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Dr. Ali Benamer[1]
Dr.Djamel Benouioua[2]
Dr.Youcef Bennaa[3]

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Difficulties of conducting scientific experiments in physics in the middle school stage from the point of view of the physics professor

Dr. Ali Benamer[1*], Dr.Djamel Benouioua[2], Dr.Youcef Bennaa[3]

[1]*Laboratoire de Mathématique et Physique Appliquées, École Normale Supérieure de Bousaada, 28001 Bousaada, Algeria.benamer.ali@ens-bousaada.dz. Orchid:Orchid0000-0002-3547-3823*
[2]*University Akli Mohand Oulhadj of Bouira.Djamel615@gmail.com*
[3]*Université Mohamed BoudiafM'sila.Youcef.bennaa@univ-msila.dz*

Abstract:

The present study aims to investigate the challenges encountered by physics educators in conducting scientific experiments during the middle school stage, as perceived by the educators themselves. Additionally, it seeks to analyze the differences in the assessment of these difficulties based on gender and teaching experience. Employing a descriptive analytical methodology, a questionnaire comprising 37 items was developed, organized into three dimensions, and its psychometric properties were thoroughly validated for both reliability and validity. The study sample consisted of 52 physics professors from various middle schools within the region, selected through a simple random sampling technique. The findings indicated that educators experience moderate challenges in executing scientific experiments in physics. Furthermore, statistically significant differences were observed in the average assessments regarding these difficulties, attributed to the gender variable. In contrast, no significant differences were found when considering the variable of teaching experience. These insights underscore the necessity for targeted interventions to enhance the experimental teaching practices in physics, thereby improving educational outcomes.

Keywords: Difficulties, scientific experiments, physics professor, middle school.

The Problematic of the Study

Physics is one of the most well-known sciences around the world. It is the science that studies the fundamental concepts to explain the mysteries of nature, such as energy, force, magnetism, and all the secrets emitted by matter, as Richard Feynman said: "In the world of physics, everything can be learned and everything can be understood." More broadly, it is the general analysis of nature, which aims to understand how the universe works. As Niels Bohr said, "Physics is the language that nature uses to speak to us, and scientists are trying to decipher its codes."The history of physics can be traced back to ancient civilizations such as Greek, Indian, and Chinese, from which the scientific method developed, and physics began to crystallize as a science. The key figures such as Galileo, Kepler, and Newton laid the foundations of classical physics, which focused on the study of gravity, motion, and their

[*]*benamer.ali@ens-bousaada.dz*

laws.In the 19th and 20th centuries, physics expanded its scope and advanced with the discovery of electricity, magnetism, and the atomic structure of matter. This included the development of modern physics through Einstein's work, which introduced the theory of relativity within the framework of quantum mechanics, further developed by Planck, Bohr, and others.Today, physics continues to expand our understanding of the universe through research and exploration in various fields such as particle physics and atomic physics. Interest in physics has increased in the last decade due to the scientific revolution in several areas, especially the technological and educational fields. Physics is a science that has greatly contributed to the progress of countries, and the work in physics is based on the experimental method to understand various natural phenomena. Experiments are the primary goal that produce the accuracy of observation, as Al-Bashir Al-Haqani mentioned, based on Claude Bernard in his book Introduction to Experimental Medicine: "Experiment is the observed observation to achieve the hypothesis or suggestion."Experiments in physics are the essential part in the study of this science. Through them, students and scientists can understand natural phenomena and physical laws more deeply, and they enhance scientific thinking and skills. Therefore, experiments in physics are necessary to enhance students' understanding of scientific concepts and their practical application, which contributes to enhancing their learning and developing their mental and practical abilities. As Picasso said, "Physics gives us a better understanding of the material world around us, but experiments bring us the truth."Therefore, the most important thing in physics is experiments, especially at the secondary level, as the study at this stage is one of the most important stages in the student's educational journey. Students learn the curriculum and foundations in all subjects and are in the adolescent stage, which is a period of building their personality. This stage is known for its difficulty among all teachers, as the teacher is the main element in the implementation of the educational process and may face several problems during the implementation of this process due to several obstacles that may be attributed to the teaching methods used, the textbook used, the lack of means, devices and tools needed in the teaching process and conducting experiments, or the idea that physics is a complex and difficult science that students have in their minds. Undoubtedly, the shortcoming in one of the aspects involved in the teaching process will certainly create a difficulty in students' understanding of the content of the physics material.

