A Program based on English for Specific Purposes (ESP) to Enhance Scientific Literacy Dimensions among Secondary Students

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Abstract :

Purpose – The study aimed to investigate the effect of a program based on ESP to enhance scientific literacy among secondary students. It proposes modeling four dimensions of SL (nominal, functional, procedural, and multidimensional) and outlining why and how to enhance these dimensions throughout ESP.

Design/methodology/approach – The study adopted the quasi-experimental design using the one experimental group pre-test post-test design, (20) third-year secondary students were randomly selected from two schools. The data were complemented using a structured test comprising 46 questions based on the criteria used in TOSLS by Gormally (2012).

Findings – The study provided empirical insights about the significance of ESP as a learning approach to enhance the students' SL. The multi-dimensions of SL were developed accordingly, those students have language needs to be sustained over time with its content, its functions, organizing and maintaining resources and information during the secondary stage. The results showed a remarkable improvement upon participants regarding all scientific literacy dimensions. Procedural Scientific Literacy came first with an effect size of (2.07), then Functional Scientific Literacy with an effect size of (1.82), then Multidimensional Scientific Literacy with an effect size of (1.40), and lastly Nominal Scientific Literacy with an effect size of about (1.17). The findings also revealed remarkable improvement regarding the overall scientific literacy with an effect size of (1.614).

Research limitations/implications – The study is limited to third-year Arabic governmental secondary schools students, and four dimensions of SL. The students' achievement of scientific knowledge and attitude towards university scientific specialties were the most fulfilled objectives of the study.

Practical implications – The study includes implications for developing programs based on ESP as a learning approach to enhance the students' SL.

Originality/value – The study fulfills an identified need to study how to enhance SL among secondary students throughout needs analysis that leads to developing language programs for those students based on ESP.

Keywords: English for Specific Purposes, ESP, Scientific Literacy, Secondary Students, EFL

برنامج قائم على مدخلِ الإنجليزية لأغراض خاصّة(ESP) لتنمية الوعي العلمي لدى طلاب المرحلة الثانوية

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المستخلص :

هدفت هذه الدراسة إلى قياسِ فاعليّة برنامج قائم على مدخلِ الإنجليزية لأغراض خاصّة لتنمية الوعي العلمي لدى طلاب المرحلة الثانوية، ولتحقيق أهداف الدراسة اتّبع الباحث المنهج شبة التجريبي، وتكونت عينة الدراسة من (20) طالبًا وطالبة بالصف الثالث الثانوي (9 ذكور – 11 إناث). وباستخدام اختبار (ت) الإحصائي لتحليل البيانات، قام الباحث بتطبيق البرنامج المقترح على عينة الدراسة، كذلك اختبار الوعي العلمي متعدد الأبعاد قبليا وبعديا. وقد أظهرت نتائج الدراسة تحسنًا ملحوظًا لدى المشاركين فيما يتعلق بأبعاد الوعي العلمي، حيث جاء بعد الوعي العلمي المفاهيمي الإجرائي بالمرتبة الأولى بحجم تأثير مقداره (2.07)، ثم الوعي العلمي الوظيفي بحجم تأثير مقداره (1.82)، ثم الوعي العلمي متعدد الأبعاد بحجم تأثير مقداره (1.40)، وأخيراً الوعي العملي الإسمي بحجم تأثير مقداره (1.17). كما أشارت النتائج إلى وجود فروق ذات دلالة إحصائية فيما يخص الوعي العلمي ككل قبل وبعد تطبيق البرنامج لصالح ما بعد التجربة، وبلغ حجم التأثير (1.614). واعتمادا على النتائج، قدم الباحث توصيات لمخططي المناهج والبحوث المستقبلية.

