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An experimental Study on Students' Psychological Interest in the Study of Physics.

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Abstract.

The essay discusses how learning may be multidisciplinary in the context of physics as well as psychology. It covers a lab experiment based academic course that focuses on observation and experimentation, new scientific fact discovery, measurement, error detection, and the examination of psychological traits of individuals. Both physicists as well as psychologists frequently employ the methods mentioned above. These subjects pique the curiosity of students. Despite their significance, they are not included in conventional physics and mathematics, courses in psychology.

Keywords: Psychological physics, Interest on Physics, physics learner, experimental physics, Interdisciplinary Learning.

Introduction

Physics is a branch of knowledge that examines the composition of matter and interactions between its basic elements. Psychology is a branch of science that investigates human thought and behaviour. The most fundamental issues in nature are explained by physics. Psychology and the social sciences are closely intertwined.

Physics is interested in every facet of nature. The study of individual or social behaviour is known as psychology. Even in so many radically diverse areas, there are similar issues despite basic distinctions.

The best way to understand interdisciplinary is as the fusion of unique elements from two or more fields.

Interdisciplinary activity is frequently criticised for having low standards and being amateurish. There are numerous characteristics, nonetheless, that are contained in fundamentally quite distinct sciences. Additionally, many elements of learning are not covered by multidisciplinary sciences like psychophysics. Numerous transdisciplinary problems have deep philosophical underpinnings. There are several publications that provide a thorough justification of interdisciplinary learning, research, and knowledge. Utilizing transdisciplinary parts of science can assist our students develop a greater level of scientific literacy in practise.

In physics, experiment and theory serve complimentary and crucial functions. Observation, interviewing, psychological testing, laboratory experiments, statistical analysis, and other techniques are utilised in psychological research. The examination of these fields' integrated lab-based methodologies is the main topic of this paper's discussion.

There are moral and legal restrictions on using humans in experiments. This results in certain procedural issues with psychology's application to the learning process.

The structure of this essay is as follows: General information about the described problem is included in section 1, the course's objectives are described in section 2, multidisciplinary experiences were applied in section 3, the interdisciplinary discussion of research ethics is addressed in section 4, and some conclusions are provided in section 5.

Curriculum Description

A natural (experimental) science is physics. These labs' main objective is to demonstrate certain fundamental ideas and procedures in experimental physics. We instruct students on how to create objectives, choose values, and compute random and systematic mistakes. Also an experimental (humanitarian) science is psychology. Because of this, there is a tremendous chance to research how people's psychological traits affect their use of experimental techniques. There are many topics that physics instructors and psychologists can discuss together, but this research only addresses the following interdisciplinary topics: "The Scientific Observation," "The Study of Scientific Facts," "The Study of Perception Of time by Humans," "The Study of Response Time (to Light and Sound)," "The Scarborough's Experiment," and "The Difference Threshold."

These laboratories are designed to be used in a college-level introductory physics course. Each laboratory may be finished in 45 minutes. Students can utilise the calculations, questions, and explanations included in the lab instructions. Calculations are a common homework assignment.

The Scientific Finding.

"The Scientific Observation" is the first lab available to pupils. Physicists, chemists, and biologists frequently employ observation as an interdisciplinary research tool, as do psychologists, sociologists, and other researchers. This study method entails watching things in their native habitat (Usova, 2002). This approach is frequently utilised when experimental research is unreliable. Since astronomers cannot conduct experiments on the skies, astronomy is solely an observational discipline. It is possible to compare observation to experimentation. Students are shown a thing or phenomena by the teacher. The following sections are included in the report:

- The date and time of the observation, as well as the observer's identity.
- The observation's objective (which is determined by the instructor or by the students).
- A description of the thing under observation
- Observational equipment (students may choose this).
- The observation's conditions.
- A summary of the observational process.
- The observation's findings
- A conclusion from the findings analysis.

The instructor argues that the strategy is applicable to both physics and psychology. The instructor might next inquire about the observation using the following questions.

- What characteristics distinguish an observations as a scientific research technique?
- What distinguishes observation from experimentation?
- Which are the benefits and drawbacks of observation in psychology and physics?
- What methods may researchers use to get information about the observation?
- What are some illustrations of observations in the natural and social sciences?

The examination of scientific data.

Everything in the world can be learned via scientific research. A scientific fact is a piece of information that has been verified scientifically and is widely acknowledged as factual. A fact is an event or a situation that truly happened or is the case. "The Study of Scientific Facts" is the second lab available to students.

