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## LABORATORY ACTIVITIES IN SECONDARY EDUCATION (a case study with school physics manuals for grade 10<sup>th</sup>)

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### ABSTRACT

The purposes of this research are to identify the implementation policy of laboratory activities for grade 10th students in secondary school, to know the methods that teachers use to practice laboratory, and to discover the difficulties that teachers faced in implementing laboratory practices. The researcher utilized the qualitative method. The informant is 22 teachers (from 22 Secondary schools in three different municipalities: Baucau, Dili, and Maliana, and 44 students as additional informants. Data collection utilized observation, structured interviews, documentation, and a questionnaire approach. The categories of questions were used to analyze the data. It discovered that 72.73% of teachers did not implement laboratory practices on Physics Textbooks for Grade 10th students because schools have no laboratory. The 22.73% of teachers practice even though schools have no adequate instruments; only 4.54% of schools have laboratory instruments. Concerning the laboratory, 63.64% of teachers conducted practice laboratory, and 31.82% did not practice. It indicated only 4.54% practiced in the laboratory. Furthermore, no one of the teachers utilized the procedure practices. However, 95.46% of teachers used the Student Manual and explored further related teaching materials.

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## INTRODUCTION

The development of education in Timor-Leste is an important factor for the national development of the entire country. One of the challenges in the area of education is the lack of training for teachers in general and in the area of natural sciences in particular, especially concerning practical laboratory activities. In the official documents of the Ministry of Education of Timor-Leste, three principles of learning are pointed out that are considered fundamental: cultural relevance, the promotion of integrated human development, and student-centered learning.

The Ministry of Education should promote teacher training, mainly focused on practical laboratory activity, so that teachers gain experience in teaching and learning experimental sciences and so that they can develop a good quality teaching and learning model, both in the context of Timor-Leste as well as in the international context. Education in Timor-Leste has adopted a system that serves the interests of citizens in general so that they can have equal opportunities and access to education. From 1999 to 2010, the Ministry of Education in Timor-Leste implemented the transitional curriculum, similar to the curriculum used during the Indonesian occupation.

Based on the new Basic Education Law, the Minister of education of Timor Leste encompassed a system of education beginning from pre-school, school, extracurricular and professional training, organizing itself for lifelong education. School education comprises basic education, secondary education, and higher education, integrates special modalities, and includes leisure activities. Basic education is compulsory and free for each Timorese child for nine years. The objectives of this education policy are to provide opportunities for the development of skills and basic knowledge of students. The knowledge that allows the student to continue their studies or enter into vocational training schemes. As well as to facilitate the development of personal, and group work instruments and value the human resources (Murerwa & Guantai, 2019; Ministry of Education, 2016; Ministry of Education, 2008).

Article 14 described secondary schools. It is set for three years same as all education systems throughout the globe. Aims of this period are to continue and deepen the learning acquired in basic education (article 15). Secondary education is organized in different ways, considering the existence of general and vocational courses. The general courses are constructed of a humanistic and scientific nature, predominantly oriented towards the pursuit of studies in higher education at university, as well as allowing the student to enter higher technical education. Vocational training courses are oriented on a technical and technological nature or professionalizing, predominantly to the working life. It provides access to both technical and university higher education. To obtain those goals it needs an adequate curriculum.

The curriculum of General Secondary Education in Timor-Leste is established based on two alternative training approaches such as Sciences and Technologies, and Social Sciences and Humanities. Each approach is constructed of specific disciplines, which provide opportunities for pursuing a higher study. Mirroring both approaches

is a general training component, which is composed of subjects that encourage students the deepen important knowledge to choose a specific option. (Education, 2011). In figure 1 the structure of the curriculum is outlined

**Table 1 Structure of the General Secondary Education curriculum plan (Educação, 2011)**

Science & Technology	General components	social Humanities	Science&
(5 subjects	4+4 subjects - grade 10 <sup>th</sup> & 11 <sup>th</sup>	5 subjects	
	4+3 subjects for grade 12 <sup>th</sup>		

Students deepen knowledge about concepts, principles, and methodologies of natural and social science through a scientific approach, technological applications, and implications of a perspective and sustainable development. Furthermore, students must deepen a humanistic culture that allows them to understand as well. Some of the main current problems of societies in historical and geopolitical contexts. Figure 1 demonstrates the eight subjects for the 10th and 11th grades and seven subjects for the 12th grade. Meanwhile, the Physical and Sport Education subjects are not included in the 12th-grade syllabus.

The curriculum of Science and Technology categorize as an addition to the General Component. The Physical-Natural Sciences and Mathematics Component consisted of the disciplines of Biology, Physics, Geology, Chemistry, and Mathematics. In terms of the weekly teaching load, the Secondary Education curriculum distributes 20 teaching times for the general subjects in grades 10th and 11th, and 18 teaching times for grades 12th. As well plus 16 teaching times for the Science and Technology subjects, in the 10th and 11th grades and 18 teaching times in the 12th grade.

The curriculum for Secondary school is based on the school calendar defined for Timor-Leste. The curriculum is divided into (a) three academic periods: January-March; May-July; September to November, (b) six-day school weeks, and (c) teaching times of 50 minutes. It should be noted that it is convenient that teaching times are 50 minutes each hour. It means two hours of the teaching times according to the students' timetable, to allow students for practical activities. Furthermore, each teacher takes principal responsibility for a subject.