Several previous studies and research have been conducted in this regard. A researcher conducted an open-ended questionnaire on a pilot sample and directed it to physics teachers to identify the difficulties they face in conducting physics experiments. The researcher asked the question: "What are the difficulties faced by physics teachers in conducting experiments in the laboratory?" and found many difficulties facing the process of teaching laboratory experiments in schools, including the lack of appropriate display devices within the school laboratory, the existence of one laboratory for all scientific subjects (physics, chemistry, and biology), and the shortage of time allocated for conducting experiments.Among the studies, we find the study of (Al-Khalili, 1988) which concluded the obstacles of experimental work as perceived by teachers, and recommended that those in charge raise teachers' awareness of adopting the best and most effective ways to present practical demonstrations, so that they contribute to the development of critical scientific thinking as best as possible, and allocate science lessons for the practical aspect.The study of (Al-Sabah and Rawaq, 2017) aimed to know the obstacles to the use of general science teachers towards scientific laboratories in teaching science in Irbid Governorate. Its results showed that the most important obstacles are the large size of the science curriculum and the existence of statistically significant differences in the obstacles to the use of teachers of laboratories attributed to gender and in favor of male teachers, and the absence of statistically significant differences attributed to the variable of training courses, qualification, and gender.The study of (Ndihokubwayo, 2017) aimed to reveal the reality and obstacles of science laboratory activities in teacher training colleges in Rwanda, and the results showed that teachers face a lack of laboratory equipment and materials, lack of necessary experience to conduct experiments, lack of time, and lack of skills.The study of (Shuaib, 2017) concluded difficulties related to the educational environment for teaching, difficulties related to students, and difficulties related to the teacher.The study of (Al-Alwani, 2018) found that the field of educational means came in the first place in terms of teaching difficulties.Therefore, the researchers delved into posing the problem represented in the difficulties of conducting experiments in physics in the intermediate stage from the teachers' point of view, in order to find solutions to the problem and address it. In light of the above, we pose the following questions:

1. Are there difficulties in conducting scientific experiments in the subject of physics in the intermediate education stage from the point of view of physics teachers?
2. Are there differences between the mean views of teachers regarding the difficulties of conducting experiments in the subject of physics due to the gender variable?
3. Are there differences between the mean views of teachers regarding the difficulties of conducting experiments in the subject of physics due to the seniority variable?

2- Study hypotheses

1. There are difficulties in conducting scientific experiments in the subject of physics in the intermediate education stage from the point of view of teachers.
2. There are differences between the mean views of teachers regarding the difficulties of conducting experiments in the subject of physics due to the gender variable.
3. There are differences between the mean views of teachers regarding the difficulties of conducting experiments in the subject of physics due to the seniority variable.

3- Study objectives

No scientific research study is devoid of set objectives that it achieves through the results it produces or the facts it reveals, and these objectives are:

- Revealing the difficulties facing science teachers in conducting scientific experiments in schools.
- Revealing statistically significant differences in science teachers' estimation of the difficulties of conducting scientific experiments in laboratories in the subject of physics, which are attributed to the gender variable.
- Revealing statistically significant differences in science teachers' estimation of the difficulties of conducting scientific experiments in laboratories in the subject of physics, which are attributed to the seniority variable.

4- Importance of the study

The importance of the current study lies in the fact that it investigates the following:

- Revealing the difficulties of conducting scientific experiments that prevent the effective use of the science laboratory in teaching.
- This study comes in response to modern educational trends that call for the need to focus on the difficulty of conducting scientific experiments in laboratories, and providing all the moral and material capabilities that enable students to research and experiment on their own.
- It deals with an important aspect of the scientific aspects, namely the practical aspect in teaching science.
- Revealing the difficulties facing the physics teacher during the completion of the experiment in light of the teaching process that focuses on consolidating concepts and ideas in the minds of students and providing them with a set of experiences that make them capable of solving the problems they face.
- Identifying the views and opinions of professors about the teaching difficulties of physics and the obstacles they face when conducting experiments, which hinder their performance, is one of the main steps to reform the educational system and develop the teaching-learning process, and to reconsider the educational specialists in building curricula, teaching methods and strategies for this material.
- Identifying the views of professors about the difficulties of teaching physics, which negatively affect their performance in moving away from old teaching methods and diversifying the strategies and methods followed in implementing the educational process.
- Benefiting from the current study as the first study conducted at the University of Saida that investigates the difficulties of conducting experiments in the subject of physics in the intermediate stage from the point of view of professors to the best of the researcher's knowledge.

5- Defining terms

1. **Difficulties:** They are the obstacles facing the middle school teacher in conducting scientific experiments in the subject of physics that can be overcome.

