ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr556

The Development and Use of ICT-Supported Teaching Materials: What Training is Needed for Science Teachers? The Case of Secondary Education in Madagascar

Dr. Faly Tinasoa Andrianandrasanirina[1]; Volatiana Freda Ralimampionona[2]; Ratsimbazafy[2]

[1,2] Laboratoire de Recherche Interdisciplinaire en Didactique et Education (LIDIE), Ecole Doctorale Gouvernance et Société en Mutation (GOUVSOMU), Ecole Normale Supérieure de l'Université de Fianarantsoa – BP 1264 - 301 Fianarantsoa City, Madagascar.

Publication Date: 2026/04/27

Abstract: In order to ensure a sustainable and effective educational and teaching solution, we must focus on improving the education systems in Madagascar. This involves creating the structures through which education systems and curricula can be continuously updated; schools must be able to draw not only on education systems and curricula, but also on teaching materials – including digital resources – that are appropriate and consistent, adapted to the challenges of modern-day teaching, and capable of evolving alongside society.

Today, technology plays a major role in our lives. The use of ICT has social, cultural and economic implications. Thanks to ICT, many societies have become knowledge- and information-based societies (modern societies). These digital societies, powered by technology, offer citizens a wide range of opportunities in areas such as commerce, healthcare, education and so on.

In Madagascar, the dramatic expansion of the information and communications network and its impact on society are forcing educational institutions to recognize a new reality that could lead to significant changes in teaching methods. In fact, the ability to instantly find information, communicate, interact and collaborate without the constraints of time and space, and to learn anytime and anywhere via electronic means, has created, in the current Malagasy context, a virtual environment that competes directly with the traditional school environment.

The constant advancement of technology, as well as of educational theories concerning learning and teaching, necessitates the immediate and ongoing adaptation of teacher training. In this era of digitalization in education, it would be absurd to exclude digital teaching materials. Thus, based on the survey we conducted amongst physics teachers, we sought to examine the relationship between the practices and attitudes of physics teachers regarding the use of information and communication technologies (ICT) in the design of teaching materials by themselves, and their relevant training. Teachers' familiarity with ICT due to personal involvement, the limited availability of suitable and free training, the disconnect between the theoretical training provided and real classroom conditions, as well as teachers' keen interest in creating teaching materials, are some of the findings of our survey. These findings lead us to a different conception of the role of teacher training in the field of ICT.

Keywords: *Educational Use of ICT, Teaching Materials, Training; Teachers, Integration of ICT; Education.*

How to Cite: Dr. Faly Tinasoa Andrianandrasanirina; Volatiana Freda Ralimampionona; Ratsimbazafy (2026) The Development and Use of ICT-Supported Teaching Materials: What Training is Needed for Science Teachers? The Case of Secondary Education in Madagascar. *International Journal of Innovative Science and Research Technology*, 11(4), 1944-1953. https://doi.org/10.38124/ijisrt/26apr556

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr556

I. INTRODUCTION

Today, technology plays a major role in our lives. The use of ICT has social, cultural and economic implications. Thanks to ICT, many societies have become knowledge- and information-based societies. These digital societies, powered by technology, offer citizens a wide range of opportunities in areas such as business, healthcare, education and so on.

Indeed, this requires individuals to develop new skills and to adopt a critical perspective on technology and the internet, so that they can use them in a considered, efficient and effective manner. In fact, we believe that pupils' mastery and use of ICT in their learning activities depend largely on that of their teachers.

However, after more than a decade of initiatives led by various donors and other non-governmental organizations in Africa (East and Sub-Saharan), the use of ICT in education remains at a low level.

In Madagascar, the dramatic expansion of the information and communications network and its impact on society are forcing educational institutions to recognize a new reality that could lead to significant changes in teaching methods. In fact, the ability to instantly find information, communicate, interact and collaborate without the constraints of time and space, and to learn anytime and anywhere via electronic means, has created, in the current Malagasy context, a virtual environment in direct competition with the traditional school environment.

The aim of this article is to outline the training context for physics teachers with regard to the development and use of ICT-supported teaching materials. In an initial theoretical section, we will outline the pedagogical integration of ICT and explain the role of ICT training. We will then present the types of training provided to physics teachers. This theoretical section concludes with a discussion of the pedagogical benefits of developing ICT-supported teaching materials.

The second part of our article presents a survey designed to explore teachers' attitudes and practices regarding the use of ICT in the development and implementation of teaching materials they have created themselves, as well as how these relate to the relevant training provided.

II. THEORETICAL FRAMEWORK

The main areas of our research focus on the challenges of teacher professionalisation and the importance of integrating ICT, the benefits and opportunities offered by educational technologies in the classroom, and the obstacles and factors influencing the introduction of ICT into the education system.

The presence of technology in society is shaping the way we learn. Schools are therefore being called upon to make use of and integrate technology into their practices, so that they can meet society's demands and cater to learners' needs.