The Physics teacher takes responsibility for the Physics learning process in the class or laboratory. The Physics subject is integrated with the specific training. The training is developed over the three academic years of Secondary School, with a weekly workload of three academic periods. In each academic year, three thematic units are addressed that encompass several sub-themes. Throughout this cycle, the study of Classical Physics, namely Kinematics and Dynamics became privileged. The object of this learning process students can understand the macroscopic world, Thermon Dynamics Optics, and Electromagnetism.

Students enable to interpret those mentioned topics. It's essential because Electromagnetism become the basis of technological innovations. Although, Classical Physics becomes the main object of the program. Concerning Modern Physics, the

teacher has to address, particularly Nuclear Physics, due to its essential to understanding aspects related to energy issues experienced in the contemporary world. (ME, 2011).

The following table displayed the themes and thematic units that make up the Physics program for secondary school:

**Table 2. Thematic units of the secondary education Physics program**

ORGANIZING THEME YEAR	THEMATIC UNIT
Grade 10 <sup>th</sup> Mobility in Security & Resources Energizers	From Rest to Movement; Movement in Security Energy and Movements
Grade 11 <sup>th</sup> Human Perception & Development Sustainable	From Stars to Earth Warming; Fluids on Earth From Starlight to Vision on Earth
Grade 12 <sup>th</sup> Technology and Quality of Life	Electric Energy in Society; From Energy Production to Telecommunication in Society; Nuclear Radiation: Risks and Benefits in Society

The students in the grade 10th obtain the discipline of Physics focuses on the study of movement quantities, in the context of Forces, Dynamics, Work, and Energy. The program is based on a theme and is organized into Sub-themes, as shown in table 2.

**Table 3. Thematic units of the grade 10th Physics program in secondary school**

THEMATIC UNITS	SUBTHEMES
Unit A from Rest to Movement	subtheme A.0 Quantities, Units, and Measurements; Subtheme A.1 Movement Description Subtheme A.2 Movements on Earth and Space Subtopic A.0 quantities, units, and measurements quantities, units, and measurements Subtopic A.1 Movement Description; Subtopic A.2 movements on earth and space
Unit B Safety Movement	subtheme b.0 forces and vectors; subtheme b.1 movement and forces subtheme b.2 safety and prevention; subtopic b.0 forces and vectors subtopic b.1 movement and forces; subtopic b.2 safety and prevention
Unit C Energy and Movements	Subtheme C.0 worldwide energy situation Subtheme C.1 transfers and energy transformations in mechanical systems Subtopic C.0 worldwide energy situation Subtopic C.1 transfers and energy transformations in mechanical systems

For each sub-theme, the contents of table 3 defined the learning goals and practical-laboratory. The learning goals reflected the desirable learning for the respective thematic unit in the dimensions of substantive knowledge, procedural knowledge, and reasoning and communication skills. The practical-laboratory

activities (PLA) replicate and represent demonstration and illustration activities also suggested practices in the classroom classes. The students analyzed and interpreted PLA the application problems under the guidance of the teacher (ME, 2014). Table 3 showed the PLA of the program in the grade 10th.

**Table 4. Practical laboratory activities (APL) of the grade 10th**

Thematic units	The topics of practical laboratory activities)
Unit a from rest to movement	1. Position-time graph, 2. Using GPS, 3. Free fall
Unit b Safety movement	1. The resultant of forces, 2. Construction of a rudimentary dynamometer 3. Movement of a parachutist, 4. Newton's laws, 5. Center of gravity 6. Cavendish experience, 7. Inclined plane, 8. Horizontal launch
Unit c energy and movements	1. Electricity in Timor-Leste, 2. Solar oven, 3. Energy efficiency 4. Energy consumption, 5. Kinetic energy along an inclined plane 6. Bounce of a ball, 7. The efficiency of an electric machine

The student experienced PLA at the grade10th, in-unit A, rest to movement offered 3 PLA. Meanwhile, unit B offered 8 PLA including the Movement in Safety. Finally, unit C consisted of 7 PLA to explain Energy and Movements. These PLA are contained in Student Manual for secondary school even though teachers did not implement them well.

Based on the description above, the researcher formulated three problems as follows: (a) What are the opinions of secondary school teachers on the implementation of practice laboratory activities? (b) What are the methods that teachers use in practice laboratory activities? (c) What are the main difficulties that teachers experience in implementing practice laboratory activities?

The researcher defined three objects of this research such as (a) to identify the opinion of teachers in regards to the implementation of laboratory activities for grade 10th students of secondary education, (b) to know the methods that teachers use in practical activities, (c) to identify the main difficulties that teachers experience in implementing laboratory practice activities.

Existing three essential factors of this research are as follows: (a) To understand as a personal enrichment that could prove for the future. Since the researcher has professional activities as a teacher in a Higher school at Physics, (b) To allow researchers to discover the learning process that teachers implement in secondary school including laboratory activities proposed in the Student Manual; It to develop the laboratory activities in Physical-Natural Sciences in Secondary Schools. (c) to analyze the views of teachers on the performance of laboratory practice activities in general secondary school; that utilized the manual of Physical-Natural Sciences become a source of information to implement the practical

laboratory activities in secondary school, even though the researcher faces some limitations.