They are everything that hinders achieving a specific goal that requires overcoming it with more physical and mental efforts **(Al-Alwani, 2018)**.

•**Procedural definition:** They are everything that hinders the science teacher and limits his ability to use the laboratory.

2. **Scientific experiments:** They are practical activities carried out inside the school laboratory in order to reach a solution to a specific problem, and are carried out using materials, devices and tools according to specific steps and rules that vary according to the experiment **(Mala Youssef, 1920).**

• **Procedural definition:** Practical activities carried out by the teacher with his students inside the laboratory to verify a hypothesis aimed at reaching certain results.

3. **Intermediate stage:** It is the second stage in the educational system in the Algerian state, preceded by the primary stage which lasts four years, ending with the middle school certificate exam and followed by the secondary and university stages.

4. **Professor:** He is every person who practices the profession of teaching physics in the intermediate stage, and he is the main element who designs the lesson, plans for it, conducts experiments and carries out the teaching process.

6- Previous studies

Study (Al-Khalili, 1988): A survey study aimed at identifying the obstacles to this laboratory work as seen by male and female teachers, numbering 176 teachers in northern Jordan. The study recommended that the supervisory authorities work to educate teachers about the best ways to present practical demonstrations, so that they contribute to the development of critical scientific thinking in the best possible way, and allocate science lessons for the practical aspect.

Study (Al-Fityani, 2008): He addressed in his study the obstacles that prevent science teachers from using applications for grades five to twelve in Palestinian government schools in the governorates of Jerusalem and Ramallah towards practical applications and their use in education, and the relationship of these attitudes to some variables, as well as their relationship to the extent of use of laboratories and obstacles to their use. Three research tools were used in this study, represented by two questionnaires and an interview, and the study sample included (283) male and female teachers. The study reached a number of results, including: There are statistically significant differences between the mean responses of science teachers due to gender, experience, academic qualification, interaction between the sexes, and specialization in favor of specialization in biology, and to the variable of the educational stage in favor of teachers of grades seven to nine. The results of the study showed that there are obstacles that prevent science teachers from using practical applications in teaching science, represented in material and human obstacles, and they also showed a moderate statistically significant relationship between attitudes towards practical applications and the practice of practical applications.

Study (Al-Sabah and Rawaq, 2017):

The study aimed to (know the obstacles to the use of general science teachers towards scientific laboratories in teaching science in Irbid Governorate). To achieve the goal of the study, the researcher used the descriptive approach and applied the questionnaire and interview as a tool for conducting the study. The study sample consisted of 130 male and female teachers. The results showed that the most important obstacles were the large size of the science curriculum, and there were statistically significant differences in the obstacles to the use of teachers of laboratories attributed to gender and in favor of male teachers, and the absence of statistically significant differences attributed to the variable of training courses, qualification, and gender.

Study (Ndihokubwayo, 2017):

This study was conducted in Rwanda and aimed to (reveal the reality and obstacles of science laboratory activities in teacher training colleges in Rwanda). To achieve the goal of the study, the researcher used the descriptive approach and applied the questionnaire and interview as a tool for the study. The study sample consisted of (44) teachers and (196) students. Data were analyzed using percentages, frequencies, and the weighted average. The results showed that teachers face a lack of laboratory equipment and materials, lack of necessary experience to conductexperiments, lack of time, and lack of skills.

Study (Adel Kamal Shuaib, 2017):

The study aimed to identify the difficulties in applying modern trends in teaching physics in intermediate schools in Baghdad Governorate from the point of view of physics teachers. The researcher used the descriptive survey method in his study. The sample consisted of 127 teachers in the Directorate of Education, using the questionnaire as a data collection tool after applying it to teachers with experience of 05 years or more, after verifying the validity and reliability of the scale tool. The results of the study showed that the difficulties were in the following order: difficulties related to the educational environment for modern teaching trends, difficulties related to the curriculum, difficulties related to students, and difficulties related to the teacher.

7- Study Methodology and Procedures

1- Study Methodology: The researchers in this study relied on the descriptive analytical approach, as it is suitable for the nature and objectives of the study. This approach is based on collecting sufficient and accurate data and information about the phenomenon, then analyzing and interpreting it to reach logical conclusions that help understand and develop reality.

2- Study Population: The study population consists of all physics teachers in the intermediate stage in the province of M'sila for the academic year 2023-2024, numbering 52 male and female teachers.

