

TEACHING SCIENTIFIC ENGLISH IN THE DEPARTMENTS OF PHYSICS AND CHEMISTRY - A CHALLENGE TO THE ALGERIAN TEACHERS*

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Abstract

Due to globalization, English has become the most demanded and useful language in the world. It is, in fact, the language of science, technology, communication, medicine, media, research, academic meetings, business, and many other fields. In Algeria, this language has been given much priority as the language of knowledge and skill transfer. However, at university level, the teaching of English in the scientific fields is still facing many challenges and obstacles. Many scientific departments still rely on unspecialized EFL (English as Foreign Language) teachers just to fulfil the curriculum requirements. Therefore, this paper tries to shed light on the real needs of the Algerian university for more EFL curricula in the scientific departments. It attempts to highlight the obstacles and difficulties that face EFL teachers in these branches. Therefore, a case study was conducted in the Department of Physics and the Department of Chemistry in the University of Tiaret. The results revealed that the English language programs in these departments still need to be refined so as to meet the real learning needs of the students and a pre-training for EFL teachers is required.

Key words: Challenges, Chemistry, EFL teachers, Physics, Scientific English.

1. Introduction

Due to globalization, English has become the language of science and technology and many countries in the world have given much importance to this language (Crystal, 2003). Being the language of global research, international scientific events, international media, and cultural encounters, the global demand for learning English has been increasing over the world (Gimeno *et al.*, 2010; Marsh, 2006).

A great bulk of scientific knowledge and material in the internet is written and stored in English. Indeed, something like 80 % of all the scientific and technological information in the world is either published, stored, or abstracted in English. Scholars worldwide tend to publish in English to interact with the international scientific

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community (Kaplan, 1991). Therefore, students as well as teachers and scholars need to learn this language to get access to this scientific and technological literature.

The importance of the English language does not relate the number of people who speak it, but lies in what it is used for (Kitao, 1996). In some universities, English is used as medium of instruction and students' success is correlated with English language proficiency (Berman & Cheng, 2010; Evans & Morrison, 2011). Certainly, scientific English is different from general English. Literary and figurative language such as metaphors and idioms are not useful (Day & Gastel, 2011).

Teaching English to students of Physics and Chemistry is a demanding job, as it requires EFL (English as a Foreign Language) teachers to make research to develop their knowledge in these domains. In fact, the course should be tailored to meet students' specific needs and fulfil their scientific requirements. The EFL teacher should decide about the type of English his /her students will use in their studies. In this research paper, we intend to investigate the type of English that is offered to the students of the scientific departments, namely Physics and Chemistry, and to detect the difficulties and the obstacles that both teachers and students face in teaching and learning scientific English. In this regard, we set these research questions:

1. What are the challenges that face EFL teachers in the scientific departments?
2. How can EFL teachers offer better English instruction in the Departments of Physics and Chemistry?
3. What are the difficulties that face students of Physics and Chemistry in learning scientific English?

To answer these questions, a case study was conducted in the department of Physics and Chemistry to investigate this issue. Both students and teachers are involved in this study.

2. Literature Review: Teaching Scientific English

After the Second World War, the world witnessed of a great boost of scientific, technological, and economic activity. Therefore, foreign language experts created an English language teaching discipline called ESP (English for Specific purposes). Long (2015) argues that an ESP curriculum should be goal-oriented. For instance, the English language programme for students of Physics and Chemistry should be well designed as it must meet their actual learning needs.

Students of science and technology need the linguistic tools that help them develop literacy and build up knowledge in their field of study. They can learn from the scientific literature that includes information and meaning (Schleppegrell *et al.*, 2004). They can produce discipline-related contents as they benefit from the scientific texts they read (Schleppegrell & Achugar, 2003). The Scientific English has special features in terms of syntax, lexis, and morphology.

The great value accorded to English has created specialised EFL disciplines. Many countries, like Algeria, have sought to produce domestically specialised EFL teachers. Further, scientific findings and modern technologies are exchanged all round the world through the English language medium. Therefore, it is important that students

and professionals in these fields develop the necessary English language skills that help them explore scientific studies and play significant roles in the world.