الكلمات المفتاحية: الإنجليزية لأغراض خاصة – ESP – الوعي العلمي – طلاب المرحلة الثانوية

Introduction :

English is now used almost exclusively as the language of science. The adoption of English as the universal language of science has had an extraordinary effect on scientific communication. By learning a single language, scientists around the world gain access to the vast scientific literature and can communicate with other scientists anywhere in the world. However, the use of English as the universal scientific language creates distinct challenges for those who are not native speakers of English. A lot of students of many specialties, including medicine, engineering, pharmacy, astronomy, and health sciences of different types are taught in all countries of the world, including Egypt in English. Such sciences cannot be taught based on the local level in Arabic, because of the disruption of scientific communication around the world as well as the lack of ongoing updates on those sciences locally. For example, medical sciences in Egypt are taught in English since the student has been enrolled in the university regardless of whether the student has studied the sciences in Arabic or English at the secondary level.

Also, there is a great overlap between teaching English to students in various stages of education and the readiness of those students to study various sciences in English at the university level, which led to the emergence of the term "English for specific purposes" or ESP, which guides EFL towards the development of some abilities and skills for scientific purposes, This is done in line with the four language skills of listening, speaking, writing, and reading.

The scientific literacy of secondary students is an important factor in the enrollment of these students in scientific faculties of different types. If we succeed at this stage to develop scientific literacy among secondary students, it will help them to succeed in their studies at the university level. The language can stand in front of these students and eventually lead to a loss of motivation and a lack of direction in the study of scientific specialties at the university level.

Statement of the problem

As a matter of fact, ESP combines subject matter and English language teaching. Such a combination is highly motivating because students can apply what they learn in their English classes to their main field of study, whether it be accounting, business management, economics, computer science, or tourism. Being able to use the vocabulary and structures that they learn in a meaningful context reinforces what is taught and increases their motivation. Agustina (2014) argued that within ESP contexts the students' abilities in their subject-matter fields, in turn, improve their ability to acquire English. Subject-matter knowledge gives them the context they

need to understand English. In ESP classes, students are shown how the subject-matter content is expressed in English. The teacher can make the most of the students' knowledge of the subject matter, thus helping them learn English faster.

From the local perspective, Abdel-Fattah, (2015) proved that there is a weakness regarding scientific literacy of students in the secondary stage, as well as the study of El-Sayed Dadour, (2014) who proved that science students have difficulties understanding their English language subjects. Rashwan, (2017) proved that the students of medical faculties need help in comprehending terminologies and texts in English, his study investigated the effect of using translation in ESP medical classes to help students in comprehending terminologies and texts. It also aimed at motivating them and meeting their learning needs. Ibrahim, (2020) also proved that there were several problems that the students in medical faculties face at the faculty such as the lack of some of the basic skills, especially speaking and listening skills.

From the global perspective, Belmekki (2016) demonstrated the effectiveness of using English for specific purposes in helping students in scientific colleges write papers and articles correctly. Soller (2017) demonstrated the effectiveness of this approach in improving the performance of scientific students within the framework of non-English scientific communities.

Questions of the study

To answer the problem elaborated above, this research aimed at addressing the following research questions:

1) What are the main features of the suggested program based on ESP to enhance scientific literacy among secondary students?
2) What are the effects of teaching the suggested program based on ESP regarding all dimensions of scientific literacy among secondary students?

Hypotheses of the Study

1) There are statistically significant differences between the students' mean scores on the pre-post **Nominal scientific literacy test** at (0.05) level in favor of the post-test.
2) There are statistically significant differences between the students' mean scores on the pre-post **Functional scientific literacy** test at (0.05) level in favor of the post-test.

3) There are statistically significant differences between the students' mean scores on the pre-post **Conceptual and Procedural scientific literacy** test at (0.05) level in favor of the post-test.

4) There are statistically significant differences between the students' mean scores on the pre-post **Multidimensional scientific literacy** test at (0.05) level in favor of the post-test.

5) There are statistically significant differences between the students' mean scores of the overall scientific literacy pre-posttest at (0.05) level in favor of the post-test.