## **LITERATURE REVIEW**

### **The School Manual as a Curriculum Mediator in the Educational Process**

The school manual is an instrument used to develop skills/attitudes, acquire disciplinary knowledge, and apply and assess student learning (Afonso, 2010). The school manual is considered, in the teaching-learning process, an essential instrument for accessing knowledge or one of the most important resources as an important mediator in the construction of scientific knowledge (Musasia et al., 2016; Figueiroa, 2001). On the other hand, utilizing the manual became widespread from the moment when the concept of "Education for All" was underlined and recognized by the politics of each nation as a right (Santo, 2006). Based on the aforementioned authors, the researcher considers that the school manual is the main facilitating element between students and teachers, which allows them to acquire the scientific knowledge necessary for academic life and which was adopted by the educational policy of each country taking into account the situation. daily life and the evolution of technological application through programs or curricular guidelines.

According to (ministry of education, 2011), students who enter secondary education and acquire scientific knowledge will learn to apply this knowledge in the productive sector in Timor-Leste; they will therefore be prepared to enter the labor market or to continue their studies at university. To materialize this plan, the objectives were established in the basic education law, article 15, (Ministry of Education, 2008), and the curriculum plan for general secondary education (Kagama & Irungu, 2018; ME, 2011).

### **Laboratory Activities in the Science Teaching-Learning Process**

The importance of the laboratory practice activity (LPA) in science teaching and learning was asserted in the 19th century when several countries began to integrate the subject into their curricula. The main purpose of the APL achievement is to develop scientific skills and provide students with skills to solve scientific problems and acquire knowledge. To achieve these purposes, the proper functioning of the practical activities in laboratories with good conditions, equipped with good equipment and materials, must be guaranteed, and knowledge of the rules for the use of materials and equipment must also be known (Jacoby & Siminoff, 2008).

## **METHOD**

The objectives of this investigation were defined in the introduction knowledge of the opinions of secondary school teachers on the implementation of the laboratory activity, the understanding of the methods that teachers use in the laboratory practice activity, and the identification of the main difficulties that teachers experience in implementing the laboratory practice activity. To collect these opinions, interviews were conducted with secondary school teachers from 3 municipalities: Dili, Baucau, and Maliana.

The research sites where we performed the data collection were the following secondary schools: ESG Nicolao Lobato, ESG São Miguel, ESG São José Operário, ESG São Pedro, ESG St. Madalena de Canossa, ESG No4 de Setembro, ESG Sagrado

Coração de Jesus, ESG SENOFA, ESG Nobel Peace Prize, ESG 12 November, ESG Paulos VI, ESG Externato and ESG 5 May, from the municipality of Dili, ESG 02 Vila Nova Baucau, ESG ESSA Baucau, ESG 01 Baucau, ESG São João Bosco Laga , ESGF Quelicai and ESG SACORJES Vila-Nova Baucau, from the municipality of Baucau and ESG Colégio Verbo Divino Maliana, ESG No1 Maliana and ESG Colégio Infante de Sagres Maliana, in the municipality of Malina. The time determined for data collection and recording was one month.

The population is the totality of the set of units considered to be analyzed (Rachmawati, et al., 2021; Kumari, 2017). That's why the population of this research are the professors who teach the discipline of Physics to the grade 10th of Secondary Education students in the 3 municipalities (Díli, Baucau, and Maliana).

The sample is a part of the population (Rachmawati et, al., 2021; Marconi & Lakatos, 2013); therefore, the sample of this research corresponds to 22 teachers from the three municipalities (Díli, Baucau, and Maliana).

To obtain information that could give credibility to this work, the researcher adopted the mixed method (Levitt et al., 2018). Creswell & Clark (2011) define mixed methods as a procedure for collecting, analyzing, and combining quantitative and qualitative techniques in the same research design and Small (2011) classifies studies according to the sequence in which different types of data are collected. In addition to the aforementioned authors, there is another author who states that the use of the mixed method provides technical gains for the researcher (Molina-Azorin, 2016; Freitas, 2016).

Based on the theories of the mentioned authors, in this work the technique of interviewing teachers is used, which preceded the construction of an interview guide, to strengthen the opinions of teachers concerning laboratory practice activities, the researcher applied also questionnaires to students and made the observation of the laboratory and documental analysis concerning the methods of using APL. Information gathering is a process that presupposes an organizing objective, the definition of a strategy, the actual collection of information, and the codification of information. This method allowed us to answer our initial problem: how the school, in general, understands the issue of implementing practical laboratory activities.

The interview is one of the techniques used in primary data collection in which one person requests information from the informant to obtain data about a particular problem (Da Costa et al., 2019; Kauark, 2010). It is obtaining information from an interviewee about a certain subject or problem (Özreçberoğlu & Çağanağa, 2018; Feevale, 2013). Before carrying out this research, an interview guide was created, consisting of 9 questions whose answers, we think, will solve the problem that gave rise to this work.

The questionnaire is an ordered series of written questions that must also be answered in writing by the informant (respondent); a questionnaire can contain open questions, closed questions, and open and closed questions (Fevale, 2013). In this investigation, a questionnaire consisting of open questions directed at students was chosen to strengthen their teachers' opinions.

In addition to using the technique of data collection through interviews and questionnaires. Here researcher also opted for the technique of laboratory

observation and documentation of laboratory practice work reports. This is to validate the results of the interviews. After the phases of collecting and recording all data, the procedures for data processing were followed. A qualitative analysis was displayed, reduction, to conclude the established objectives.

## RESULT

### Analysis of Teachers' Opinion on the Implementation of Laboratory Activities

The analysis of the interviews is based on the categories established for this study. We interviewed Physics teachers who teach in public and private secondary schools in three municipalities: Dili, Baucau, and Maliana. Taking into account the research objectives, namely to understand the opinions of secondary school teachers regarding the implementation of the laboratory practice activity in their schools, we chose to consider, for analysis, three contexts: the laboratory instruments, the methods used in the practical laboratory activities and the difficulties in implementing these activities.