As far as the challenges posed by ICT are concerned, they are of great importance in the field of education. They are true allies of teaching. They transform the teacher–pupil relationship and alter the relationship with knowledge (Devauchelle, 2012). They facilitate the development of subject-specific skills, as well as cross-curricular skills.

Klein (2013) confirms that digital technology not only boosts learners' motivation but also has other effects: 'Beyond this welcome, indirect psychological effect, digital technologies, when used in teaching, are learning tools in their own right, profoundly altering the strategies pupils use to learn and the strategies teachers use to facilitate learning' (Klein, 2013, p. 8).

With regard to the use of ICT in French language learning, for example, some researchers have highlighted its positive impacts and the opportunities it offers. Guichon confirms that: 'ICT can provide added value in the development of language skills' (2012, p. 9).

Pouts-Lajus and Riché-Magnier (1998) emphasise the intercultural and international aspects of networks and the richness of the web.

This aspect encourages international language exchange among pupils: 'Because networks are based on an international approach, they create situations that are particularly motivating for language learning' (Pouts-Lajus and Riché-Magnier, 1998, p. 75). These tools are easy to use and provide authentic materials. By using the media, the teacher gives the learner access to native speakers and a wealth of audiovisual resources.

In education, impact is defined as the overall outcome of an intervention on the education system. It can be described using a variety of qualitative indicators, such as improvements in national test results or improvements in learning outcomes in schools in line with policy objectives. Impact is the end point of an intervention involving inputs, processes, outputs and outcomes. 'Isolating the variable that caused the impact is problematic in education' (Becta, 2006).

Analysing the benefits that education derives from ICT has become a major concern for the academic community (Karsenti, 2006; PISA 2001; 2003; 2006; Caret, 2006). This research aims to gain a better understanding of the impact of ICT on:

- *The Use and Integration of ICT in Education and the Role of Teacher Training in Madagascar:*

Much research has focused on the factors that promote or hinder the educational use of ICT in the teaching process (Vagkelatos et al., 2011). Survey results show that ICT is underused in schools in terms of both quantity and quality (Muir-Herzig, 2004; Vosniadou et al., 2001).

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr556

In order to gain a clear understanding of the use of ICT in education, it is necessary to conduct a study amongst teachers themselves, as they are key players in the teaching process (Schoretsanitou et al., 2010). It is also important to focus on the factors that influence their decisions regarding the integration of ICT in the classroom.

Teachers note that the use of ICT brings about changes in the learning environment and in the traditional roles of teachers and pupils. Consequently, they consider that their training and support regarding the educational use of ICT are very important factors in enabling them to adopt modern teaching approaches (Kassimati et al., 2001; Kynigos et al., 2000; Mitsiopoulou, 2011).

International research into the use of ICT shows that even after upgrading the equipment used, ICT remains generally underused in the classroom (Baron et al., 2008). Indeed, Moeglin's (2005) analysis suggests that teachers' mixed reception of ICT can be attributed in particular to resistance to changes in teaching practices.

Teachers need to be familiar with the possibilities offered by ICT, not only to ensure their own professional development and growth, but above all to provide effective support to pupils, so that they can learn within these new digital environments (Tzimoyannis et al., 2004).

However, teachers must not simply use technology to gain access to new sources of information. They must be able to rethink their teaching methods and, with the help of ICT, develop new learner-centred activities.

Indeed, it is true that integrating ICT into the classroom is a particularly difficult and complex process. Consequently, teacher training programmes must not be limited to conventional workshops on general-purpose software. On the contrary, they must be set within a framework that takes into account both the technical and pedagogical aspects of ICT.

- *Types of Training for Science Teachers:*

Teacher training encompasses all the measures and activities adopted and implemented to develop teachers' knowledge, skills and practical, academic, personal and professional interests, both at the start of their careers and throughout their working lives (Gkotovos et al., 2000).

In Madagascar, at the École Normal Supérieure (ENS), the types of teacher training offered are: initial training, continuing professional development and distance learning (hybrid).

Initial teacher training is provided at the ENS, which aims to equip students with both theoretical and practical knowledge for a career as a physics teacher (and in other subjects).

Continuing education is defined as 'the continuation or resumption of organised learning following the completion of several years of study at school or university'.

Finally, distance learning (hybrid), as a training and teaching method designed for those who are unable to attend face-to-face sessions.