According to Day and Sakaduski (2011), scientists must use the English language with precision. Nation (2001) says that teachers of English must help and provide their learners with technical vocabulary related to their area of study. According to Ball (2000), good teaching is strongly related to subject matter knowledge. They must know the content and how to teach that content. Certainly, teachers of English in the scientific and technical departments should acquire subject matter knowledge related to their students' field of study, because those who lack knowledge about the field of study would interact ineffectively with their learners (Newton & Newton, 2001). Indeed, they cannot ask challenging questions or create productive content –related discussions.

3. Methods and Materials

To investigate the research topic, a case study was conducted in two different scientific departments; the Departments of Chemistry and Physics at Ibn Khaldoun University of Tiaret in Algeria.

3.1. Participants

A sample population of 30 students from two scientific departments at Ibn Khaldoun University was selected. 15 students from the Department of Physics and 15 others from the Department of Chemistry, 17 of them are males and 13 are females. More, 5 EFL teachers were involved in this study. They teach English in Departments of Physics and Chemistry. Three of them work in the University of Tiaret while two others work in the University of Mostaganem.

3.2. Research Instruments

A questionnaire for students and an interview for EFL teachers were used as research instruments.

3.2.1. Students' Questionnaire

The questionnaire is a research tool that includes predetermined questions that limits the respondents' answers to a set of items, and it is usually concerned with quantitative and qualitative data. Its questions must relate to the research questions (Roopa & Rani, 2012). In this research paper, a questionnaire was drafted to 30 students from two scientific departments at Ibn Khaldoun University of Tiaret; the Department of Physics and the Department of Chemistry. It offers different question types and aims at collecting data about the importance of the scientific English in the scientific fields and the type of English that is taught in the above-mentioned departments. The questionnaire's items are aimed to know about the students' opinions, needs, obstacles, and suggestions about the English language instruction they receive.

3.2.2. Teachers' Interview

The interview is an important data gathering instrument which allows verbal communication between the researcher and the informant. In fact, interviews are especially helpful for learning more about a participant's experiences. Indeed, it is an effective flexible research tool that helps the investigator receive views and opinions from the participants. In this research paper, the interview is composed of

a number of questions directed to 5 EFL teachers who teach in the departments of Physics and Chemistry. The main goal of using this data collection instrument is to know more about the difficulties and the challenges that the English language teachers face in the scientific departments. More, it aims at investigating EFL teachers' roles and contributions in enhancing learners' scientific English skills.

3.3. Research Procedures

This research is conducted in the form of case study. It was conducted in two scientific departments: the department of Physics and the department of Chemistry. A questionnaire was distributed to 30 students in these two departments. 15 students from the department of Physics and 15 students from the department of Chemistry. They belong to the same faculty. More, a semi-structured interview was conducted to 5 EFL teachers in these departments, three from the Ibn Kahldoun University of Tiaret, and two others are from the University of Mostaganem.

4. Results

4.1. Analyses of Students' Questionnaire

Item 1 and 2: Do you think that English is important for your field of study? To what extent does scientific English contribute to improving your knowledge in your field of study?