Significance of the study

The importance of the current study - at the theoretical level - is that it contributes to dealing with a vital and realistic problem, namely, the lack of scientific literacy among secondary students, which in turn is an important and pivotal reason for the decline in the tendency to study scientific specialties. As well as the effectiveness of designing and teaching a program based on ESP that can achieve more positive results in students' achievement of scientific knowledge and improve their attitude towards the study of scientific specialties at the university level.

At the practical level, the importance of the study appears to be an attempt to verify the effectiveness of using ESP as an approach to teaching EFL at the Egyptian secondary level. It is expected that the final report of the study will provide curriculum planners and designers with real-life experience on how students learn and develop their scientific literacy effectively and practically. The study may help to direct the attention of curriculum planners to the necessity of applying the program proposed by the study into account to be taught to secondary students.

Delimitations of the study

This study is limited to

1) Third-year secondary students at the Egyptian Arabic governmental schools (Science section students).

2) Four dimensions of scientific literacy (nominal, functional, procedural, and multidimensional scientific literacy)

Definition of terms

– English for specific purposes (ESP)

According to the definition of Evans (2000, p 3), ESP is "The way English teaching develops procedures appropriate to learners whose main purpose is learning English for a purpose other than just learning the language system. That purpose may be educational or maybe professional.

Betyna, (2018, p 14) defined ESP as "An approach to language teaching in which all decisions as to content and method are based on the learner's reason for learning,"

Operationally: ESP in the current study is defined as the approach to which the designed program is set to meet the specific needs of secondary students to enhance their scientific literacy.

– Scientific Literacy

Kiabi, & Heidar, (2015, p 20) defined scientific literacy as "an evolving combination of the science-related attitudes, skills, and knowledge students need to develop inquiry, problem-solving, and decision-making abilities, to become lifelong learners, and to maintain a sense of wonder about the world around them."

Scientific Literacy is defined as "Possessing the knowledge, skills, and attitudes necessary for a career as a scientist, engineer, doctor, or technician. (Yuenyong & Narjaikaew, 2009, p 18)

Operationally: Scientific Literacy in the current study is defined as the knowledge and ability to understand scientific concepts and processes required for the fulfillment of succeeding in the study of scientific specialties in Egypt.

Literature Review

From the early 1960s English for specific purposes (ESP) has grown to become one of the most prominent areas of EFL enterprise. The rationale behind integrating ESP in ELT is to help language learners cope with features of language or develop the competencies needed to function in disciplined, professional practices, or workplace. The development of science discourses through ESP has been promoted in the current study as an effective teaching and learning approach for language learners.

According to Stoller & Robinson (2018) ESP courses take on many different configurations. Some are taught by ESP faculty; some are taught by disciplinary

faculty; and others are team taught by interdisciplinary teams, comprising an ESP specialist and discipline-specific instructor. Some ESP courses are geared toward students just entering their academic fields; others are geared toward students at more advanced levels of disciplinary study. ESP instruction sometimes is the sole focus of the course; in other settings, ESP is addressed as one component of a discipline-specific content class or lab. Instructional practices and materials used in this range of ESP classes vary, in part depending on many factors.

From a pedagogical perspective, many researchers i.e. Quero & Coxhead (2018) believe that it is important that the ESP teachers approach vocabulary instruction of this high frequency vocabulary in a way that focuses students' attention on the vocabulary that is worth learning. The motivation for the present study originates from the constant need in ESP research to identify its effectiveness in developing many language learning criteria, the current study verifies the effectiveness of using ESP as an approach of teaching EFL at the Egyptian secondary level. According to Yacoub (2022) there is nothing called ESP teachers in EFL Egyptian classrooms. Teachers are an important and powerful factor in the ESP classroom because of their influence and roles in teaching and learning. English teachers in Egyptian schools are novices regarding ESP and teaching ESP programs would be a challenging task for them.

ESP Course/Program Design

According to Lin, (2018) the main problem in ESP is usually one of the time available and student experiences. First, the aims may be defined in terms of what is desirable i.e. to be able to read in the literature of the students' specialism, but there may be nowhere near enough time to reach this aim during the period of the course. Secondly, the students may be in their first year of studies with little experience in the literature of their specialism accordingly, both these factors may be constraints which say right from the start, the aims cannot be achieved during the class.