The length of service of teachers. (Q1)

When Physics teachers were asked how long they had been teaching, most teachers responded that they had been working for more than 10 years, as shown in table 4.

**Table 4. The working time of teachers in schools**

Teachers' Answers	Frequencies	Percentage
> 5 Years	7	31,82%
Between 6 years - 10 years	4	18,18%
Between 11 years - 15 years	7	31,82%
≥ 16 years	4	18,18%

Regarding the first question (1st item of the interview guide), about working time in schools, seven teachers (31.82%) reveal that they have less than five years of service, four teachers (18.18%) have between six to ten years of service, seven teachers (31.82%) said they have eleven to 15 years of service and four teachers (18.18%) said they have been working for sixteen or more years.

Teachers' answers about the number of subjects they teach at their school, in addition to the Physics subject (Q2).

**Table 5. Number of teachers teaching in their schools in addition to the subject of Physics**

Teachers' Answers	Frequencies	Percentage
Only the Physics subject	19	86,36%
The discipline of Physics and other disciplines	3	13,64%

Table 5 indicates that of the 22 respondents, the majority, 19 teachers (86.36%), only teach the subject of Physics. The evidence for the response is presented below:

"I only teach the discipline of Physics". (P1, P2, P4, P5, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P16, P17, P19, P21, P22). The teachers who not only teach the discipline of Physics but also other disciplines are only three teachers (13.64%). They state the following:

"In 10th Grade, I teach Physics, but in 11th grade, I also teach the Tetum Language" (P3); "I teach the subject of Physics and I also teach the subject of Multimedia Technologies." (P18); "I teach the subject of Physics and I also teach the Tetum language." (P20).

Teachers' answers about training in the area of Physics and year of completion (Q3)

**Table 6. education in the field of Physics and year of completion**

Teachers' Answers	Frequencies	Percentage
Training in Physics for 5 years	5	22,73%
Training in Physics for over 5 years	13	59,09%
No training in Physics	4	18,18%

Based on the analysis of Table 6, it appears that most respondents, 13 teachers (59.09%), received training in the field of Physics and completed their studies more than five years ago, as corroborated by the following comments: "Yes, I finished at UNTL in the Physics area in 2005" (P1, P4, P5, P14); "Yes, I finished at ISC in the Physics area in 2005" (P8); "Yes, I finished at UNTL in the Physics area in 2009." (P11, P18, P21); "Yes, I finished at UNTL in Physics in 2010" (P6): "Yes, I finished at UNTL in Physics in 2011." (P7, P9, P13); "Yes, I finished at UNTL in the Physics area in 2013." (P17)

Five teachers (22.73%) were also trained in the field of Physics but completed their graduation less than five years ago. Thus, your justification states: "I finished the course at UNTL in the field of Physics and completed it in 2018." (P2, P3, P20, P22); "I finished the course at UNTL in the field of Physics and completed it in 2016." (P19). Some teachers are not trained in the field of Physics but are currently teaching the subject. Only 4 teachers (18.18%) are in this situation. In your answers, we can see: "No, I finished the course at UNTL in the field of engineering and I finished it in 2003." (P10); "No, I didn't finish the course in the physics area but in chemistry at UNTL and concluded in 2018." (P12); "I finished the faculty of agriculture in the livestock department at UNTL in the year 2018." (P15); "I finished the course in the mathematics area at ISC and completed it in the year 2013." (P16).

Teachers' opinions on the quantity and suitability of laboratory instruments in their schools (Q4). Table 7 Laboratory instruments in schools

**Table 7. The instruments of laboratories in schools are sufficient**

Teachers' opinions	Frequencies	Percentage
The laboratory instruments in your schools are adequate.	1	4,54%
The laboratory instruments in your schools exist but are not adequate.	5	22,73%
The laboratory instruments in your schools do not exist.	16	72,73%

Regarding the fourth question (4th item of the interview guide), about laboratory instruments in their schools, sixteen teachers (72.73%) reveal that laboratory instruments do not exist in their schools. Below are examples of answers that show these justifications: "There are no laboratory instruments here." (P1, P2, P7, P9, P10, P11, P12, P13, P14, P16, P17, P18, P19, P20, and P22); "My school still doesn't have the instruments and the laboratory that are enough for us to take our students to the practice activity." (P3). Five teachers (22.73%) report that in their schools there are laboratory instruments but that these are neither sufficient nor adequate. Thus, your justification states: "This school has the instruments concerning the student manual but some instruments don't exist." (P4, P5, P6, P8, and P21). One (4.54%) of the interviewed teachers stated that the laboratory in their school is adequately equipped. "The physics practice instruments are complete and are in the laboratory." (P15).

Teachers' opinions on the performance of practical activities in the laboratory and amount of achievement per quarter (Q5).