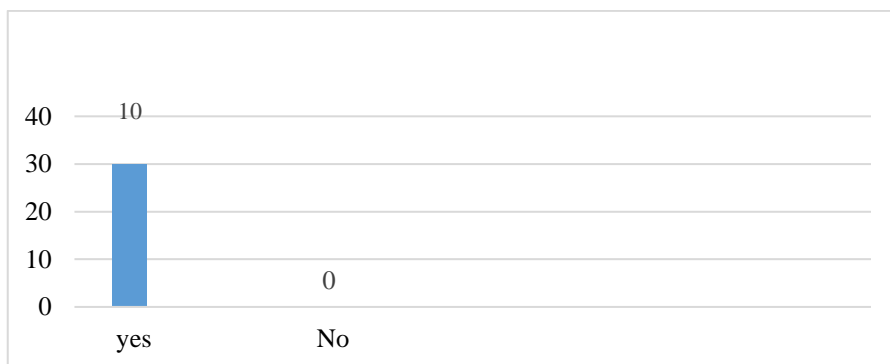


Figure 1. Students Attitudes towards the Importance of Scientific English

The results showed that all the participants believe that scientific English is important for the students of Physics and Chemistry. Some students argued that English helps them get access to scientific corpora published in English. They said that many scientific articles are written English. More, some participants said that they listen to YouTube videos, produced in English, which explain and facilitate some obstacles and misunderstandings related to their field of study. One student talked about her professional career as she said that English would help her work in international companies, as many of them require a good level in English. Further, some students revealed that scientific English keeps them updated with latest information related to their field of study. Gaining communicative competency in English helps them communicate and collaborate with researchers and students from

different universities in the world. Many research findings in Chemistry, one student said, can be shared with our peers in the world. Another student of physics said that he always communicate technical issues with students from other universities in the world. One of the participants said that he want to make higher studies as he needs to make research and publish articles in English.

Item 3: Do you face difficulties in learning scientific English? If yes, what are these difficulties?

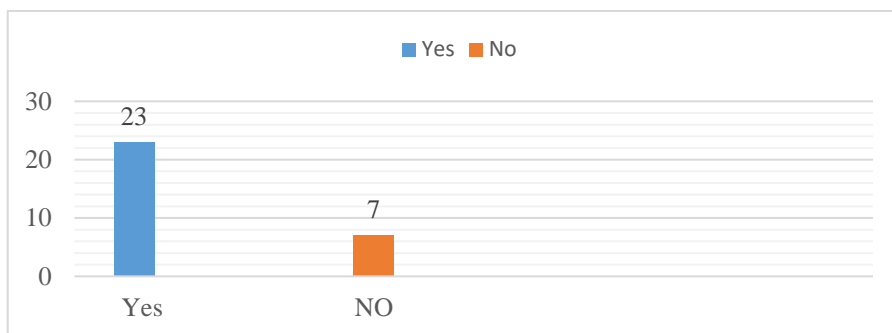


Figure 2. Students' Difficulties

As mentioned in the above figure, the results illustrate that 23students have difficulties in learning scientific English while 07 of them say that they do not face any difficulties. Indeed, this shows that most of the students are not performing well in scientific English. Here are the difficulties revealed by the participants:

- Unfamiliar vocabulary
- Inadequate and insufficient time devoted to the English language module.
- EFL teachers' lack of knowledge related to Chemistry and Physics.
- Inabilities to produce appropriate scientific writing.
- Lack of practice, almost no Physics or Chemistry exercises, notations, equations, technical expression, theories, experiments, or mathematical structures are put in English. Only theoretical courses that give literature review or contain information about physical and chemical concepts.
- Inability to communicate effectively the scientific ideas due to the weaknesses in speaking.
- Stereotype instruction and the absence of updated techniques and strategies in teaching English in both departments.
- Inability to understand scientific texts written in English.
- Lack of exposure to authentic English of Chemistry and Physics in the English language module.
- No incentives or requirement to produce and expose filed-related research.

Item 4: Is your general English level: Good, average, low?

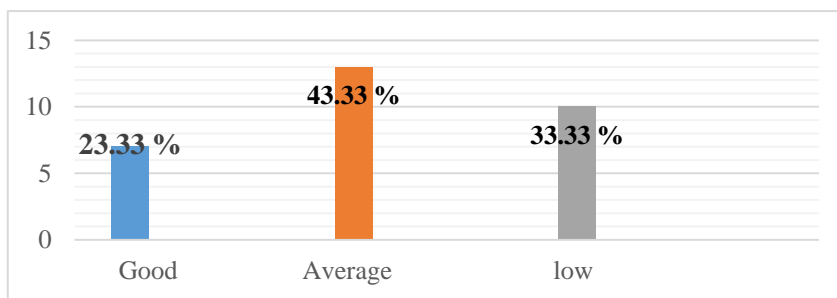


Figure 3. Students' Level in General English

The above figure illustrates that most students have average level in general English. Only 23.33 % of them have good level while 33.33 % have low level. This indicates that offering general English including the four skills is necessary in the scientific departments.