The characteristics of the proven evidence that are significant for both physics as well as psychology are as follows: 1) Reliability, 2) Repetition (and reproducibility), and 3) Objectivity (credibility).

What information regarding the proven evidence (in the natural and social sciences) should we be aware of? This lis can be used.

1. Data about the research scientist who discovered the scientific fact; 2. The researcher's objectives; 3. The subject of his study; 4. The researcher's equipment; 5. The study's conditions; 6. A summary of the detector procedure; 7. The study's findings and the formulation of a scientific fact; and 8. The scientific fact's application.

The study of telepathic abilities.

In our lab, telepathy human skills are being experimentally studied in order to better understand the characteristics of scientific truths.

The direct transmission of ideas from one person (the sender) to another (the receiver) without the need for customary means of communication is known as telepathy.

Students and teachers both have the potential to send and receive signals. The sender's signal consists of the two numbers 0 and 1, respectively. Telepathic signals that have the same two possible values included in them are received by the recipient as = 0; 1. 100 tests are what I advise (N = 100). After the last exam, the sender dictates previously supplied data to the recipients (), and the students finish calculating the scores.

Students then determine the quantity M of equal values and (fourth column). Finally, students draw the conclusion that telepathic communication exists between both the recipient and the sender based on P=M/N.

According to the given approach, students should write papers regarding the scientific fact. A teacher might inquire about the following:

- How do you define a scientific fact?
- What characteristics distinguish scientific truths?
- If you find a scientific truth, what are you required to say?
- What value is it possible to calculate in this lab?
- What scientific truth did you learn in this lab?

In my experience, the outcomes of this experiment consistently support the null statistically hypothesis (with slight variations P0.50): the null hypothesis could be that there is no association between the two things being examined (and), or that the transfer of ideas has no impact. We can draw a conclusion regarding how to continue studying telepathy if P>0.95. But sadly, that never occurred in my class. Students might see oscillations in this study.

The investigation of how people perceive time.

"The Study of Time Perception by Human" is the third lab available to students. Many scientific fields, including physics, astronomy, psychophysics, philosophy, psychology, etc., have fields of study dedicated to time perception.

We can directly experience time. It is caused by both irreversible biological pathways in the neurological system and the rhythm of bodily functions (such as breathing and pulse).

Tachychronia ("accelerated" times sense) & bradychronia ("decelerated" time sense) are the two different ways that people perceive time. All people may be classified based on how they perceive time; the majority of people underestimate and overestimate time intervals, respectively.

However, specialised training could greatly increase the precision of time estimations.

In this lab, the researcher and the test subject work in pairs. Following the measurement, they switch roles.

Using an inner sense of time, the challenge is to calculate the length of the time period of one minute (1 minute).

The experimenter looks over the stopwatch, explains the scale, the regulations, and the instrumentation error before requesting your readiness. The test subject provides a report on their level of preparation. "Go!" is the indication for the test to begin, and the experimenter then starts the stopwatch. When one minute has passed, the subject who had their sense of time tested calls out, "Stop!" The experimenter records the findings. They must complete a total of seven of these examinations. the following

They determine the average duration and assess the measurement inaccuracy.

The following inquiries can be made by the instructor:

- What time is it?
- What units of time do we use?
- Which time scales do we employ?
- How can "an internal feeling of time" be explained?
- What kinds of mistakes can the lab calculate?
- Specify the setup for your experiment.

Analyzing Reaction Times (Light and Sound) The response time is the amount of time that passes between both the stimulus as well as the resulting muscle response. Gender, age, mental health, the strength of the stimulus, experience, physical condition, and other factors can all affect how quickly you react. Although quickness of reaction is a natural talent, it may be developed through effort.

Both the investigator and the subject being tested work in pairs in this lab (in previous lab). Following the measurements, they switch roles.

The rulers drop test allows us to evaluate our responses.

The tip of a metre ruler is held by the experimenter. Between the tested partner's hand and the wall, a ruler should be held erect. The subject of the experiment catches the ruler as soon as it is dropped by the experimenter. The individual being tested presses the ruler to stop it from dropping as soon as they see it has been dropped. The experimenter then notes the distance in centimetres that the ruler travels before being caught by the subject of the test. The less the ruler lowers before being grabbed, the quicker the test subject reacts.

This is an easy technique to gauge how quickly people react.