**Table 8: Practical laboratory activities take place and amount of performance per quarter**

Teachers' opinions	Frequencies	Percentage
Carrying out practical activities in the laboratory	1	4,54%
Failure to practice activities in the laboratory; just demonstrate in the classroom	7	31,82%
Failure to carry out practical activities and lack of a laboratory	14	63,64%

Analyzing table 8, concerning the place where the practical activities are carried out, we conclude that most of the teachers, fourteen (63.64%), reveal that they do not carry out practical activities due to the lack of a laboratory, as revealed by the interviewees: "We do not carry out the practice in the laboratory, because we do not have the laboratory" (P1, P2, P3, P5, P8, P10, P11, P13, P15, P16, P20); "we never performed the practical activity" (P7); "there is no practice because we do not have the laboratory instruments" (P9 and P19). In table 10, above, we can see that seven teachers (31.82%) also do not carry out practical laboratory activities, but only demonstrate instruments in the classroom, as shown in the following comments: Only use the simple instruments to show students in the classroom but to practice not yet. (P6, P12, P14, P18, P21, and P22); "we performed the practice only in the year 2014 until 2017, this practice was helped by the students but after this, some students were criticizing or regretting so in the year 2018 to date we did not perform the practice but only show the instruments in the classroom. (P17). One (4.54%) of respondents also stated that they carry out practical activities in the laboratory with the following comment: We carry out the practical laboratory activity once a quarter (P4).

Teachers' opinions on the methods use carrying out practical activities to teach the topic of movement, strength, and energy in the laboratory (Q6) the methods they use

in carrying out practical activities to teach the topic of movement, strength, and energy in the laboratory.

Table 9. The methods they use in carrying out practical activities to teach the topic of movement, force, and energy in the laboratory

**Table 9 Teachers' opinions**

Teachers' opinions	Frequencies	Percentage
Use the procedure in carrying out practical activities	0	0%
Do not use the procedure in carrying out practical activities	22	100%

The data indicated in table 11 are related to the use of experimental methods (experimental procedure or experimental protocol); all respondents - 22 teachers (100%) - reveal that they do not use experimental methods. In their answers, they justify their choice as follows: "Only use the simple instruments to show students in the classroom but to practice not yet." (P3, P5, P7, P16, P18, P20, and P22); "does not practice." (P1, P2, P6, P8, P9, P10, P11, P12, P13, P19); "the method we use first, identify the topic, then the objective, then the experimental procedure, observation, the result, and the report." (P4 and P21); "We're going to guide the students, then the students of each can do it alone, we're just going to show the instruments." (P14); "the method he uses as in the practice physics book where it was produced by Mr. Gabriel and currently using it at UNTL in the physics department." (P15 and P17). The technique of data collection in the part of documentation sources concerning the method that teachers use in their practical classes as an answer to P4, P21, P14, P15, and P17 but unfortunately the researcher did not find some documentation on these issues so in the end researcher found that no teacher uses the experimental procedure.

Teacher responses on the use, in teaching the Physics subject, of the Student Manual, Teacher's Guide, and other relevant support materials (Q7). Use of the Student Manual, Teacher's Guide, and other relevant support books in teaching the discipline of Physics.

**Table 10. Use of the Student Manual, Teacher's Guide, and other relevant support books in teaching the discipline of Physics.**

Teachers' opinions	Frequencies	Percentage
Use the Student Manual, Teacher Guide, and other relevant resource books	21	95,46%
Uses only the Student Manual and the Teacher's Guide	1	4,54%
Does not use the Student Manual or the Teacher's Guide	0	0%

Table 10 shows that twenty-one teachers (95.46%) reported using the Student Manual, Teacher Guide, and other support materials to prepare and teach their classes. Let's look at your answers: "Yes, I use the student's manual, the teacher's guide and I also use some references such as the Internet and books." (P2, P3, P4, P5,

P7, P8, P9, P11, P12, P13, P15P17, P18, P19, P21, and P22); “Yes, I use the student's manual, the teacher's guide and I don't use internet references but I also use other books like Brazil or Indonesia” (P1, P10, P14, P16, and P20), One (4.54%) of the interviewed teachers stated that they only use the Student Manual and the Teacher's Guide and do not look for other references concerning the topic they teach. So, in your answer, you say: Yes, I use the student's manual, the teacher's guide, but I'm not going to search for references on the internet, only use the books that are in the library” (P6). The views of teachers on training attended on practical activities in the laboratory by INFORDEPE, UNESCO and others. (Q8). Table the training on practical activities in the laboratory by INFORDEPE, UNESCO, and others

**Table 11. Training on practical activities in the laboratory by INFORDEPE, UNESCO, and others**

Teachers' opinions	Frequencies	Percentage
Attended INFORDEPE training	1	4,54%
Attended the UNESCO training	5	22,73%
Attended the formation of INFORDEPE and the UNESCO	1	4,54%
Attended the formation of other institutions	2	9,10%
Never attended any training	13	59,09%

Regarding the training received by teachers on practical laboratory activities, table 13 indicates that 11 teachers (59.09%) reported that they had never attended any training promoted by INFORDEPE, UNESCO, or any other institution. Below are examples of responses that demonstrate this statement: “I still haven't attended some training on practical activities by Infordepe, UNESCO, or other institutions.” (P1, P2, P3, P4, P5, P7, P9, P10, P12, P13, P16, P20, and P22). Although most teachers have not yet received training within the scope of practical laboratory activities, there are 5 teachers (22.73%) who reveal that they have already attended training promoted by UNESCO. Let's check your answers: “I've already attended UNESCO through SESIM.” (P8, P14, P15, P17, and P21). There are also two professors (9.10%) who attended training given by other institutions. Only one teacher (4.54%) received training from the two institutions, UNESCO and Infordepe, and only one teacher attended training promoted by Infordepe.