Item 5: Do your teachers of English offer appropriate English that is related to your discipline?

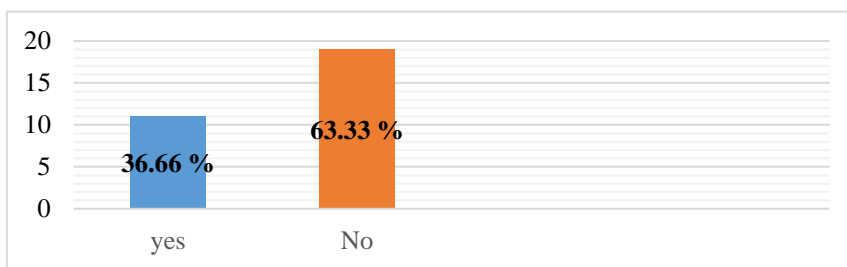


Figure 4. The Type of English provided by EFL Teachers

The above figure shows that most of teachers do not offer field-related English instruction. Only 36.66 of the students in the departments of Physics and Chemistry receive appropriate scientific English. This led us to say that many EFL teachers in these departments are not doing good job.

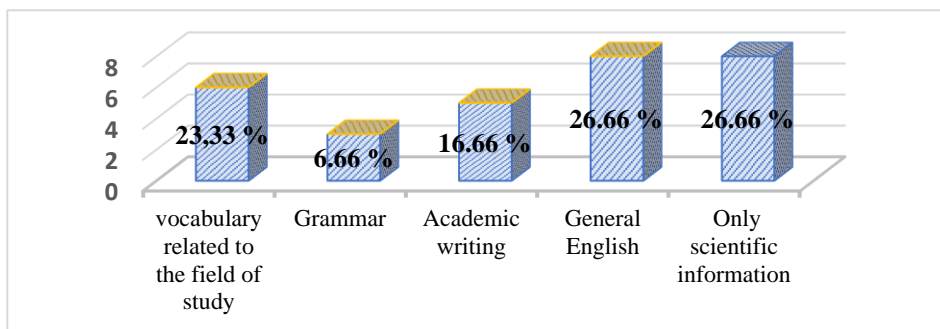


Figure 5. Students' Opinions about the Focus of the English

Item 6: Should the English language instruction focus on:
A/Vocabulary related to the field of study. B/Grammar. C/Academic writing.
D/General English. E/Only scientific information.

Language Instruction

The results revealed that most of the students want general English and scientific English instruction. Few of them want grammar while a considerable number of them want vocabulary related to their field of study. This would say that EFL teachers should find a balance between general English and scientific English instruction.

Item 7: What strategies do you suggest for your department to offer better scientific English?

Here are the main suggestions and strategies given by the informants:

- Elaborating adequate curricula and programs for students.
- Improving the four language skills through introducing both general and scientific English.
- The content should involve scientific knowledge transmitted through the English language medium.
- Using adequate vocabulary related to Chemistry and Physics.
- Guiding and helping students to make research in English.
- Taking into account our learning needs, our level, and our interests.
- Integrating technology and providing the necessary equipment.

4.2. Teachers' Interview Analysis

Item 1: Have you received any specific training before your assignment in this department?

Table 1. Teachers Pre-service Training

Yes	0
No	5

All the participants said that they had not received any training in the field of scientific English. The training they received focused on the pedagogic and the didactic issues.

Item 2: Do you think that specialized training for EFL teachers is necessary before sending them to teach in the scientific departments? Why?

Table 2. Teachers' Opinions about Specialized Training

Yes	5
No	0

All the informants emphasised the necessity of having a specialised training in the scientific domains. One of the participants who teaches English in the department of Chemistry said that the EFL teacher should be equipped with a specific curriculum which offer specific courses in English that provide learners with knowledge about their field of study. Another teacher in the department of Physics viewed that a specific training is very much crucial so that he avoids instructing

general English. Another one said that he struggles to elaborate specific courses in relation to chemical sciences.

Item 3: What encouraged you to teach in this department? Is it your choice?