In other words, speaking about goal-oriented courses, failure is likely the expected results. This is since ESP is designed to facilitate the road for students to achieve their goals so how it is possible to build the course over those goals. On the other hand, process-oriented courses aim at solving that problem associated with goals by bridging the gap between the ESP course and the target situation. This is done by believing that most students are not able to reach their goals.

As a result, the core of any ESP course should be how to facilitate the task of achieving the goals and clean the road in this process from all constrains. As Akhmadjanovna, (2019, p 125) stated ‘‘The process-oriented approach is at least

realistic in concentrating on strategies and processes of making students aware of their abilities and potential, and motivating them to tackle target texts on their own after the end of the course so that they can continue to improve.''

The current study made use of the language-centered approach and despite the fact of adopting a language, learning, or skills-centered approach; making the ESP course as dynamic and flexible as much as possible is the most important thing. Hence, a clear understanding of students' needs and the demands of the target situation would serve in developing the appropriate materials and methodologies needed to function effectively in a given domain.

ESP and Scientific Literacy

Although the term "scientific literacy" has been used to characterize the aim of science education, there is still considerable uncertainty about its meaning and implications for the curriculum. According to Martins, (2007, p 56) many science educationists and curriculum developers simply coupled content with methods courses, rather than viewing scientific literacy as a basic level of learning in science. (Lan, 2013, p 74).

The program used in the current study synthesizes various pedagogical skills such as reading, writing, talking, and arguing in science, as well as the 'doing' aspect of conducting investigations, and is underpinned by various theoretical positions, which suggest that:

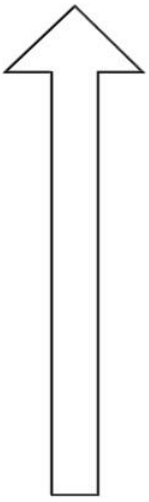
- Pedagogical practices, relating to science and literacy, can be used to develop and scaffold learners' ideas.
- language is a powerful tool for developing scientific knowledge and understanding.
- Metacognitive knowledge is essential to become effective science learners.

The current study adopted the dimensions of scientific literacy of Bybee, Powell, and Trowbridge (2008) who presented the four levels framework starting from nominal scientific literacy to multidimensional scientific literacy in which an individual develops a greater and more sophisticated understanding of science. The main concepts of each dimension can be summarized as follows:

- **Nominal Scientific Literacy**: The ability to identify terms, questions, as scientific but demonstrate incorrect topics, issues, information, knowledge, or understanding, have misconceptions of scientific concepts and processes, give inadequate explanations of scientific phenomena and express scientific principles in a native manner

- **Functional Scientific Literacy**: The ability to use scientific vocabulary, define scientific terms correctly, and memorize technical words
- **Conceptual and Procedural Scientific Literacy**: The ability to understand the conceptual schemes of science, understand procedural knowledge and skills of science, understand relationships among the parts of a science discipline and the conceptual structure of the discipline, and understand organizing principles and processes of science.
- **Multidimensional Scientific Literacy**: The ability to understand the unique qualities of science, differentiate science from other disciplines, know the history and nature of science disciplines, and understand science in a social context.

Fig. (1) The dimensions of scientific literacy



Level	Scientific literacy
Multidimensional	not only has understanding, but has developed perspectives of science and technology that include the nature of science, the role of science and technology in personal life and society
Structural : conceptual and procedural	demonstrates understanding and a relationship between concepts and can use processes with meaning
Functional	can use scientific and technological vocabulary but usually this is only out of context as is the case for example in a school test of examination
Nominal	can recognise scientific terms but does not have a clear understanding of the meaning

Source: Bybee, et al (2008, p 70)

So, the concept of scientific literacy used in this study begins with the premise that learners read content-specific literature to foster ideas about the topic while improving language through written text. The ideas gained through the reading encourage learners to discuss and ask questions; thus, prompting an investigation to test and answer these questions. Through the process of reading learners' may gain a deeper understanding of the content and relevant terms, while writing assists them to organize their understandings. Pelger & Nilsson, (2016, p 442) analyzed and identified scientific terms which people would be frequently exposed to in the media, they had critical ideas regarding the development of meaning through systems of literacy, such as communication and social interactions, as well as within the written text. This interactive approach allows readers to make sense of text and writers to build knowledge while they produce text.