Teachers' opinions on carrying out practical activities in the laboratory in terms of the difficulties they face, the importance of the practices, and suggestions relevant to the Ministry (Q9)

Carrying out practical activities in the laboratory in terms of the difficulties they face, the importance of practices, and suggestions relevant to the Ministry Difficulties they face in carrying out practical activities.

**Table 12. the difficulties they face in carrying out practical activities (J. C. Belo, 2019)**

Teachers' opinions	Frequencies	Percentage
The difficulties they face with the use of the Student		

Manual such as the words, the experimental protocol, and the instruments	22	100%
Has no difficulty using the Student Handbook	0	0%

Based on the analysis of table 12, we find that all 22 teachers (100%) reveal that they experience difficulties in carrying out practical activities in the laboratory, the largest consisting in understanding the words used in the Student Manual, in the experimental protocol and the knowledge of the instruments. In their justifications mention the following:

The words in the student manual some easy and some difficult for me and also the experimental method” (P1, P7, P8, P10, P15, and P22); “It talks about the student manual, I think it's not complete yet because I only put the main ones.” (P2); “About this book is a little difficult because most of it is just concepts and the formula is less.” (P3); we have difficulty because the instruments do not complete and also the language.” (P4, P6, P9, P10, P14, P16, and P19).

**Table 13. The importance of laboratory activities**

Teachers' opinions	Frequencies	Percentage
Practical activity is very important	22	100%
Practical activity is not necessary.	0	0%

In table 13, we see that concerning the importance that respondents attribute to practical laboratory activities, 22 teachers (100%) recognize that practical laboratory activities are very important, as they facilitate the learning of exact and experimental sciences. Below are examples of responses that evidence these statements: “Practice is very important because we have a theory, there is also practice so that students can better understand what we teach and it is difficult to forget” (P1, P2, P4, P6, P7, P8, P9, P10, P11, P12, P16, P17, P18, P19, P20 P21, and P22); “practice is very important because through practice we can see our eyes, we can feel and you reinforce the theory we teach” (P3, P13, P14, and P15). Relevant Ministry Suggestions (Ministry of Education, Youth, and Sport).

**Table 14. Suggestions to the MEJD**

Teachers' opinions	Frequencies	Percentage
Distribute instruments across schools	8	36,36%
Build laboratories in schools and distribute instruments	14	63,64%
No instruments or the construction of a laboratory are needed.	0	0%

In table 14, we observe that 14 teachers (63.64%) recommend that the competent Ministry (MEJD) build laboratories in their schools and distribute instruments to carry out practical activities. See the following comments: “I think that from now on the MEJD has to prepare the laboratory for each school because some schools do not yet have the laboratory.” (P1, P2, P3, P7, P9, P10, P11, P13, P14, P17, P18, P20, and P22); “Suggest to MEJD to distribute the practical instruments and

build the laboratory in schools and also see the curriculum because the subject of physical discipline is a lot." (P16)

Eight teachers (36.36%) also suggest to the MEJD the distribution of instruments in their schools. So, in your answers, we can see: "Suggest the MEJD distribute the practice instruments in schools." (P4, P5, P6, P8, P12, P15, P19, and P21). Teachers' opinions regarding training in practical laboratory activities of MEJD.

**Table 15. Teachers' opinions regarding training in practical laboratory activity of MEJD**

Teachers' opinions	Frequencies	Percentage
Provide teacher training, particularly in laboratory practice.	22	100%
No training required	0	0%

The data in table 15, regarding specific training in practical laboratory activities, reveal that 22 teachers (100%) consider that the MEJD should provide specific training in practical laboratory activities. So, in your answers we can see: "The MEJD has to provide training to teachers, particularly on practical activity." (P1, P2, P3, P4, P6, P7, P8, P9, P10, P11, P12, P13, P14, P15, P18, P19, P20, P21, and P22); "suggest the MEJD can cooperate with universities such as UNTL or Cristal, in the end, the professors at the university can provide training to the professors." (P5)

#### Analysis of Student Opinion on the Implementation of Laboratory Activities

The applicable questionnaire of this work is composed of (6) six questions about the implementation of the practical laboratory activity. The questionnaire applicable to students in each class represents two people from each school as a way to strengthen their teachers' opinions through the interview. The result of the questionnaire is shown in table 18.

**Table 16. Students' opinions regarding APL**

Students' opinions	Frequencies	Percentage
Opinions equal to those of your teachers	44	100%
Opinions contrary to those of your teachers	0	0%

To obtain credible data in this work, the researcher not only applied interviews with the teacher but also distributed questionnaires to students, observed the laboratories, and documented, as already mentioned, the techniques and instruments for data collection. From the results obtained in the questionnaire indicated in table 18, above, it was verified that 44 students (100%) agree with their teachers. Concerning question 5, about the place where practical activities are carried out, some of the students mention the following: "No practical activity in the laboratory"

Asked if his teacher performed practical activities in the laboratory, another student answered the following: "Not because at my school in São João Bosco de Laga there is no laboratory room"

Regarding question 6, about the use of the experimental procedure in their practice, most students did not give any answer. Only a few students responded, therefore. Note the following comment:

“The method that the teacher uses to teach students only demonstrates the instruments in the classroom”

#### The Observation

Existence of laboratories in secondary schools in Dili, Baucau, and Maliana

**Table 17. Results of observation of laboratories in schools**

General Secondary Education Schools	Frequencies	Percentage
There is no laboratory	14	63,64%
There is a laboratory but the instruments are not adequate or insufficient	7	31,82%
There is a laboratory and the instruments are adequate	1	4,54%