Table 1: Frequencies and Percentages of the Study Sample by Gender

Variable		Frequency	Percentage
Gender	**Male**	**16**	**31%**
	Female	**36**	**69%**
Total		**52**	**100%**

Table 1 shows the frequencies and percentages of the study sample by gender. We can see that the number of females is greater than the number of males, where the percentage of females was 69% while the percentage of males was 31%.

Table 2: Frequencies and Percentages of the Study Sample by Seniority

Variable		Frequency	Percentage
Seniority	**Less than 5 years**	**04**	**08%**
	More than 5 years	**48**	**92%**
Total		**52**	**100%**

Table 2 shows the frequencies and percentages of the study sample by seniority. We can see that the number of teachers with more than 5 years of teaching experience is much higher than the number of teachers with less than 5 years of teaching experience. The percentage of those with more than 5 years of experience was 92%, while the percentage of those with less than 5 years of experience was 8%.

Table 3: Frequencies and Percentages of the Study Sample According to Scientific Diplomas Obtained

Variable		Frequency	Percentage
diplomas obtained	Bachelor's degree (licence)	33	63.3%
	Master	17	32.7%
	Master's (Magister)	1	2%
	Ph.D	1	2%
Total		52	100%

Table 3shows the frequencies and percentages of the study sample by academic qualification. We can see that the number of professors holding a bachelor's degree is the largest category in the study sample, as their percentage was 63%, followed by the master's category, representing 33%, then the master's category, 2%, and the doctorate category, 2%.

4- Study Tool: The questionnaire is one of the most widely used tools in collecting data, especially in descriptive research, as it is the most appropriate tool for this matter. One of the most important features of the questionnaire is that it saves the researcher a lot of time and effort and obtains the largest amount of data to be accessed. To collect data on the study variables, we built a questionnaire directed to intermediate-level physics professors centered on the following points:

The first section: includes the personal data of the sample members (gender, seniority, level)

The second section: It consists of 37 statements divided into three dimensions (questions related to the professor, questions related to the student, and questions related to the laboratory) and three answer alternatives were identified (always, sometimes, never). See Table 4.

Table 4: Represents the Distribution of the Questionnaire and its Dimensions

Dimensions	Number of Items	Item Numbers
Questions related to the teacher	**16**	**1 to 16**
Questions related to the student	**9**	**17 to 25**
Questions related to the laboratory	**12**	**26 to 37**

5- Tool Validity: To verify the validity of the tool, it was presented to a group of specialized arbitrators in science curricula, teaching methods, measurement and evaluation, and educational psychology, to judge the validity and appropriateness of the items for the domains to which they belong. Their observations were taken into account and the items were modified accordingly.

6- Tool Reliability: To verify the reliability of the tool, the Cronbach alpha equation was used, and the reliability coefficient value reached (0.89), which is a high value indicating the reliability of the tool and its suitability for application.

7- Statistical Analysis: The Statistical Package for Social Sciences (SPSS) was used in the statistical analysis of the data, by extracting arithmetic means, standard deviations, percentages, the t-test for two independent samples, and one-way analysis of variance.

8-The psychometric properties of the questionnaire

8-1-Validity

It relates to the extent to which the tool succeeds in measuring what it was designed to measure and achieving the purpose for which it was designed. Based on the scores obtained from its application, certain inferences can be accurately drawn. In calculating the validity, we relied on:

8-1-1- Judges' validity

To calculate the validity of the tool, we distributed the questionnaire in its initial form to a number of experienced and specialized judges in the field of psychology and educational sciences from the faculty members of the Faculty of Humanities, in order to consider the extent to which the paragraphs express the subject, their relationship to the axes, and the soundness of their language. After taking the judges' notes into consideration, the final version of the questionnaire was reached, consisting of 37 phrases divided into 3 dimensions.

8-1-2- Internal consistency validity

After distributing the tool to a pilot sample of 10 professors, we calculated the correlation coefficients between the total score of each dimension and the total score of the questionnaire, and table No. (05) shows that.

Table 5: Represents Correlation Coefficients Between Dimensions and the Total Score of the Questionnaire

Dimensions	Questions related to the teacher	Questions related to the student	Questions related to the laboratory
Questions related to the teacher	**1**		
Questions related to the student	**0.66***	**1**	
Questions related to the laboratory	**0.541**	**0.745***	**1**
Total Score	**0.837****	**0.884****	**0.896****

Table (05) shows the results of the correlation between the dimensions among themselves and between the dimensions and the questionnaire as a whole. The correlation between the first dimension (questions related to the teacher) and the total score of the questionnaire was 0.837**, which is a high and statistically significant coefficient at the significance level of 0.003. The correlation between the second dimension (questions related to the student) and the total score was 0.884**, which is also a high and statistically significant coefficient at the significance level of 0.001. The correlation between the third dimension (questions related to the laboratory) and the total score was 0.896**, which is also a high and statistically significant coefficient at the significance level of 0.000. In addition to the correlations between the dimensions themselves, this gives an indicator of the internal consistency validity of the dimensions. In its final form, the questionnaire consisted of 37 statements.