Two teachers said that teaching scientific English was their choice. The reason behind their choice was their postgraduate ESP (English for Specific purposes) specialities. One of them said he likes the scientific disciplines, as he wanted to broaden his knowledge in these fields. The second said he selected the department of Physics for he endeavours to continue his post-graduate research which was about teaching English for students of Physics as he graduated in ESP. Three other teachers said they did not choose teaching English in the scientific departments, as they did not have the opportunity to teach in the EFL departments.

Item 4: Are you familiar with this field of study?

Table 3. Teachers' Familiarity with the Field of Study

Yes	2
No	3

The results showed that only two teachers are familiar with teaching scientific English in the scientific departments. Three teachers said that they are struggling to offer field-related content to the students of Chemistry and Physics. They said they are making efforts to expand their knowledge in these fields to offer better instruction.

Item 5: Do you offer field-related English instruction to your students? Why?

Table 4. EFL Teachers' Field –related Instruction

Yes	2
No	2
Sometimes	1

As mentioned in the table, two teachers offer specialised English instruction. One of them said that although he is not familiar with chemistry, he said he asks his learners about their specific needs, ask other colleagues, and make research to select materials related to chemistry in order to offer English language instruction tied to scientific information. Those teachers who provide scientific English instruction believe that the general English is not useful in the scientific disciplines. One of them said: "It is not my job to teach punctuation or grammar, they are supposed to learn them by their own". Two other teachers said they, most of the time offer general English instruction as their students are weak in all language skills. They focus on grammar, speaking and writing. They believe that students at university should assume their responsibility to use the English language to make research in their field of study. However, they do not deny that they are trying to improve their scientific English skills in order to make a balance between providing a language instruction and scientific information. Only one teacher gives, sometimes, scientific English instruction.

Item 6: Do you make any research or efforts to improve your knowledge in this field? Why?

Table 5. EFL Teachers' Research in the Field of Study

Yes	4
No	1

The results revealed that most of the participants make research to improve their scientific English skills. One of the teachers said: "I have been developing my knowledge in Chemistry since I was recruited because I must give appropriate English instruction to students so that they get motivated to attend my sessions". Another participant argued: "I started with almost zero knowledge in Physics, after 4 years, I can now include scientific concepts in English instruction. I could not have reach this level without making research". The teacher who does not make research to enhance his scientific English instruction said that he is new in the Department of Chemistry and he is still working on general English instruction.

Item 7: Do you collaborate with other teachers in the department? Why?

Table 6. EFL Teachers' Collaboration with Colleagues

Yes	2
No	3

Two teachers collaborate with other teachers in the department, while three of them do not do so. Indeed, collaboration is very necessary to offer decent instruction which deal with the content of other modules. This would help learners foster their knowledge of other programmes through the medium of the English language.

Item 8. What obstacles and difficulties do teachers and students face as far as teaching scientific English is concerned?

The participants revealed the following difficulties and obstacles:

- Teacher 1: Subject knowledge limitations, teachers lack background knowledge of scientific concepts. Teachers' lack of English vocabulary repertoire in the field of Physics and Chemistry. Lack of cooperation among teachers. And students' low communicative abilities.

- Teacher 2: Lack of good understanding of the scientific studies and concepts. Inability to explain and instruct Chemistry -related topics. Teachers' challenges to decipher language related to Physics. And students' general English weaknesses; in writing, speaking, reading, listening, grammar, and vocabulary.

- Teacher 3: Teachers' scientific vocabulary shortage. Teachers' difficulties in contextualizing scientific language. Most students are unable to write scientific research papers in English. Most of students are unable to comprehend scientific literature written in English due to their weaknesses in academic English.

- Teacher 4: Lack of authentic materials that bond foreign language teaching with specific scientific contents. Absence of specialised textbooks, guides, or curricula that help EFL teachers offer successful instruction in the scientific departments. Complex syntax and language style. Students' weaknesses in the four skills. Lack of interest by students.

- Teacher 5: Failure to conduct appropriate assessment in scientific contexts. Inability to interpret information related to scientific contexts related to Chemistry and physics. Unavailability of field-related material written in English in the library. Students' writing and speaking difficulties. Students do not make research related to their field of study in English.