Seven repetitions must pass before we can compute the average distance the test subject must drop the ruler before catching it. Knowing the distance that a metre ruler travelled and the acceleration of gravitation (9.8 m/s2), we can always calculate the time of catching, or response time.

For a straightforward visual or auditory stimuli, reaction times are often closer to 0.20–0.30 s. Students then determine the uncertainty.

To measure the response time to both light and sound cues, this test is run twice.

And following that, the instructor may query:

- What do the light and sound mean?
- What is the response?
- How long does it take to react?
- What variables influence response time?
- How quickly do people react to outside stimuli?
- When is knowing the reaction time necessary?
- What phenomena from nature is employed in the lab?
- How are measurement errors calculated?

A study conducted by Scarborough

The sixth lab demonstrates the causes and characteristics of unintentional mistakes. The next experiment should be performed by students.

The experimenter gets a sheet of paper and divides the area towards the centre of the page with a line. She (or he) next places the paper on the table or the floor and picks up a pencil with a sharp point. She holds the pencil by the top among her fingertip and the paper, about 40–50 cm above the page. Then, with a precise aim, he or she tries to strike the line just on paper by dropping the pencil on it. In an effort to strike the line, the pencil must be thrown in this manner at least 100 times. The shots will be recorded by themselves as dots on paper.

The result of this task should be a curve that the students have drawn using the goal line's distance from intervals containing dots as an abscissa and the number of dots in each interval as an ordinate. I advise breaking up the entire dot region into 11 intervals, denoted by the numbers -5, -4, -3, -2, -1, 0, 1, 2, 3, and 4.

The Normal Probability Curve, which corresponds to the depicted points, would have been followed by them. Accidental mistakes of all types adhere to the same law.

The following statements are valid in both physics and psychology:

- Small mistakes happen more often than big ones.
- The likelihood of a mistake relies on its magnitude.
- There are about equal numbers of positive and negative mistakes of the same size.
- Extremely uncommon extremely massive inadvertent mistakes happen.

The effect of random error typically averages out to almost nothing if we collect enough data. All measurements have inherent uncertainties, which are never totally removed. However, measurements are useless if their corresponding errors are unknown. For each measurement, we must determine the measurement's level of uncertainty.

The instructor might then inquire as follows:

- How does this experiment illustrate?
- In this lab, what results did you calculate?
- What random error characteristics are you aware of?
- Why is the Normal Quantile Curve necessary?

Fluctuations are defined as differences between experimental data and the theory (Gaussian distribution).

Students' observations of fluctuations in this research may be the topic of additional instructor explanations.

The Threshold of Difference

Students can assess their difference thresholds (differential threshold, just-noticeable difference, and difference limen) for the distinction of line length in the sixth lab, "The Difference Threshold." A variation of the Method of Consistent Stimuli is utilised here.

Using their own eye assessment, the participant splits the section (I = 18 cm) into two equal pieces. Such a divide is, of course, always quite approximate, with one portion of the segment being a few millimetres (I) bigger than the other. The test is run ten to fifteen times. Students then determine the average value and construct the relative and absolute error estimates for this number.

The differential threshold is referenced by the computed value ΔI. (just-noticeable difference). Students can determine the Weber Constant using this method: $k = \Delta I/I$, where ΔI is the difference threshold computed above and $I = 18$ cm denotes the constant stimulus intensity. For any other intensity number, one might calculate the magnitude of the observer's difference threshold using Weber's Law (length of the segment).

The instructor might then inquire as follows:

- What is the threshold for a difference?
- Why is it important to understand the various thresholds?
- How is the difference threshold determined?
- To what situations may we apply Weber's Law?

By identifying these psychological traits, the teacher may show how a normal physical experiment might look and function.

Ethics of Research Discussion

The issue of study participants becomes more pressing when our labs are put into action. It provides the chance to talk about multidisciplinary research ethical concerns with students. The truth is that scientific advancements are neither morally right nor wrong. Researchers may, however, judge them differently (for example, positively or negatively).

Students participate in all of our lab experiments and testing. Every lab is completed in pairs. Even if there are no risks in the labs, some individuals could be extremely sensitive to the findings of the detection. It is important to let students know how the measured amounts connect to their psychological traits. This makes it clear that their involvement in these labs is completely voluntary. The outcomes of the experiment will remain anonymous and secret, according to the teacher.

Here, it is essential to take into account other facets of researcher ethics, such as scientific fraud, plagiarism, and responsibility for the outcomes.