8-2-Reliability: It refers to the extent to which the results of the measurement tool are stable when applied to the same individual or group of individuals in similar circumstances. In calculating the reliability, the following was relied upon:

8-2-1- Cronbach's alpha (α) coefficient:

To measure the reliability of the study tool, it was applied to a pilot sample of 10 professors, and the Cronbach's alpha (α) reliability coefficient was used for the questionnaire as a whole. Table (06) shows this.

Table 6: Represents the Table of Alpha (α) Cronbach, Values of Reliability Coefficients

Dimensions	Number of Items	Cronbach's α
Questionnaire	**37**	**0.902**

From Table (06), it is evident that the value of the questionnaire's reliability coefficient (0.902) is suitable, which indicates that the questionnaire has a high degree of reliability, and therefore, the results can be relied upon and trusted.

9- Statistical Methods

Any research does not lack the use of statistical methods to handle the study variables. In our study, we relied on the following methods:

• **Percentages**: This is a method that expresses a part of the total number as a percentage of 100, represented by the symbol %.

• **Average arithmetic**: This is a value that represents a group of numbers divided by their number.

• **Standard deviation**: This is a measure of the spread of values within a group of numbers, which measures how data is dispersed around the average.

• **Pearson's correlation coefficient**: This is a measure of the strength of the relationship between two quantitative variables, ranging from (-1) to (+1).

• ***t*-test**: This is a statistical tool used to verify the differences between the means of two groups.

1- Presentation and Interpretation of Results:

After addressing the methodological procedures of the field study, this chapter will be dedicated to presenting the results of the current study and interpreting them in light of some previous studies that have dealt with some aspects of our topic and based on the opinions of some researchers.

1-1 Presentation and Interpretation of Results:

This study aims to understand "the difficulties of conducting scientific experiments in physics in the intermediate education stage from the perspective of a physics teacher".

1- Presentation of the results of the first hypothesis: It states that **"there are difficulties in conducting scientific experiments in physics in the intermediate education stage from the perspective of a physics teacher"**.To verify the validity of this hypothesis, the average, standard deviation, and relative weight of each statement in the questionnaire were calculated. Table (7) shows the results of the average, standard deviation, and relative weight of each statement, sorted in descending order according to the relative weight.

Table (7): Represents the means, standard deviations, and relative weights for each statement

Rank	Statement	No.	Mean	SD	Relative Weight
01	Lack of a sufficient number of laboratories compared to the number of classes and study sections in the school.	29	2.63	0.59	87.82%
02	Overcrowding of students in the laboratory.	25	2.61	0.63	87.17%
03	Lack of safety measures and procedures in the school laboratory.	27	2.5	0.64	83.33%
04	Some laboratories do not have the necessary laboratory equipment.	34	2.5	0.54	83.33%
05	Scarcity of necessary services such as water and electricity in the laboratory.	26	2.46	0.64	82.05%
06	Training courses for teachers focus only on the theoretical aspect.	11	2.32	0.65	77.56%
07	Neglect of periodic maintenance of laboratory tools and equipment.	36	2.32	0.7	77.56%
08	The evaluation methods used focus on the theoretical aspect without the practical.	2	2.28	0.6	76.28%
09	My fear of financial responsibility, as I am asked to sign for receiving and handing over materials and devices before and after use.	9	2.26	0.63	75.64%
10	I suffer from the large number of course content items and the lack of adequate time to complete them properly while using the laboratory.	12	2.26	0.69	75.64%
11	The small size of the laboratory hinders the accommodation of students.	28	2.26	0.79	75.64%
12	Lack of awareness of the school administration about the importance of laboratories in teaching science.	37	2.26	0.77	75.64%
13	Lack of availability of the necessary chemicals to conduct experiments.	32	2.21	0.69	73.71%