- *The Benefits of Developing Teaching Materials Supported by ICT:*

The design of ICT-supported teaching materials offers the following advantages: very low cost; a neat layout and presentation, no scribbles or corrections; better organisation of content on the page (Lemeunier – Quéré, 2004); linguistic and cultural content that is always up-to-date and relevant; and considerable time savings. Furthermore, within the framework of computer-assisted teaching, the appearance on screen of various communication media (text, images, sound, video clips) places the act of learning at the heart of a more playful and dynamic context than that generally offered within so-called more or less traditional teaching (Viallion, 2003; Jewitt, 2008; Hirschsprung, 2005). Moreover, the combined presence of text, sound and images has an undeniable impact on the memorisation process (Hirschsprung, 2005), facilitates learners' understanding and increases their motivation (Herman, 2003). Non-linearity, interactivity, multi-channel approaches and multi-referentiality are conducive to action-centred learning (Hirschsprung, 2005).

III. METHODOLOGY, STATEMENT OF THE PROBLEM, ANALYSIS AND INTERPRETATION OF THE RESULTS

The issue of using information and communication technologies in the education system arises at various levels, depending on the approach and intended purpose, whether they are used as a management tool or, from an educational perspective, as teaching content (ICT-based education).

The main areas of our research focus on the challenges of teacher professionalisation and the importance of integrating ICT, the benefits and opportunities offered by educational technologies in the classroom, and the obstacles and factors influencing the introduction of ICT into the education system.

The presence of technology in society is shaping the way we learn. Schools are therefore being called upon to make use of and integrate technology into their practices, so that they can meet society's demands and cater to learners' needs.

Indeed, this requires individuals to develop new skills and to adopt a critical perspective on technology and the internet, so that they can use them in a thoughtful, efficient and effective manner. In fact, we believe that pupils' mastery and use of ICT in their learning activities depend largely on that of their teachers.

- *Results of Our Survey on the Use of Teaching Materials, ICT and ICT in Education:*

The study by Tzimoyannis and Komis (2004) shows that science teachers are more familiar with and competent

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr556

in ICT than their colleagues who teach so-called 'theoretical' subjects.

The aim of our study is divided into two parts (areas of focus). In the first part, we will conduct a comparative study of pedagogical and didactic integration within the teaching process. The second part of our article consists of the presentation of a survey aimed at exploring teachers' attitudes and practices regarding the use of ICT in the development and use of teaching materials they have prepared themselves, whilst presenting the types of training provided to teachers of physical sciences.

We present the results of the survey in the tables below, together with explanatory and interpretative notes, to make the report easier to read and follow.

Table 1 Number of Physics Teachers in the Three Secondary Schools.

Secondary school	Number of teachers
Lycée Zafy Ambilobe	06
Lycée Laurent Botokeky	05
Lycée Jean Joseph Rabearivelo	10
Total	21

Source: Based on the Survey Results and Documentation

- *We used a five-point rating scale as follows:*

✓ TF: very easy: that is, the question is straightforward and poses no difficulty;
✓ E: easy: the question is less straightforward than the previous one;
✓ D: difficult: the teacher encounters difficulties;
✓ VD: very difficult: the teacher encounters greater difficulties than in the previous cases;
✓ NR: no response: the teacher has no answer.

Candidates are therefore asked to tick the box that applies to them, and we have asked them to explain their choices by citing the reasons for the various difficulties.

➢ *Axis 1: Pedagogical and Didactic Integration:*

- *An Interdisciplinary Approach: Teaching Methodology in Secondary Schools and the Psychology of Emotions*

What, then, is the impact that teaching methodology can have on education? To what extent does the level of teachers' education contribute to, or hinder, the quality of the teaching methodology employed? And what tools can be made available to the Madagascan education system to ensure effective teaching methods? These are the questions this document will attempt to answer through research in the field of Educational Sciences, particularly in the teaching of Physics and in emotional education.

So, in seeking answers to these questions, we began by analysing field data on the relationship between the teaching methods used and the quality of teaching as perceived by different stakeholders. Our research into the types and levels of difficulty encountered by secondary school pupils in different regions of Madagascar enabled us to conduct an analytical

study of the influence of teaching methods on the quality of teaching. This should enable us to test the initial hypothesis that all difficulties encountered by pupils depend primarily on the teaching methods employed by the teacher.

Next, regarding the impact of a trainer's level of education on the quality of their teaching in terms of pedagogical ability, the methodology adopted involves an analysis of educational data, using as a reference a model of emotional education based on the Triangles of Fundamental Emotions (TEF). This part of the study relates to the following second hypothesis: the quality of teaching depends on the teacher's level of education (levels of education, intelligence, creativity, intuition, personal development).

The aim of this study is therefore to analyse the findings of research carried out at three secondary schools in different regions of Madagascar on the teaching of physics: at the Lycée Laurent Botokeky in Tulear; at the Lycée Jean Joseph Rabearivelo in Antananarivo; and at the Lycée Zafy Albert in Antsiranana. Subsequently, the impact of emotional intelligence on the design of teaching methods in general will be presented based on data from research conducted with trainee teachers. To this end, this article will present literature reviews and case studies in order to ultimately propose an effective educational solution that promotes best practice in lesson preparation and classroom management.