On the other hand, it is worth mentioning that Nuraenah, & Miarsyah, (2019) in their study about correlation between English proficiency and reading comprehension with scientific literacy skills of senior high school students. The result showed that there was a positive correlation between English proficiency and scientific literacy skill. The determination coefficient obtained in their study was relatively low for English proficiency and scientific literacy skills. They indicated that there was another factor that contributed more to students' scientific literacy skills. This result research is expected to be a basic reference for further research. Furthermore, the process of argumentation allows learners to share their knowledge in a structure that requires evidence, backings, and warrants to support claims. As a result, the integrated teaching approach is used to assess learners' ability to read, write, discuss, and communicate their conceptual and procedural understandings in science (Silva, et al 2018).

Design of the study

The current study adopted the quasi-experimental design using the pre-experimental one-group pre-test post-test design, in terms of using one experimental group that was chosen randomly (Stratified Random sampling) from two Egyptian secondary schools. The experiment was during the summer vacation of the academic year 2018/2019.

Participants of the study

A random sample was selected of (20) third-year secondary students (9 males and 11 females) who were randomly selected from two Egyptian secondary schools. Their age was around 18-19. The students have enrolled and preliminarily accepted to study in faculties of medicine around Egypt starting from the academic year 2019-2020. The researcher gathered the contact details of the students and began to offer to teach the ESP Program (the experiment). All the study participants were so motivated to have such a program that might help them in their academic study in faculties of medicine.

Materials & Instruments of the study

1) The ESP program Framework

The program took place in one of the institutions concerned about ESP, (The Scientific Academy for Translation and Training – Alexandria branch). The group was taught by the researcher for five weeks – three sessions per week. Every session lasted an hour. First, the group was given a pretest to measure their scientific literacy.

Then, the group received training throughout the suggested program based on ESP. Finally, the group was given a posttest to measure how far the students developed their scientific literacy.

2) The Scientific Literacy Test

To measure the score of scientific literacy after and before the application of the ESP program, a structured test comprising 46 questions was developed adapting from the literature review and many surveys, tests, and questionnaires developed to measure scientific literacy upon similar samples. The test was built mainly based on the criteria used in TOSLS (Test of Scientific Literacy Skills) By Gormally, Brickman, & Lutz, (2012).

All the questions of the scientific literacy test were objective. The test included four parts that include preliminary **OBJECTIVE** questions regarding the extent to which respondents stay up to date with new articles in their field of study and with new technological advances, integration of science into everyday life, and specific attitudes in health and medicine. All of that was formulated as statements using 5-point Likert-type response options, ranging from 0 marks (total disagreement) to 4 marks (total agreement), in the positive questions. while the other negative questions were using 5-point Likert-type response options, ranging from 0 marks (total agreement) to 4 marks (total disagreement), the dimensions were as shown in Table (1):

Table (1) The Scientific Literacy Test Specifications

N	Dimension	N	Type	Mark*
1	Nominal Scientific Literacy	15	Objective	60
2	Functional Scientific Literacy	10		40
3	Conceptual and Procedural Scientific Literacy	9		36
4	Multidimensional Scientific Literacy	12		48
Total		**46 Q**		**184**

*** Using equations, - (Student score ÷ Full mark) × 10 - each section of the test was given a mark out of 10, and the overall test was given a mark out of 40**