Item 9: What strategies and recommendations can you provide to EFL teachers to enhance their students' scientific English skills?

The teachers provided the following strategies:

- Teacher 1: Selecting texts that deal with scientific topics related to students' field of study. Considering students' real needs and adjusting instruction constantly. Selecting specific vocabulary related to the field of study. Courses should include scientific contents relevant to the field of study. Using authentic materials.

- Teacher 2: Recommending students to read scientific books, journals, and articles related to their domains written in English instead of French. Students should be required to provide the summaries and expose the new vocabularies to their peers in the classroom. Finding a middle ground between general English and scientific English. Building vocabulary knowledge, with much emphasis on scientific terminology. This can be done through preparing vocabulary lists or extracting them from texts.

- Teacher 3: Recommending the use of scientific English dictionaries. Integrating general English to foster grammar, pronunciation, reading, speaking, listening, and writing skills. Asking learners to conduct research, do projects, or write papers in their fields of study in English. They should present their research findings orally in English. Integrating the four skills focusing on scientific contents can be a useful technique.

- Teacher 4: Posting online courses in English. Encouraging learners to debate scientific subjects using English. Using authentic materials which include scientific texts with vocabulary related to students' area of study. Asking students to use specialized dictionaries. Encouraging students to write reports in English about the experiments they conduct in other modules. Teachers' self-reflection is necessary. They must acquire knowledge of the relevant field of study. For example, an EFL teacher in the department of Physics or Chemistry must learn about these disciplines. Continuous professional development is very much important. Teachers should update their knowledge about the field of teaching constantly.

- Teacher 5: Encouraging autonomous learning. Considering students' real needs and adjusting instruction constantly. Encouraging scientific writing. Providing lists of field-related vocabulary. Adjusting instruction according to students' needs. Continuous assessment is necessary. Encouraging students to write scientific essays, make field-related research in English. Integrating technology.

5. Discussion of Findings

The findings of this research paper reveal obviously both teachers and students' awareness about the importance of the scientific English in the scientific departments. Indeed, English is a vital tool that helps students and teachers gain knowledge and gather scientific information that is produced and published in

English. More, English will help them become brilliant researchers and professionals in the future. In this respect, teachers' knowledge and instructional strategies play significant roles in simplifying the language complications related to science and technology (Seah & Silver, 2018).

However, the findings imply that students of Physics and Chemistry face difficulties in studying scientific English such as scientific vocabulary, unspecialised teachers, and limited time, no practical scientific English, stereotyped instruction, lack of motivation and interest, lack of-field related English and the focus on general English. This lead us to say teachers of English are required to offer adequate English related to students real learning needs. It is important to follow an instructional plan that responds to students' interests. As many of them do not have good level in general English, it is recommended that teachers of English in the scientific departments offer courses in the four skills in addition to grammar and vocabulary. On the other hand, they should involve scientific English through selecting authentic materials. It is not useful to follow only the traditional ways which provide only texts and comprehension questions.

Obviously, EFL (English as Foreign Language) teachers in the Departments of Physics and Chemistry face various obstacles and difficulties. They face challenges such as; limited knowledge in Physics and Chemistry, lack of collaboration, scientific vocabulary deficiency, failure to contextualize the scientific concepts within the English language instruction, lack of the authentic materials written in English in the library, and failure to explain and interpret information related to Chemistry and Physics. Besides, they face student-related obstacles such as: lack of motivation, weaknesses in the four skills, and less students' autonomous efforts to enhance their English language learning.

Further, the findings indicate that a pre-service training is an obligation before sending EFL teachers to the scientific departments. Indeed, most of them are lost as they lack the field-study knowledge. Only few of them are familiar with scientific English while the others are struggling to gain knowledge and set up Physics and Chemistry-related courses. Those teachers do not offer specialised English to the students of scientific disciplines. Therefore, EFL teachers must be equipped with syllabi with clear objectives. More, they must make efforts as they should ask and collaborate with colleagues, detect students' needs, adjust instruction, seek the appropriate teaching materials, and make research to gain scientific knowledge. This would minimise the over-instructing of general English. They should not consider students' weaknesses in general English as pretext to teach only grammar or reading comprehension texts.