- *The Reasons for Difficulties in Problem-Solving: the Case of Physics Teaching in Secondary Schools*

The teaching of wave phenomena and electromagnetic induction in sixth form was chosen as the focus of the study to identify the main causes of the difficulties encountered: two identical questionnaire-based surveys were therefore conducted in the three sixth forms mentioned above. This study involved gathering information from two distinct, randomly selected samples: 21 Physics and Chemistry teachers and 181 Year 10 pupils.

A qualitative analysis of the results obtained has enabled us to divide the factors representing the probable causes of difficulties in teaching wave phenomena and electromagnetic phenomena into three categories: issues relating to pedagogical prerequisites (PRE), which concern the intellectual resources of the teacher or the pupil; items related to pedagogy (PED), which concern the psycho-pedagogical and organisational realities of the training; and questions related to didactics (DID), which address the

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr556

science of teaching methods and how to conduct learning in an efficient and intellectually stimulating manner.

Thus, surveys of physics and chemistry teachers and secondary school pupils show that the vast majority of the items selected to analyse the difficulties encountered in learning about induction phenomena relate largely to teaching methodology. In this regard, Table 2 below presents the results of the surveys conducted among 21 secondary school teachers, showing the levels of difficulty experienced by these teachers according to the selected cause of difficulty.

Table 2 Survey Results of 21 High School Physics and Chemistry Teachers

SURVEY OF 21 HIGH SCHOOL PHYSICS AND CHEMISTRY TEACHERS								
Difficulty level: TF: Very Easy, F: Easy, D: Hard, TD: Very Hard, SR: No Answer								
Item characteristics: PED: Pedagogy, PRE: Prerequisites, DID: Didactics								
#	**Item**	**Character**	**TF**	**F**	**D**	**TD**	**SR**	**Total**
1	Understanding the course	PED	0	14	7	0	0	*21*
2	Insufficient course simulation time	DID	3	5	4	2	7	*21*
3	Existing gaps in mathematics	PRE	1	2	4	7	7	*21*
4	Difficulties related to the complexity of physical phenomena	PRE	2	2	10	3	4	*21*
5	Inadequacy of the problem-solving methods	DID	2	3	5	1	10	*21*
6	The professor's method	DID	4	11	4	0	2	*21*
7	The formulas are difficult	PRE	2	7	4	2	6	*21*
8	Lack of mastery of mathematical concepts	PRE	2	2	8	4	5	*21*
9	The lack of practical work	DID	2	4	6	4	5	*21*
10	The lack of exercises on the different types	PED	1	8	6	3	3	*21*
11	Few exercises are covered in class	PED	2	8	3	4	4	*21*
12	Insufficient use of technologies (programmable computer, recorder, etc.)	DID	0	2	5	8	6	*21*
13	The use of ICT in education and ICT	DID	1	3	3	10	4	*21*
14	Use of teaching materials	DID	2	6	5	6	2	*21*
15	Use of educational resources	PED	3	7	3	5	3	*21*
Total		*27*	*84*	*77*	*59*	*68*		

Source: Based on the Survey Results

Initially, without analyzing the degrees of difficulty reported by the Physics and Chemistry teachers and the students involved, we can simply reveal that 7 of the 15 selected items relating to learning difficulties, or 46.67%, indicate a predominance of difficulties related to teaching methods compared to those related to pedagogy (26.67%) or prerequisites (also 26.67%). In fact, almost half of the probable causes of learning difficulties concern the field of teaching methods. The other half is divided between the teachers' pedagogical skills and the prerequisites of the stakeholders involved, including the students. This reality on the ground is illustrated in Figure 1 below, which helps us understand where we should focus our efforts—according to the comments of the teachers and high school students surveyed—to improve the "performance" of specific learning objectives.