14	There is one laboratory for all scientific subjects (physics, chemistry, and biology).	31	2.17	0.88	72.43%
15	I avoid the failure of the experiment in front of the students.	4	2.15	0.77	71.79%
16	The financial resources to finance the laboratory experiments are not commensurate with the topics of the curriculum.	30	2.09	0.69	69.87%
17	Converting the laboratory room into a classroom.	33	2.07	0.81	69.23%
18	Some students' negligence in taking the experiment seriously.	23	1.98	0.54	66.02%
19	The large number of lessons I teach per week.	13	1.96	0.65	65.38%
20	I prefer teaching methods that do not require the use of the laboratory.	7	1.9	0.8	63.46%
21	I see that laboratory experiments require a great deal of effort from me.	5	1.88	0.67	62.82%
22	I suffer from the lack of a practical activity guide that matches the textbook.	1	1.88	0.67	62.82%
23	Students' tampering with laboratory tools and equipment.	19	1.86	0.56	62.17%
24	Lack of my conviction in the importance of the role of laboratories in teaching science.	14	1.8	0.79	60.25%
25	Students' fear of using laboratory equipment.	20	1.8	0.65	60.25%
26	Lack of student interaction during scientific experiments.	17	1.78	0.6	59.61%
27	Lack of student behavioral discipline during the conduct of scientific experiments.	18	1.69	0.58	56.41%
28	Most laboratory experiments do not touch the reality in which the student lives.	22	1.69	0.58	56.41%
29	Lack of students' interest in practical applications because they are not subject to evaluation in general exams.	21	1.67	0.67	55.76%
30	Lack of students' motivation to work within the laboratory.	24	1.65	0.65	55.12%
31	The laboratory tools and equipment do not fit the topics of the curriculum.	35	1.65	0.52	55.12%
32	I find it difficult to implement experiments related to the lesson.	3	1.61	0.53	53.84%
33	Shortage of time allocated to conduct experiments.	10	1.42	0.72	47.43%
34	The large size of the curriculum makes me devote time only to teaching inside the classroom.	8	1.36	0.62	45.51%
35	The school administration prevents me from using the laboratory to preserve the tools.	16	1.28	0.6	42.94%
36	I avoid consuming or damaging laboratory materials.	15	1.19	0.52	39.74%
37	I suffer from a weakness in my inclination towards laboratory work.	6	1.17	0.43	39.10%
Total			1.96	0.65	65.33%

It is clear from the table that the averages of the difficulties faced by teachers in using scientific laboratories in teaching physics ranged between (2.63 and 1.17) and a relative weight ranging between (87.82% and 39.10%). The questionnaire statements obtained a total average of (1.96), a standard deviation of (0.65), and a relative weight of (65.33%), which is at the medium level.Statement number (29), which states "the lack of a sufficient number of laboratories compared to the number of classes and divisions in the school", received the highest average of (2.63), with a standard deviation of (0.59) and a relative weight of (87.82%), which is at the medium level.In second place came statement number (25), which states "the large number of students in the laboratory", with an average of (2.61), a standard deviation of (0.63), and a relative weight of (87.17%), which is at the medium level.In third place came statement number (27), which stated "the lack of safety measures and procedures in the school laboratory", which was equal to statement number (34), which states "some laboratories do not have laboratory equipment", with an average of (2.5) and a relative weight of (83.33%), which is at the medium level.On the other hand, in the last place came statement number (6), which states "I suffer from a weak tendency towards laboratory work", with an average of (1.17), a standard deviation of (0.43), and a relative weight of (39.10%), which is at a low level.In the second-to-last place came statement number (15), which states "I avoid consuming or damaging laboratory

materials", with an average of (1.19), a standard deviation of (0.52), and a relative weight of (39.74%), which is at a low level.After presenting the items of the first hypothesis, which states "there are difficulties in conducting scientific experiments in physics in the intermediate education stage from the perspective of a physics teacher", and its total score with an average of 1.96, a standard deviation of 0.65, and a relative weight of 65.33%, this indicates that the first hypothesis has been achieved.

2-Interpretation of the results of the first hypothesis

The first hypothesis was related to the difficulties in conducting scientific experiments faced by physics teachers in the intermediate education stage from their point of view. The results showed that the degree of difficulties is at a medium level, which may be attributed to the teachers' suffering from the lack of a classroom or room for the school laboratory, the large number of students in the laboratory, and the lack of sufficient knowledge in operating and maintaining laboratory devices. They also expressed that training courses and seminars focus only on the theoretical aspect, and the teacher is not adequately prepared to conduct laboratory experiments due to the lack of sufficient and continuous courses within the teacher's scientific preparation. The administration's lack of cooperation in funding laboratory experiments and the difficulty of controlling students in the laboratory also contribute to these difficulties. These results are consistent with the studies of (Al-Sabbah and Rawaqah, 2017), (Al-Jubouri and Radi, 2021), (BaniDomi, 1998), and (Ababneh, 1990). All these obstacles prevent the experiment from proceeding properly and, consequently, the desired results are not achieved.