3) The Rubric of the Scientific literacy Test

The researcher used **Holistic Rubrics** - Single criterion rubrics (one-dimensional) - to assess participants' overall achievement on the test and item based on predefined achievement levels. The holistic rubric used a percentage-only scoring method. The test contains 16 positive questions and 30 negative questions. The researcher used a marking criterion from 4 marks for (totally agree) to zero marks for (totally disagree) regarding positive questions. The researcher used a marking

criterion from zero mark for (totally agree) to 4 marks for (totally disagree) regarding negative questions. Every section of the four test sections was marked and given a mark. Then the researcher used the following equation to have a mark out of 10 for every section and out of 40 for the overall test:

$$\text{Section Score} = \frac{\text{The student Score}}{\text{Number of Questions } \times 4} \times 10$$

The overall Test Score = The Section Score × 4

Data Analysis & Results

Results of the first Question

What are the main features of the suggested program based on ESP to enhance scientific literacy among secondary students?

To answer this question, the researcher applied a needs analysis survey before the current experiment, the researcher designed the suggested ESP program. This course is designed to provide students with the ESP skills necessary for medical faculties, and it also helps students get exposed to a range of issues through different readings that are read and discussed in class. The suggested program lasted for 15 sessions and the session lasted for 60 minutes. The ESP approach that the researcher had carried out was the language-centered approach. The researcher set the main Objectives of the ESP Program as follows:

1) Analyze and Appraise medical textbooks & Explain medical terminology
2) Describe and Identify medical manuals, course handouts, and written lectures
3) Extrapolate instructions for medical equipment and labs.
4) Determine and Compare illnesses & diseases
5) Review and Trace medical reports and field-trip reports
6) Interpret and Restate lectures and question/answer sessions in class
7) Propose medical instructions & Produce class presentations
8) Employ Interactions in hospitals and pharmacy

Each unit was designed on the basis that integrates the direct and indirect approaches to teaching terminology and focuses on developing different components of reading, listening, and speaking competence. At the beginning of each unit General objectives, Behavioral Objectives, Content Area, Teaching Methods, Duration, Teaching Activities & Techniques, Teaching Aids, and Evaluation Techniques are established. After that it comes to the medical terminology related to the title of the unit, followed by a reading passage that the student should read and listen to (The Program Audio Reading Activities), the audio file of each unit is distributed among

the participants at the beginning of every unit. The content of the program includes **Five** Units as follows:

1) Unit One: The Human Body
2) Unit Two: Medical Equipment
3) Unit Three: In the Hospital
4) Unit Four: At the Pharmacy
5) Unit Five: Diseases and Illness

The researcher used many teaching methods and techniques when applying for the ESP Program as follows:

- **Resourcing**: having recourse to dictionaries and other materials
- **Inference**: matching an unfamiliar word against available information (a new word etc.)
- **Directed attention**: deciding an advance to concentrate on general aspects of a task
- **Transfer**: using knowledge acquired in the first language to remember and understand facts and sequences in the L2
- **Prediction**: predicting what the text will be about or what it will cover next

The researcher then applied the suggested ESP Program which contains Five units upon participants for 15 sessions within (15) training hours. Every unit was implemented for three sessions, each of which 60 minutes. Every unit was divided into three lessons, as follows:

1. Part (1) terminology
2. Part (2) Reading
3. Part (3) listening sessions, activities & assessment

Results of the second Question

What are the effects of teaching the suggested program based on ESP regarding all dimensions of scientific literacy among secondary students?

To answer this question the researcher highlighted five hypotheses regarding the four dimensions of scientific literacy used in the current study. A pre and post-test of scientific literacy were applied. The appropriate statistical techniques (Paired Sample T-test) were used to compare the students' scores on the test before and after the program. According to Dodgson, (1983), and to make sure that the application of the Paired Sample T-test is valid, we should apply tests of normality upon the Participants results which should be above (0.05), the results are as follows:

Table (2) Results of Normality of the Scientific Literacy Test

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Scientific Literacy Pre-Test	.183	20	.080	.925	20	.126
Scientific Literacy Post-Test	.177	20	.099	.896	20	.065
a. Lilliefors Significance Correction						

Table (2) shows that the Significance of the pretest according to Kolmogorov-Smirnova is (.080) and according to Shapiro-Wilk was (.126) and the Significance of the posttest according to Kolmogorov-Smirnova was (.099) and according to Shapiro-Wilk was (.065), all these results show that the tests had an excellent rate of normality so that we could use the Paired Sample T-test.

