists of activities or projects that teach students to think critically and creatively?”, we obtained 52.4% of positive answers and 30.3% of undecided answers. When students are asked about – “The Physics discipline consists of activities or projects that encourage students to explore and investigate”, 63.4% agree with the statement and 20.7% of respondents do not have an opinion on this subject. The question - “How do you assess the likelihood that the Physics course will help prepare students to face the challenges of technology in the 21st century”, the answers reflect a moderate probability, shared by 60% of the students. When the students were asked about the question – “How do you consider the study of Physics?”, 10.3% consider the study of Physics very interesting, 42% consider it interesting and 47.6% consider it not very interesting.

Next, we will present the results obtained by the respondents’ responses to dimension 2 – “Students’ Perceptions on Teaching and

Learning the Discipline of Physics”. Analyzing the students’ responses to the question – “Have you had the opportunity to carry out experiments in the laboratory to prove physical concepts?”, 60% said it a few times, 20% said it never and 20% said it many times. Regarding the question – “If you answered the previous question many times, do you think that the practical activities carried out at school helped you to understand the Physical concepts more effectively?”, 89.6% answered yes. When asked about the question – “Do you consider that your professors provide information and advice about careers and opportunities in the field of Physics?”, we obtained 49.6% of positive statements. Regarding the question – “Does your Physics teacher usually use a creative and innovative approach in teaching this discipline?”, 50.3% agree with the approach adopted by their Physics teacher. Of the answers to the question – “Does your Physics teacher encourage students to search for Physics information on the Internet?”, only 17.9% of the students answered that they receive this incentive frequently and 9.6% of the students refer that, their Physics teachers disseminate Science or Physics articles in the classroom with some frequency. On the question – “Your Physics teacher has the habit of encouraging you to use your physical knowledge to produce some product or idea that may be economically profitable”, 33.1% say they receive this type of incentive. “My Physics teachers always gave me the opportunity to think and give opinions on the concepts covered in the classroom.”, 33.1% agree with this statement. When analyzing the students’ responses to the question – “My Physics teachers usually encourage me to participate in competitions about innovation in science”, 22.7% agree with the aforementioned statement.

Figure 2 shows the results of calculating Cronbach’s alpha coefficient. For dimension

1 – “Students’ Attitude towards the Discipline of Physics”, we obtained the

value 0.623, considering items 1.7 to 1.10 of the questionnaire. While, for dimension 2 – “Students’ Perceptions about Teaching and Learning the Discipline of Physics”, a value of 0.74 was found for the coefficient mentioned above for items 2.3, 2.4, 2.7 and 2.8. Both dimensions correspond to moderate reliability.

## CONCLUSION

Students’ attitudes and perceptions of teaching and learning at school are important concerns in determining the effectiveness of these processes. It is crucial to know if the content of the scientific area Physics is being understood by the students. Hence the realization of this study to investigate the relationship between skills in the 21st century and students’ attitudes and perceptions in relation to Physics.

From the analysis of the responses to the questionnaire, it appears that a large percentage of Portuguese students reveal a moderate enthusiasm for the study of Physics, and that they even follow the information released about scientific and technological developments. They consider laboratory classes to be important, however, access to the laboratory is reported to happen rarely. It has been recognized by them that laboratory classes help to understand physical concepts effectively. A moderate percentage of respondents have the notion that the field of Physics helps students to think critically and creatively. A small percentage of students reported having received encouragement from their teachers to participate in competitions about innovating in science. A moderate number of students have a perception that Physics will help them to be prepared for technological challenges throughout the 21st century. They reveal little knowledge about



professional opportunities in this area of science.

Based on the analysis carried out through the answers to the questionnaire, the students' attitudes towards Physics are of a moderate level, as well as the students' perceptions about the teaching and learning of Physics.

The calculation of Cronbach's alpha coefficient showed that we are facing moderate reliability for the two dimensions adopted in this questionnaire (questions 1.7 to 1.10, 2.3, 2.4, 2.7 and 2.8). Even without calculating the reliability of the other items, it was decided not to disregard any of them for each dimension.

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