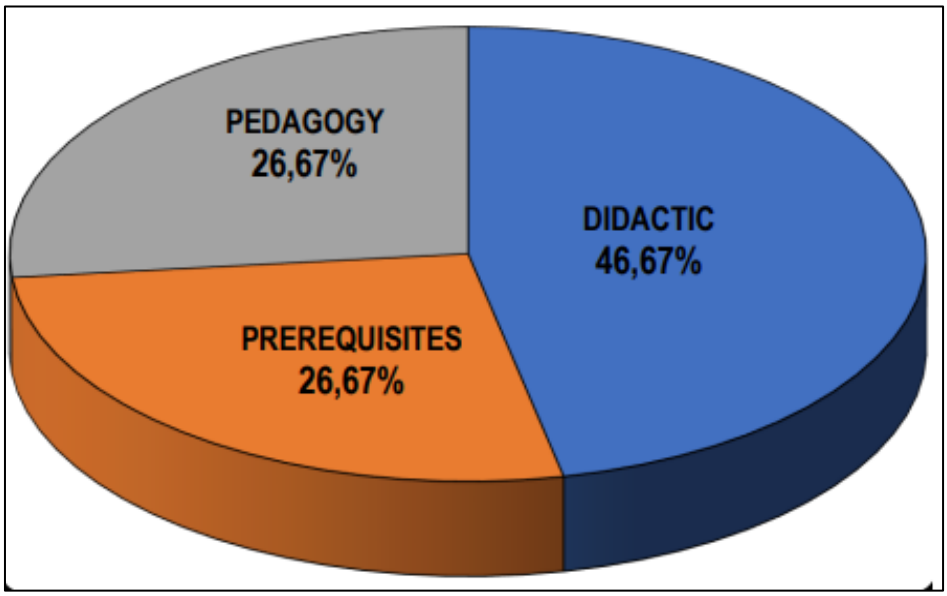

Fig 1 Distribution of Recorded Causes of Difficulty

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr556

The study now continues with response frequency rates, emanating solely from the teaching staff, corresponding to the three areas of difficulty stipulated above. For each level of difficulty reported, the aim is to understand how many times the item (or the answer to the question asked) was selected by the respondent.

These respective rates (percentage relative to the total number of recorded responses) thus represent the proportionality of the factors contributing to the ease or difficulty of learning, ranging from very low to very high degrees. This is presented in Table 3.

Table 3 Response Frequency Rate According to Teachers

RESPONSE FREQUENCY RATE ACCORDING TO TEACHERS							
ITEMS RELATED TO DIDACTICS (DID)							
#	**Question**	**TF**	**F**	**D**	**TD**	**SR**	**SOMME**
2	Insufficient course simulation time	3	5	4	2	7	21
5	Inadequacy of the problem-solving methods	2	3	5	1	10	21
6	The professor's method	4	11	4	0	2	21
9	The lack of practical work	2	4	6	4	5	21
12	Insufficient use of technologies (programmable computer, recorder, etc.)	0	2	5	8	6	21
13	The use of ICT in education and ICT	1	3	3	10	4	21
14	Use of teaching materials	2	6	5	6	2	21
	Total	**14**	**34**	**32**	**31**	**36**	**147**
	Rate (%)	**9,52**	**23,13**	**21,77**	**21,09**	**24,49**	**100**
ITEMS RELATED TO EDUCATION (PED)							
#	**Question**	**TF**	**F**	**D**	**TD**	**SR**	
1	Understanding the course	0	14	7	0	0	21
10	The lack of exercises on the different types	1	8	6	3	3	21
11	Few exercises are covered in class	2	8	3	4	4	21
15	Use of educational resources	3	7	3	5	3	21
	Total	**6**	**37**	**19**	**12**	**10**	**84**
	Rate (%)	**7,14**	**44,05**	**22,62**	**14,29**	**11,90**	**100**
ITEMS RELATED TO THE PREREQUISITE (PRE)							
#	**Question**	**TF**	**F**	**D**	**TD**	**SR**	
3	Existing gaps in mathematics	1	2	4	7	7	21
4	Difficulties related to the complexity of physical phenomena	2	2	10	3	4	21
7	The formulas are difficult	2	7	4	2	6	21
8	Lack of mastery of mathematical concepts	2	2	8	4	5	21
	Total	**7**	**13**	**26**	**16**	**22**	**84**
	Rate (%)	**8,33**	**15,48**	**30,95**	**19,05**	**26,19**	**100**

In descending order of prevalence, these data, classified into the three thematic groups explained above, can be analyzed as follows: 44% of the teachers surveyed believe that problems related to pedagogy do not make learning difficult; 30% reason that a lack of intellectual background (prerequisites) makes it difficult, or even very difficult (19%); only 23% believe that a deficiency in teaching methods does not make it difficult (and therefore easy), etc.

This study should not overlook those who gave no response, representing between 11% and 26% of respondents (SR): these individuals appear to be teachers who either confused the questions asked or experienced communication difficulties with the interviewers or the questionnaires presented.

Despite this, the table clearly shows that, overall, the Physics and Chemistry teachers surveyed identified problems related to prerequisites as the primary source of difficulty (Difficult: 30.95%; Very Difficult: 19.05%; totaling 50%). Next came problems related to teaching methodology (Difficult: 21.77%; Very Difficult: 21.09%; totaling 42.86%). Problems related to pedagogical design and organization affected only 36.90% of the responses (Difficult: 22.62%; Very Difficult: 14.29%). Figure 2 below presents these opinions from the consulted teaching staff in greater detail, highlighting the role of teaching methodology in classroom practice.