The instructor may then propose talking about the following multidisciplinary issues:

- What moral guidelines ought to be used in our labs?
- What risks do science and educational plagiarism pose?
- Can deceit be used or is it safe in research, education, or daily life?
- Which labs you might have discouraged other students from taking?

- Which labs did you find to be the most insightful and helpful?

Influence on Student Interest

We conducted a pilot study in 2018–2019 to determine the impact our laboratories had on students' motivation to learn physics. Students were asked to rate their interest in physics on a scale of 0 to 1 to 2. A score of 0 indicates no fascination with physics, a level of 1 indicates a moderate interest, and a level of 2 indicates a keen interest. We picked kids that were essentially equal in terms of their accomplishments and skills.

Four student academic groups were examined: two control groups (42 participants), and two experimental groups (40 participants). The experimental group's students examined the material. The aforementioned laboratories were not studied by the students in the control group. Undoubtedly, every student took a typical physics course.

Before and after they studied in our laboratories, we gave the students a questionnaire to complete. Table 1 display the questionnaire's results and it is showed in the graph from figure1.

Table 1: Result of Questionnaire

	Groups	Total Respondents	0-Level (Low)	1-Level (Normal)	2-Level (Advanced)
Before Course of Study	**Control**	42	14	24	4
	Experimental	40	12	25	3
After Course of Study	**Control**	42	10	27	5
	Experimental	40	2	26	12

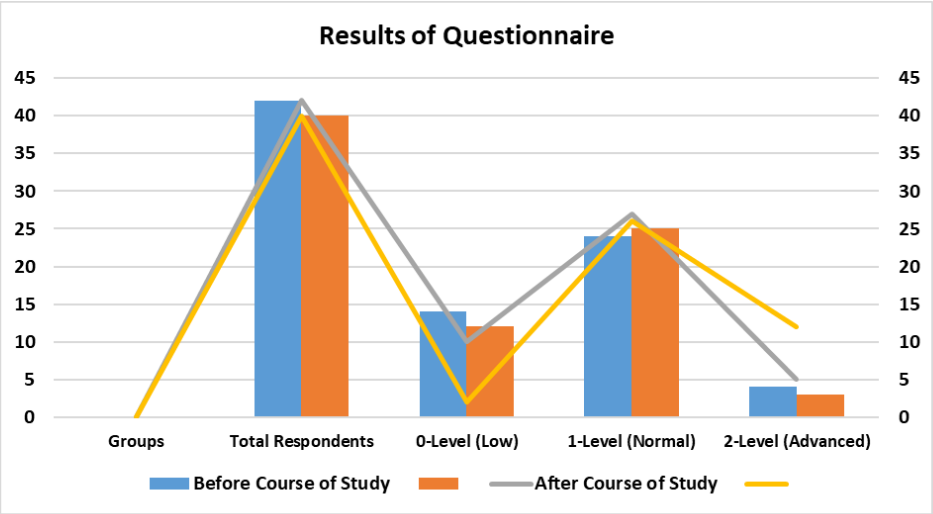

Figure 1: Graph showing Result of Questionnaire

In all groups, improvements were made during the study period. Four children in the normal control moved from level zero (low) to level one (normal), and one student advanced from level one (normal) to level two (advanced). The shift in the experimental groups was more dramatic: 12 students went from the zero (lowest) level to the first (average) level, and 10 students moved from the first (regular) level to a second (advanced) level.

Conclusion

Modern science is distinguished by its interdisciplinarity. Numerous multidisciplinary problems are only solvable by multiple disciplines working together. These topics are always of great interest to young people and are highly current. The use of human psychological traits to the study of experiments significantly boosts interest in the study of physics. However, physicists and psychologists have never interacted in a classroom setting; they debate various topics without interfering with one another.

The most intriguing issues for young people are those connected to fundamentally dissimilar fields of study, like physics and psychology. In our experiences, using an interdisciplinary course to address the interest issue is more beneficial than using a disciplinary approach alone. Unusual laboratories and their outcomes are very appealing to students.

The process of studying nature is quite complex, and sometimes it may be very challenging to determine whether physics or psychology is the root of the issue. This also holds true for research methods including observation, the discovery of novel scientific truths, measurement, and error detection. Despite being of utmost importance, these topics are not included in traditional physics and psychology curricula.

By carrying out the multidisciplinary labs mentioned above, students become familiar with them.

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Conflict of Interest

The authors declare that they have no conflicts of interest in this work.

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