The results obtained through the observation made in laboratories of twenty-two ESG schools in the municipalities of Dili, Baucau, and Maliana, as shown in Table 17, reveal that in fourteen schools (63.64%) there is no laboratory, and in seven schools (31.82%) there are laboratories but the instruments installed are still not adequate and only in one school (4.54%) is there a laboratory with all the instruments. See table 18 below:

**Table 18. The laboratories that exist in schools in the Municipality of Dili, Baucau, and Maliana**

The laboratory	Name of das Schools	Percentage
Does not exist	1. ESG Nicolao Lobato,	63,64%
	2. ESG são Miguel,	
	3. ESG São José Operário,	
	4. ESG Sagrado Coração de Jesus,	
	5. ESG Nobel da Paz,	
	6. ESG 12 de Novembro,	
	7. ESG Paúlos VI	
	8. ESG 5 de Maio,	
	9. ESG 02 Vila Nova Baucau,	
	10. ESG 01 Baucau,	
	11. ESG São João Bosco Laga	
	12. ESGF Quelicai	
	13. ESG Colégio Verbo Divino Maliana e	
	14. ESG Colégio Infante de Sagres Maliana	

The instruments are not adequate or are insufficient	<ol style="list-style-type: none"> <li>1. ESG São Pedro,</li> <li>2. ESG Sta. Madalena de Canossa,</li> <li>3. ESG No4 de Setembro,</li> <li>4. ESG SENOFA</li> <li>5. ESG Externato</li> <li>6. ESG SACORJES Vilanova Baucau</li> <li>7. ESG No1 de Maliana</li> </ol>	31,82%
The instruments are sufficient	<ol style="list-style-type: none"> <li>1. EGS ESSA Baucau</li> </ol>	4,54%

## Discussion

Practical laboratory activity is an activity that requires the use of laboratory materials that can be performed in a laboratory or a specific well-organized room, in terms of procedure and methodology (Agarwal et al., 2019). The main purposes of practical laboratory activities are: to develop student's scientific knowledge and can solve their problems concerning scientific knowledge (Wilson & Schweingruber, 2016). 22 schools were visited and the results obtained indicate that 14 schools (63.64%) in the municipalities of Dili, Baucau, and Maliana do not have a laboratory. laboratory, as provided for in the curriculum and the Student Handbook. In addition, in seven schools (31.82%) the laboratory instruments are not adequate, so the teachers also do not carry out their activities in the laboratory but only demonstrate the instruments in the classroom, for obvious reasons of lack of instruments, not fully understanding the words used in the Student Manual and/or the experimental procedure; and only in one school (4.54%) are the instruments almost complete.

Twenty-two teachers were interviewed and asked for their opinions on the difficulties they face and the importance of APL. All teachers (100%) consider the APL to be very important and reveal that they have many difficulties in understanding the words used in the Student Manual and the use of the experimental procedure (experimental protocol) and that they have few of the laboratory instruments that exist in the student manual. Due to these difficulties, 14 teachers (63.64%) recommend to the MEJD the construction of laboratories and the distribution of instruments in schools; 8 teachers ask the MEJD only to distribute instruments since they already have a laboratory. Another important recommendation made by all teachers (100%) to MEJD is the promotion of specific training on practical laboratory activities.

The discipline of physics is a discipline that is part of science and technology that encompasses the disciplines of Biology, Physics, Geology, Chemistry, and Mathematics, which makes its contribution to the country's sustainable development through scientific and technological development (Vinet & Zhedanov, 2011).

## CONCLUSIONS

Based on the results obtained, and having as a reference the objectives defined in the introduction: (a) Understand the implementation of laboratory activities in the 10th year of secondary education (b) Understand the methods that teachers use in practical activities and (c) Identify the main difficulties that teachers experience in

implementing laboratory practice activities. The main conclusions of our study are summarized below. Most high school physics teachers surveyed. (a) Recognize that there are no laboratory instruments in their schools, and only some schools have instruments but, despite this, they are neither sufficient nor adequate; (b) They claim that almost none of them carry out practical laboratory activities in their physics classes, and in some schools they only use simple materials to show in the classroom in demonstration mode; with such, they do not use the experimental protocol; (c) They affirm that almost all of them use the student manual, the teacher's guide and other sources of information, such as the internet or other books, but still have difficulties in understanding some words or phrases in the books; (d) Recognize the importance of practical laboratory activities because they are more motivating for students, as they allow them to relate physics to everyday life and because they are more suitable for understanding the phenomena under study; (e) They claim that almost no one attended training on practical activities neither promoted by INFRDEPE nor by UNESCO and, as such, they demand the Ministry of Education to provide them with the frequency of this training, as well as the distribution of instruments to schools.