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr556

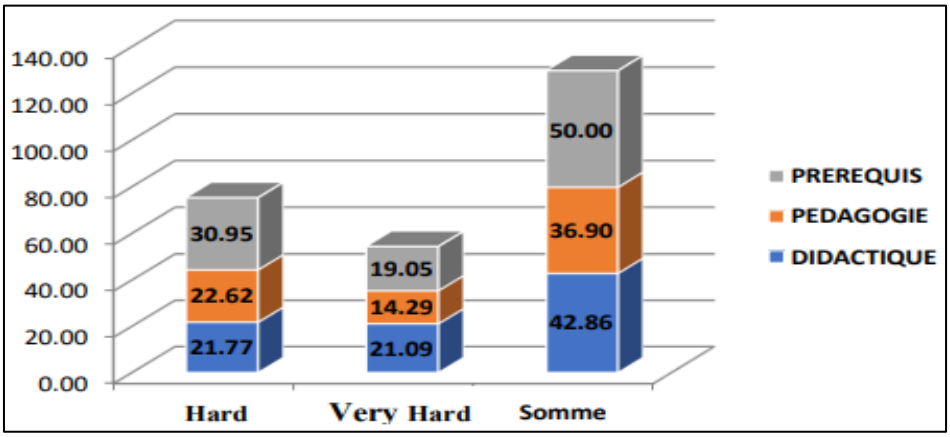

Fig 2 Response Frequency Rate According to Teachers

➢ *Axis 2: Development and use of ICT-Supported Teaching Materials and Types of Training Provided to Physical Science Teachers:*

The following figures present the data collected regarding the use of ICT for the development of teaching materials (Figure 3). More specifically, we asked our sample whether they felt familiar with the pedagogical use of ICT for the development of their courses.

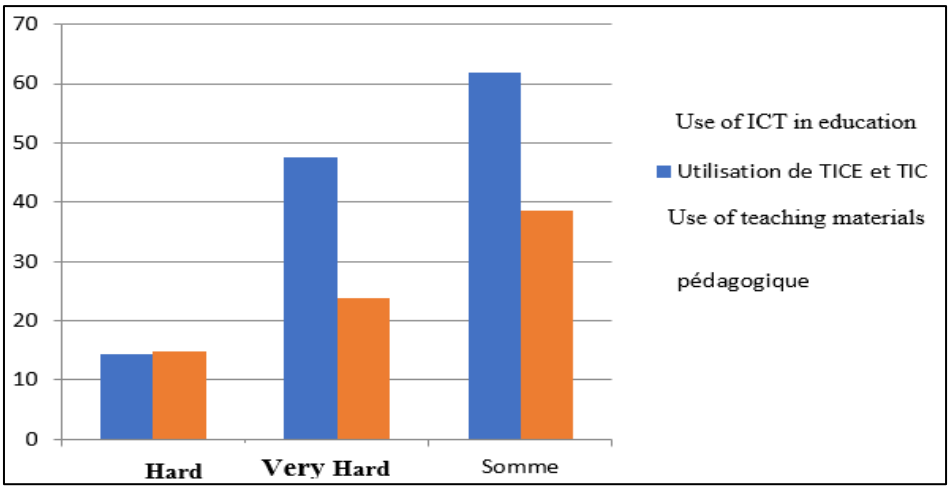

Fig 3 Familiarization with the Educational use of ICT

Regarding the frequency with which the teachers surveyed use ICT to develop their own teaching materials (Figure 4), we find that slightly more than half of the respondents report regularly using ICT to develop their own teaching materials. Fewer use ICT to offer personal teaching materials in the classroom, while a very small number of the teachers surveyed rarely or never use ICT for this purpose.

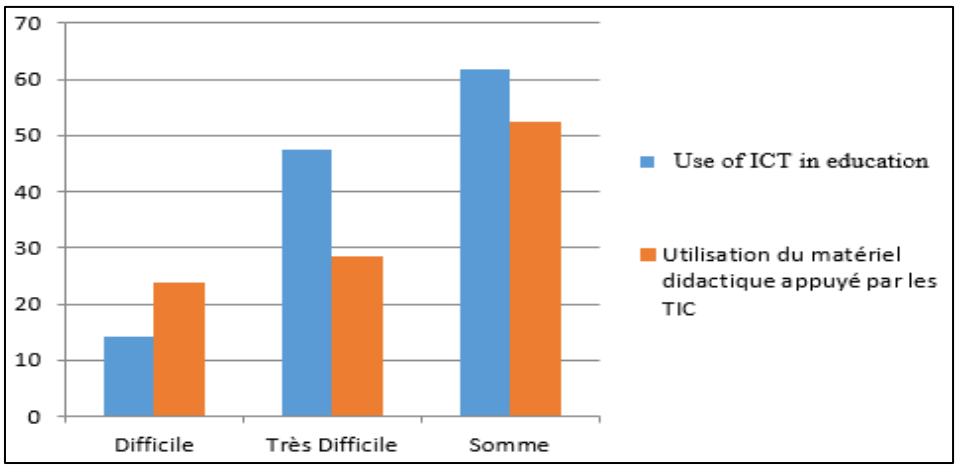

Fig 4 Frequency of use of ICT for the Development of Teaching Materials

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr556

➢ *The Objectives of the Training Project: the Types of Training Undertaken on the Development of Teaching Materials:*

According to J.-P. Cuq (2003, 162), the term "teaching material": "covers all media (paper, audio, video, computer, online, etc.), authentic or designed for teaching purposes, and used for teaching or self-learning. It assumes that a set of documents or activities is organized according to a teaching or learning objective."