3- Presentation of the results of the second hypothesis:

It states that "there are individual differences between the averages of intermediate education teachers in conducting scientific experiments in physics due to the gender variable".

Table 8: Means, Standard Deviations, Results of "t" Test, and Decisions According to Gender:

Variable		N	Mean	SD	df	t	Sig.	Decision
Gender	Males	16	77.78	06.67	50	03.12	0.003	Statistically significant
	Females	36	70.55	07.95				

It is clear from Table (08) that the average for males was (77.68) with a standard deviation of (6.67), which was higher than the average for females, which was (70.55) with a standard deviation of (7.95). The t-test value was 3.12, which is a statistically significant value at the significance level of 0.003. Therefore, there are statistically significant differences between the averages of intermediate education teachers in conducting scientific experiments in physics due to the gender variable, meaning that the second hypothesis has been achieved.

- Interpretation of the results of the second hypothesisThe second hypothesis was related to the existence of statistically significant differences between physics teachers in the difficulties they face in conducting scientific experiments in the intermediate education stage due to the gender variable. The t-test value was 3.12, which is a significant value, and this indicates the achievement of the second hypothesis. This result is consistent with the study of (Al-Fityani, 2008) and the study of (Al-Sabbah and Rawaqah, 2017), which found statistically significant differences due to the gender variable (male-female). This may be attributed to the fact that males, by virtue of their ability to participate in the various training courses organized by the Ministry of Education, unlike females who are unable to participate due to their families and raising their children, may not attend some of these courses. In addition, females are more disciplined than males in the laboratories, and therefore, the observation of female teachers of some obstacles, especially those related to teachers in the event of the experiment's failure, is not clearly noticed.

4- Presentation of the results of the third hypothesis

It states that "there are individual differences between the averages of intermediate education teachers in conducting scientific experiments in physics due to the seniority variable".

Table 9: Means, Standard Deviations, Results of "t" Test, and Decisions According to Seniority

Variable		N	Mean	SD	df	t	Sig.	Decision
Seniority	Less than 5 years	04	74.50	08.18	50	0.44	0.662	Not statistically significant
	More than 5 years	48	72.60	08.25				

It is clear from Table (09) that the average for the group of teachers with less than 5 years of experience was (74.50) with a standard deviation of (8.25), which was higher than the average for the group of teachers with more than 5 years of experience, which was (72.60) with a standard deviation of (8.18). The t-test result for the total score was 0.44, which is a non-significant value at the significance level of 0.662. Therefore, there are no statistically

significant differences between the averages of intermediate education teachers in conducting scientific experiments in physics due to the seniority variable, meaning that the third hypothesis was not achieved.

- Interpretation of the results of the third hypothesisthe third hypothesis was related to the absence of statistically significant differences between physics teachers in the difficulties they face in conducting scientific experiments in the intermediate education stage due to the seniority variable. The t-test value was 0.44, which is a non-significant value, and this indicates that the third hypothesis was not achieved. This result is consistent with the study of (Al-Jubouri and Radi, 2021) and the study of (Al-Sabbah and Rawaqah, 2017), which found no statistically significant differences due to the seniority or years of experience variable, while it differed from the study of (Andrejic and Slavko, 2011) and the study of (Al-Fityani, 2008), which found statistically significant differences according to the seniority or years of experience variable. The absence of differences in difficulties according to the seniority variable can be attributed to the fact that the services provided by physics teachers do not depend on years of experience and are not a factor influencing the severity of the difficulties they face in teaching physics. This is due to the training courses or training that new teachers undergo, and it can be said that new physics teachers strive to showcase their abilities and bring out the potential they possess, as they strive to be diligent in science and endeavor, in addition to benefiting from those with experience in the field to improve their level and develop their knowledge. Likewise, those with experience seek to transfer their experiences to those with less experience, so there is homogeneity between the two groups, where the benefit is mutual in the field.

After presenting and discussing the results, the following was reached:• Most of the sample members suffer from the lack of sufficient laboratories that are proportionate to the number of students.

• The large number of students in the laboratory impedes the proper conduct of the experiment.
• The lack of safety measures and procedures and the neglect of periodic maintenance of laboratory tools.• The lack of interest of the Ministry of Education in equipping the laboratories with the necessary devices and tools.• Training courses focus only on the theoretical aspect.
• There are statistically significant differences in the difficulties of conducting scientific experiments between physics teachers in the intermediate education stage due to the gender variable.
• There are no statistically significant differences in the difficulties of conducting scientific experiments between physics teachers in the intermediate education stage due to the seniority variable.