– **Hypothesis One**

There are statistically significant differences between the students' mean scores on the pre-post **Nominal scientific literacy** test at (0.05) level in favor of the post-test. To verify this Hypothesis, a T-test was used, the results of the scientific literacy test regarding (Nominal Scientific Literacy) obtained from the Participants (N=20) are as follows:

Table (3) The Paired Sample T-Test results for Nominal Scientific Literacy Dimension Pre-Post Test

	Paired Differences					t	df	T-Value
	Mean	SD	Std. Error	95% Confidence				
				Lower	Upper			
Nominal Scientific Literacy Pre-Post Test	1.167	1.178	.263	.615	1.718	4.42	19	.000

Table (3) shows that there is a statistically significant difference at (0.00) levels between the mean scores of the Nominal Scientific Literacy of the students in the pre-posttest in favor of the post-test. Also, the effect size is good (1.17). Consequently, hypothesis one is supported.

– **Hypothesis Two**

There are statistically significant differences between the students' mean scores on the pre-post **Functional scientific literacy** test at (0.05) level in favor of the post-

test. To verify this hypothesis, a T-test was used, the results of the scientific literacy test regarding (Functional Scientific Literacy) obtained from the Participants (N=20) are as follows:

Table (4) The Paired Sample T-Test results for Functional Scientific Literacy Dimension Pre-Post Test

	Paired Differences					t	df	T-Value
	Mean	SD	Std. Error	95% Confidence				
				Lower	Upper			
Functional Scientific Literacy Pre-Post Test	1.825	1.606	.359	1.073	2.576	5.08	19	.000

Table (4) shows that there is a statistically significant difference at (0.00) levels between the mean scores of the Functional Scientific Literacy of the students in the pre-posttest in favor of the post-test. Also, the effect size is good (1.82). Consequently, hypothesis Two is supported.

– **Hypothesis Three**

There are statistically significant differences between the students' mean scores on the pre-post **Conceptual and Procedural scientific literacy** test at (0.05) level in favor of the post-test. To verify this Hypothesis, a T-test was used, the results of the scientific literacy test regarding (Conceptual and Procedural Scientific Literacy) obtained from the Participants (N=20) are as follows:

Table (5) The Paired Sample T-Test results for Conceptual and Procedural Scientific Literacy Dimension Pre-Post Test

	Paired Differences					t	df	T-Value
	Mean	SD	Std. Error	95% Confidence				
				Lower	Upper			
Conceptual and Procedural Scientific Literacy Pre-Post Test	2.069	1.680	.375	1.283	2.855	5.50	19	.000

Table (5) shows that there is a statistically significant difference at (0.00) levels between the mean scores of the Conceptual and Procedural Scientific Literacy of the

students in the pre-posttest in favor of the post-test. Also, the effect size is good (2.07). Consequently, hypothesis Three is supported.

– **Hypothesis Four**

There are statistically significant differences between the students' mean scores on the pre-post **Multidimensional scientific literacy** test at (0.05) level in favor of the post-test. To verify this Hypothesis, a T-test was used, the results of the scientific literacy test regarding (Multidimensional Scientific Literacy) obtained from the Participants (N=20) are as follows:

Table (6) The Paired Sample T-Test results for Multidimensional Scientific Literacy Dimension Pre-Post Test

	Paired Differences					t	df	T-Value
	Mean	SD	Std. Error	95% Confidence				
				Lower	Upper			
Multi-Dimensional Scientific Literacy Pre-Post Test	1.397	1.553	.347	.670	2.123	4.02	19	.001

Table (6) shows that there is a statistically significant difference at (0.001) levels between the mean scores of the Multidimensional Scientific Literacy of the students in the pre-posttest in favor of the post-test. Also, the effect size is good (1.40). Consequently, hypothesis Four is supported.