As early as 1995, Robert Galisson suggested the existence of a new type of teacher, belonging to a generation that is "better trained, more critical, rejects any revealed truth, and no longer feels bound to the methods or textbooks that, in the absence of a dominant methodology, share the market" (Galisson, 1995, 95). Furthermore, "unlike their predecessors, these new teachers no longer adopt a textbook; they adapt and transgress it."

The design of teaching materials is not only an obligation on the part of the state, but also part of the teachers' "duties," who can create their own materials that are suitable and adapted to the specific needs of their students. Furthermore, teachers designing their own teaching materials allows for greater flexibility, especially if the materials are designed using a modular structure, giving them the possibility of adaptation as needed.

In general, this training project aimed to contribute to improving the quality of physical science teaching at the secondary level in Madagascar with three specific objectives: (obj1) to initiate and strengthen the pedagogical integration of ICT, (obj2) to strengthen the development of teaching materials by the teacher and (obj3) to support the involvement of ICT in the development and use of teaching materials.

To achieve these objectives, 15 activities (5 for the first objective, 5 for the 2nd and 5 for the 3rd) were carried out according to the training schedule.

- *Obj 1: The Pedagogical Integration of ICT:*

Numerous studies focus on the factors that promote or hinder the pedagogical use of ICT in the teaching process (Vagkelatos et al., 2011). Survey results show that ICT is underutilized in schools, both in terms of quantity and quality (Muir-Herzig, 2004; Vosniadou et al., 2001).

To fully understand the topic of the pedagogical use of ICT, it is necessary to conduct a study with teachers themselves, as key players in the teaching process (Schoretsanitou et al., 2010). It is also important to focus our attention on the factors that influence their decisions regarding the integration of ICT in the classroom.

Teachers observe that the use of ICTs leads to changes in the learning environment and in the traditional roles of teachers and students. Therefore, they consider training and support regarding the pedagogical use of ICTs to be crucial factors in enabling them to adopt modern teaching approaches (Kassimati et al., 2001; Kynigos et al., 2000; Mitsiopoulou, 2011).

Table 4 The following represents the 5 activities for the first objective:

Activities for the 1st Objective:
A1.1: Raise awareness among students, teachers, and authorities about the importance of ICT in secondary science education.
A1.2: Create and facilitate forums for exchange among science teachers of the same discipline.
A1.3: Lead science awareness conferences for young people.
A1.4: Screen educational films.

- *Obj 2: Development of Teaching Materials by the Teacher:*

Currently, the abundance of available resources can be perplexing for teachers, and the resulting questions most often include: How can I best use all that exists? And how can I make the right choice? In the following sections, we outline the necessary steps that teachers must take to create their own teaching materials.

➢ *The Steps to Follow:*

The selection and adaptation of materials for teaching purposes are indeed the two major steps in the development of teaching materials. More specifically, the selection of materials involves considering the following parameters:

- The forms of teaching material: functional, cultural, authentic, manufactured, oral, iconic, televisual or electronic documents (Cuq, 2003, 75).
- The sources of teaching material, which according to Lebrun are distinguished into conventional sources and electronic sources (Lebrun, 2006, 2).
- The selection criteria are either situational (the target audience, the level, the institution's curriculum, the content and objectives) or pedagogical (learner-centeredness, creativity, interculturality, etc.).
- As for the adaptation of the selected material for teaching purposes, it is successful following the six-step process described below:
- The pre-pedagogical analysis of the documents selected for the investigation of their functions at the sociolinguistic, linguistic and logico-syntactic levels (Moirand, 1978, 86).
- The development of activities by considering the writing of instructions, the working method followed, the duration and the equipment planned (Weiss, 2002, 9).
- The typology of activities which is closely linked to their functions (Pendanx, 1998, 69).

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr556

- The suitability between media and activities (Gaonac'h, 1987: 201) and, finally,

He care taken in the presentation and final form of the material which, broadly speaking, includes the spelling correction of the text, the presentation of clear and precise instructions, the indication of the origin of the documents and the avoidance of poorly presented or poorly photocopied documents.

Table 5 Below Represents the 5 Activities for the Second Objective:

Activities for the 2nd Year Objective:
A2.1: To brainstorm and test ideas for multimedia rooms
A2.2: To organize a training workshop on the tools produced and the activities carried out by teachers
A2.3: To set up mobile experiments
A2.4: To organize discussions on courses experiencing a shortage of qualified teachers
A2.5: To distribute the laboratory equipment produced to teach the key concepts of dynamics

➢ *Obj 3: Development and Use of Teaching Materials Supported by ICT:*

Nowadays, the Internet is impressively expanding the range of multimedia tools available to teachers, providing a wide variety of teaching methods and materials, whether authentic, semi-authentic or fabricated.