Conclusion

The topic of the difficulties of conducting experiments is considered one of the important topics in the educational field, which has been the focus of researchers and specialists, especially if it is related to the subject of physics. The difficulties of conducting scientific experiments in physics in the intermediate education stage from the perspective of the physics teacher are an important issue that deserves attention and study. Physics is a challenge for both learners and teachers alike, and in this study, which aimed to identify the main difficulties in conducting scientific experiments faced by physics teachers from their perspective in the intermediate education stage, the study concluded that the difficulties in conducting experiments are the result of the interaction of a set of difficulties (difficulties related to the teacher, difficulties related to the student, and others related to the school laboratory). The study also concluded another result, which is: the existence of statistically significant differences between the averages of teachers regarding the difficulties of conducting scientific experiments due to gender, as well as the absence of statistically significant differences between the averages of teachers regarding the difficulties of conducting scientific experiments due to seniority.Finally, it can be said that this study benefits all parties involved in the teaching-learning process (teachers, students, educational frameworks), which helps in taking a set of measures and solutions to confront the obstacles that affect the students' achievement in the physical and technological sciences.In light of the results of this study, it concluded a set of recommendations and suggestions, including:

1. The necessity of providing all schools with laboratories that are commensurate with the number of students in the school.
2. Paying attention to providing laboratories in schools and equipping them with the modern laboratory devices and tools required to achieve the highest level of understanding among students.
3. Opening new intermediate schools to reduce the number of students in the classroom and the laboratory.
4. Providing periodic maintenance for the laboratories.

5. Involving teachers in training courses that raise the level of physics teachers in maintaining the educational devices available in the laboratory, in order to avoid any problems that may occur during the conduct of scientific experiments.
6. Providing teaching aids that help the teacher in explaining the science experiments inside the laboratory.
7. Conducting a survey study on the reality of the laboratory and experimentation in the intermediate education stage.

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Annex: 01

Table: Questionnaire Statements

N^0	Statements related to the teacher	always	sometimes	never
01	I suffer from the lack of a practical activity guide that matches the textbook			
02	The evaluation methods used focus on the theoretical aspect without the practical.			
03	I find it difficult to implement experiments related to the lesson.			
04	I avoid the failure of the experiment in front of the students			
05	I see that laboratory experiments require a great deal of effort from me			
06	I suffer from a weakness in my inclination towards laboratory work			
07	I prefer teaching methods that do not require the use of the laboratory			
08	The large size of the curriculum makes me devote time only to teaching inside the classroom			
09	My fear of financial responsibility, as I am asked to sign for receiving and handing over materials and devices before and after use			
10	Shortage of time allocated to conduct experiments			
11	Training courses for teachers focus only on the theoretical aspect			
12	I suffer from the large number of course content items and the lack of adequate time to complete them properly while using the laboratory			
13	The large number of lessons I teach per week			
14	Lack of my conviction in the importance of the role of laboratories in teaching science			
15	I avoid consuming or damaging laboratory materials			
16	The school administration prevents me from using the laboratory to preserve the tools			
N^0	**Statements related to the student**			
17	Lack of student interaction during scientific experiments			
18	Lack of student behavioral discipline during the conduct of scientific experiments			
19	Students' tampering with laboratory tools and equipment			
20	Students' fear of using laboratory equipment			
21	Lack of students' interest in practical applications because they are not subject to evaluation in general exams			
22	Most laboratory experiments do not touch the reality in which the student lives			
23	Some students' negligence in taking the experiment seriously			
24	Lack of students' motivation to work within the laboratory			
25	The large number of students in the laboratory			
N^0	**Statements related to the laboratory**			
26	Overcrowding of students in the laboratory			
27	The scarcity of necessary services such as water and electricity in the laboratory.			
28	The lack of safety measures and procedures in the school laboratory.			
29	The narrowness of the laboratory space, which hinders the absorption of students.			
30	The lack of a sufficient number of laboratories compared to the number of classes and study sections in the school.			
31	The financial resources to finance laboratory experiments do not match the topics of the curriculum.			
32	The existence of one laboratory for all scientific subjects (physics, chemistry and biology)			
33	The lack of availability of the necessary chemicals to conduct experiments.			

34	Converting the laboratory room into a classroom.			
35	Some laboratories do not have laboratory equipment.			
36	The laboratory tools and devices do not match the topics of the curriculum.			
37	Neglecting the periodic maintenance of laboratory tools and devices			