To conclude this part, the results show that the students show a strong effect size of developing the scientific literacy dimensions. Procedural Scientific Literacy comes first with an effect size of (2.07), then comes Functional Scientific Literacy with an effect size of (1.82), then comes Multidimensional Scientific Literacy with an effect size of (1.40). lastly comes Nominal Scientific Literacy with an effect size of (1.17).

– **Hypothesis Five**

There are statistically significant differences between the students' mean scores of the **overall scientific literacy** pre-posttest at (0.05) level in favor of the post-test.

To verify this Hypothesis, a T-test was used, the results of the scientific literacy test regarding (The Whole Test) with means and std. deviation for every test to

calculate the effect size of the ESP Program obtained from the Participants (N=20) are as follows:

Table (7) The Paired Sample T-Test results for Scientific Literacy (The Whole Test) Pre-Post Test

	Mean	SD	Paired Differences				
			Mean	SD	t	df	T-Value
Scientific Literacy Pre-Test	6.70	1.72	1.614	1.163	6.20	19	.000
Scientific Literacy Post-Test	8.31	.874					

Table (7) shows that there is a statistically significant difference at (0.00) levels between the mean scores of the overall Scientific Literacy Test of the students in the Pre-Test (6.70) and Post-Test (8.31) in favor of the posttest. Also, the effect size (the two test means) is good (1.614). Consequently, hypothesis Five is supported.

Moreover, it can be said that the ESP Program has a strong effect on developing students' scientific literacy, as all the students' results increased after the treatment. Although the researcher was dealing with participants of a **high achiever** who were very difficult to be satisfied, the results of the test were very satisfying. All the students' means in all dimensions of scientific literacy show that the ESP Program had a very excellent effect.

Conclusion

According to the current study, and after designing and application of the program, the results revealed that there was a statistically significant difference at (0.00) levels between the mean scores of the overall Scientific Literacy Test including all dimensions of the students in the Pre-Test and Post-Test in favor of the posttest. Also, the effect size was excellent (1.614).

All the hypotheses from first to fifth were supported. In brief, the ESP Program had a great effect on developing students' scientific literacy and Attitude towards Medical Sciences, as all the students' responses increased after the treatment.

Recommendations

Based on the findings of the current study, the following pedagogical implications are suggested:

1) English Teachers at the secondary stage should be aware of the significance of ESP as a learning approach to enhance the students' scientific literacy.
2) English teachers at the secondary stage should know that they are dealing with students who are about to begin their university studies and need to develop their English skills based on these fields of study.
3) In terms of long-term learning, needs analysis allows for learning materials to be sustained over time with its content and its functions: organizing and maintaining resources and information over time by the students after the secondary stage.

The university, as well as secondary schools, should, first, help ESP teachers attend workshops and conferences about ESP for the 21st-century classroom concerning how to integrate content into ESP and use student-centered approaches. ESP teachers need to match the content, the student's prior knowledge, and the level of proficiency. With the knowledge gained from professional learning, the ESP teachers could more easily apply this knowledge to the recommended changes through integrating content and teaching ESP in a student-centered way.

Suggestions for further research

The researcher presents the following for future studies:

1) A study that investigates the effect of ESP according to other needs criteria such as engineering, history, technology, and functional purposes.
2) Conducting studies to examine which type of scientific literacy dimensions should be treated along with the secondary stage.
3) The effect of a training program based on ESP in promoting teachers' ability to enhance the language needs of other types of students as International General Certificate for Secondary Education (IGCSE) students.

4) Studies that deal with high achiever secondary students who have problems in achieving in universities integrate the experience of their colleagues in universities with their needs in the secondary stage.

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