For his part, the teacher "must abandon the role of total referent" (Hirschprung, 2005: 94) and transmitter of knowledge, because now he is inscribed in another framework, that of the conflagration of the learners' needs.

Indeed, the pedagogical use of ICT presupposes knowledge and skills on the part of the teacher, as well as prior experience in their use (Schoretsanitou & Vekyri, 2010: 618). Furthermore, obstacles to the use of ICT in teaching include teachers' lack of time, limited access to suitable equipment, its high cost, a lack of willingness to use it, and, finally, inconsistent teacher training (Muir & Herzig, 2004: 116). In addition, the need for ongoing professional development and a lack of specialization are considered the most significant barriers to teachers' use of computers and related equipment in the classroom.

Table 6 Represents the 5 activities for the third objective:

Activities for Objective 3 :
A3.1: Train science teachers in computer science
A3.2: Introduce graduating students in pilot schools to the use of computers
A3.3: Train the 21 teachers in the use of computer equipment
A3.4: Introduce students to the use of computer tools
A3.5: Establish science spaces, including a multimedia room

IV. CONCLUSION AND OUTLOOK

As confirmed by Schoretsanitou and Vekyri (2004: 618), teachers' attitudes towards the pedagogical integration of ICT constitute a complex variable which contains opinions on the value, usefulness and ease of using ICT in teaching, as well as feelings such as stress, fear and even pleasure.

In short, the development of teaching materials should not discourage the teacher, but on the contrary, it should reassure them. It allows them to reduce the distance between themselves and the learners because, in this way, they show them that they are attentive to their specific characteristics and needs and that they are sharing their own work with them, thus establishing a stronger channel of communication.

Analyzing the data obtained allows us not only to identify gaps in classroom practices or weaknesses in teacher training regarding the pedagogical use of ICT, but also to outline the changes needed to improve its effectiveness. These changes include reducing costs and expanding its geographical reach beyond Madagascar. Furthermore, it is crucial to emphasize the practical application of knowledge in real-world teaching contexts, through the use of continuously updated equipment.

REFERENCES

[1]. BECTA. ImpaCT2: The Impact of Information and Communication Technologies on Pupil Learning and Attainment. London, 2002: BECTA ICT Research.
[2]. BECTA. The BECTA *review 2006. Evidence on the progress of ICT in Education.* London, 2006: BECTA ICT Research.
[3]. Galisson, R. January. "A new teacher, new tools". In: Pecheur (ed.), "Methods and methodologies", Le Français Dans Le Monde, Special Issue, 1995, pp. 70 – 78.
[4]. 9- Vagkelatos, A., Foskolos, F. and Komninos, Th. Interactive whiteboards in education. In Proceedings of the 5th Congress of Computer Science Teachers, "Computer science in primary and secondary education. The role of the computer science teacher in the "New School"", 2011, (p. 207 – 214, in Greek).
[5]. BROUSSEAUGuy,'The Didactic Contract: The Context', Research in Mathematics Education, France, La pensée sauvage, 1990, pp. 309–336.

ISSN No: -2456-2165 https://doi.org/10.38124/ijisrt/26apr556

[6]. JEFFREY Denis et al., 'Law and Ethics in the Teaching Profession' in Guidelines for Teachers' Professional Ethics, Québec, Presses de l'Université de Québec, 2009, pp. 75–91.
[7]. Vosniadou, S. and Kollias, V. Information and communication technology and the problem of teacher training: Myths, dreams and harsh realities. Themes in Education, 2(4), 2001, P 341 – 365.
[8]. Muir – Herzig, R. – G. Technology and its impact in the classroom. Computer and Education, 42, 2004, P 111 – 131.
[9]. Mitsiopoulou, O. and Vekyri, I. Personal and school factors influencing the use of ICT in the classroom by teachers in Greek primary education. In V. Komis (ed.), Proceedings of the 2nd Panhellenic Colloquium "ICT in Education", 2011, (pp. 545–554, in Greek). Patras: New Technologies Publishing House.
[10]. Mitsiopoulou, O. and Vekyri, I. Personal and school factors influencing the use of ICT in the classroom by teachers in Greek primary education. In V. Komis (ed.), Proceedings of the 2nd Panhellenic Colloquium "ICT in Education", 2011, (pp. 545–554, in Greek). Patras: New Technologies Publishing House
[11]. Jewitt, C. Teachers' Pedagogic Design of Digital Interactive Whiteboard Materials in the UK Secondary School. Designs for Learning, I (1), 2008, P 42 – 54.