## RECOGNITION

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## REFERENCES

- Agarwal, P. K., Mcdaniel, M., Strube, M., Fitzpatrick, S., & I, K. S. (2019). Supplemental Material for Retrieval Practice & Bloom's Taxonomy: Do Students Need Fact Knowledge Before Higher-Order Learning? *Journal of Educational Psychology*, 111(2), 189–209. <https://doi.org/10.1037/edu0000282.suppl>
- Afonso, M. I. (2010). *Manual Escolar: Guia De Estudo Ou Prática De Competências? Estudo Com Professores E Alunos Do Introdução As Concepções De Manual Escolar Como Instrumento De Trabalho No Como " Todos Os Meios Materiais Utilizados Para Conv Eniente Realização Da O Desenv.* 113–126
- Creswell, John W & Clark, V. L. P. (2011). *Designing and conducting mixed methods research.*
- Da Costa, A., Goncalves, A. D. S., Pereira, S., & Moreira, P. D. J. (2019). Investigating The Values of Guidance and Counseling in Eleganaboi. *Jurnal Kajian Bimbingan Dan Konseling*, 4(1), 13. <https://doi.org/10.17977/um001v4i12019p013>
- De andrade Marconi, M., & Maria Lakatos, E. (2013). *Fundamentos de Metodologia Científica* (5 edição). são Paulo.
- Educação, ministerio da. (2008). lei bases da educação.
- Educação, ministerio da. (2011). Plano Estratégico Nacional da Educação 2011–2030. 1–259.
- Educação, M. da. (2011). Plano Curricular do Ensino Secundário Geral.

- Educação, M. da. (2011). Programa Física 10.o, 11.o e 12.o ANOS DE ESCOLARIDADE. 1-59.
- Educação, M. da. (2014). Manual do Aluno FÍSICA.
- Feevale, U. (2013). Metodologia do trabalho científico: Métodos e Técnicas da Pesquisa e do Trabalho Acadêmico. Rio Grande do sul, Brasil.
- Figueiroa, M. S. M. A. (2001). Atividades Laboratoriais E Educação Em Ciências Um estudo com manuais escolares de Ciências da Natureza do 5o ano de escolaridade e respectivos autores Alcina Maria Silva Mota Figueiroa Universidade do Minho Instituto de Educação e Psicologia.
- Freitas, D. (2016). Uma introdução aos métodos mistos. 384-411.
- Hodson, D. (1988). Experiments in science and science teaching.
- Jacoby, L. & Siminoff, A. (2008). Empirical methods for bioethics: a primer. In *Igarss 2014* (Issue 1).
- Kagama, J., & Irungu, C. (2018). an Analysis of Teacher Performance Appraisals and Their Influence on Teacher Performance in Secondary Schools in Kenya. *International Journal of Education*, 11(1), 93. <https://doi.org/10.17509/ije.v11i1.11148>
- Kauark, F. (2010). Metodologia da pesquisa. Itabuna/Bahia.
- Kumari, S. (2017). Secondary school teachers' attitudes towards creative teaching. *Scholarly Research Journal for Interdisciplinary Studies, UGC Approv(49366)*. <https://doi.org/10.21922/srjis.v4i37.10588>
- Levitt, H. M., Bamberg, M., Creswell, J. W., Frost, D. M., & Suárez-orozco, C. (2018). *D7301081Fd448954B61Fa73616Ed2D3163a0*. 73(1), 26-46.
- Ministry of education [MOE]. (2016). *Curriculum and learning support materials review cycle policy*. 2016(June 2015).
- Molina-Azorin, J. F. (2016). Mixed methods research: An opportunity to improve our studies and our research skills. *European Journal of Management and Business Economics*, 25(2), 37-38. <https://doi.org/10.1016/j.redeen.2016.05.001>
- Murerwa, T., & Guantai, F. (2019). Conflicts and Conflict Management in Modern Organisations-A Pre -Conflict Resolution Environment Approach. *International Journal of Scientific and Research Publications (IJSRP)*, 9(8), p92104. <https://doi.org/10.29322/ijsrp.9.08.2019.p92104>
- Musasia, A. M., Ocholla, A. A., & Sakwa, T. W. (2016). Physics Practical Work and Its Influence on Students' Academic Achievement. *Journal of Education and Practice*, 7(28), 129-134. [www.iiste.org](http://www.iiste.org)
- Özreçberoğlu, N., & Çağanağa, Ç. K. (2018). Making it count: Strategies for improving problem-solving skills in mathematics for students and teachers' classroom management. *Eurasia Journal of Mathematics, Science and Technology Education*, 14(4), 1253-1261. <https://doi.org/10.29333/ejmste/82536>
- Santo, E. M. (2006). Os manuais escolares , a construção de saberes e a autonomia do aluno . Auscultação a alunos e professores . 103-115.
- Small, M. L. (2011). How to Conduct a Mixed Methods Study: Recent Trends in a Rapidly Growing Literature. <https://doi.org/10.1146/annurev.soc.012809.102657>
- Woolnough, B. (1985). Practical work in Science.
- Rachmawati, I., Multisari, W., Triyono, T., Simon, I. M., & da Costa, A. (2021).

- Prevalence of academic resilience of social science students in facing the industry 5.0 era. *International Journal of Evaluation and Research in Education*, 10(2), 676–683. <https://doi.org/10.11591/ijere.v10i2.21175>
- Rachmawati, I., Multisari, W., Triyono, T., Simon, I. M., & Da Costa, A. (2021). Prevalence of academic resilience of social science students in facing the industry 5.0 era. *International Journal of Evaluation and Research in Education (IJERE)*, 10(2), 676. <https://doi.org/10.11591/ijere.v10i2.21175>
- Suzanne Wilson, Heidi Schweingruber, and N. N. (2016). Science Teachers' Learning. In *Science Teachers' Learning*. <https://doi.org/10.17226/21836>
- Vinet, L., & Zhedanov, A. (2011). A “missing” family of classical orthogonal polynomials. *Journal of Physics A: Mathematical and Theoretical*, 44(8), 1–14. <https://doi.org/10.1088/1751-8113/44/8/085201>