Furthermore, teachers should compel their students to read and write in English. They can be asked to conduct projects about other modules and present and explain them in English. More, teachers should encourage the use of specialised dictionaries. Students of Science and Technology should practice the reading, listening, writing and speaking skills. In our case, students of Physics and Chemistry should practice the four English language skills within their learning disciplines. Still, task based-language teaching can be effective (Ellis, 2009). A teacher can

encourage learners to practice asking and answering questions to review the use of tenses. These questions and answers can be about an experiment or an electric design they carried out in the laboratory.

The informants gave interesting suggestions for providing a useful English instruction in the scientific departments: Chemistry and Physics in this case. From their answers, we can infer that there is a need for elaborating specialized curricula that help teachers offer goal-oriented instruction. The syllabus should afford for the four skills and contain practice correlated with the field of study. Students can be encouraged to make research in Physics and Chemistry in English. More, teachers of English should collaborate with their colleagues in order to make useful decisions about their instructional practices.

The findings lead us to say that beside enhancing students' communicative competencies, EFL teachers should offer general English courses including grammar and writing, especially for post-graduate students as they need to communicate and publish their research articles in English. Further, at the micro level, EFL teachers should diagnose, analyse, refine and adjust their courses according to students' needs (Riemer, 2002). The following recommendations can be considered when teaching English the scientific fields, especially Physics and Chemistry:

- Credit and coefficient of the English module should be increased and admission should be based on credit pass in English language.
- The university should ensure that qualified and specialised EFL teachers are employed in the scientific fields. They should afford specific knowledge in any scientific field. Teachers should be graduated from ESP disciplines.
- Integrating a variety of authentic materials within the four language skills.
- Students should apply the four skills while being exposed to scientific articles and journals written English in relation to their particular field of study.
- Explicit and intensive instruction in the specialized language of science and technology should be given to EFL teachers (Anstrom *et al.*, 2010).
- Integrating literacy language with scientific contents (Merino & Scarcella, 2005).
- Direct vocabulary instruction. In each session, EFL teachers should provide a short list of scientific terms in the content area. So, field-related lexicon should be introduced.
- EFL teachers in the scientific departments should ask their learners to conduct projects about their scientific units and present them in English. This will push them to read scientific articles and books written in English. Students will develop significantly their academic language according to learning needs.
- Research-based curricula and courses should be set according to students' needs and areas of study. Because students, future scientists and technologists, need to learn English for good reasons related to their specialisations.

More importantly, teachers should gather evidence about students' needs and offer, accordingly, an appropriate instruction. According to Brown (2016), defining the term of "need" should be determined according to the teaching contexts and subjects. He says that the term could refer to desire, want, necessity, gaps, deficiency, requirements, essentials, or expectations. More, CLIL (Content and Language Integrated Learning) can be also an effective approach (Cenoz, 2015). It can enhance

the English language learning in the Departments of Physics and Chemistry by connecting the content of lessons to field-related topics. Green (2020) recommends that exposing students to scientific English can help them get access to conferences and research. Indeed, the language learning content should focus on facts, fundamentals, and scientific literacy (Pearson *et al.*, 2010; Polias, 2016).

We recommend three phases in preparing a programme of scientific and technological purposes, particularly for students of Physics and Chemistry. The first phase includes general English without including any scientific contents, the second phase involves contents that serve any scientific purpose, and the third phase encompasses specialised Chemistry and Physics 'contents.

6. Conclusions

Definitely, as many EFL teachers lack the knowledge in many scientific domains and disciplines, they should build up knowledge in these domains. They should tie up positive and good relationships with their learners as well as with their colleagues in the target speciality so that they can learn from them. More, they should endeavour to acquire much information as they should broaden their knowledge by making research and searching filed related-curricula.

Indeed, an EFL teacher in any scientific department should find a balance between the general English instruction and the domain-related English. Continuous reflection, making research, integrating technology, cooperating with colleagues, diagnosing students' needs and preferences, and updating instruction are necessary tools for successful instruction and professional development.

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