

**AN ERROR ANALYSIS OF THE SCIENTIFIC
WRITING OF IRAQI EFL POSTGRADUATES AT THE
UNIVERSITY OF TECHNOLOGY**

BY

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ABSTRACT

This study purports to identify linguistic difficulties that hamper the post-graduate students at the University of Technology from well-formedly writing scientific texts and explain the identified errors in the light of psycholinguistic theories. To fulfil the aims of the present research, ten M.A. and Ph.D. theses written in different branches such as computer engineering, laser engineering, and electrical engineering were analyzed to identify the linguistic difficulties those students face.

The results of an error analysis procedures show that syntactico-morphological errors constitute the majority of errors in scientific writing made by Iraqi postgraduates, followed by stylistic and lexico-semantic errors. Within the category of syntactico-morphological errors, errors in the use of tenses are the highest ones, followed by those in the use of articles, verb groups and lack of concord. Intralingual errors seem to outweigh transfer or interference errors.

Finally, a number of conclusions are drawn, recommendations are put forward, and further studies are suggested.

SECTION ONE: INTRODUCTION

1.2 The Problem of the Study

The nature of scientific writing presents obstacles to many students who require English as a means of furthering their specialized education. It has been found that non-native learners, those of science in particular, face difficulties in writing scientific texts in English (Dudley-Evans and St John, 1998: 74f). This view draws on the premise that scientific writing has special linguistic aspects such as types of English structures, tenses, cohesive devices, etc. This is supported by Selinker and Trimble (1974, as cited in Al-Samarrai, 2003: 3) who find that technical vocabulary is not the only cause of students' difficulties in ESP (English for Specific Purposes). In fact, non-technical words in technical writing give rise to more difficulty than technical ones.

Out of their experience in teaching English and in linguistically examining scientific theses at different colleges and universities, the researchers have noticed that most of Iraqi EFL students could not succeed in writing 'correct' scientific texts and theses. This problem may be attributed to several reasons, chief among which is the fact that scientific writing is characterized by some linguistic peculiarities, prominent of which are the structural (e. g. types of sentences, passive voice, article usage), semantic, rhetorical and stylistic peculiarities which, among other things, add more difficulty to our students.

The difficulty may also be due to the gaps languages manifest in their linguistic structures (Baker, 1992: 100). Accordingly, as English and Arabic are genetically distinct languages showing many linguistic gaps, a lot of mistakes will inevitably result in our students' scientific writing, unless the well-formedness of English writing is taken into consideration.

Although some researchers such as Al-Samarrai (2003) have attempted to identify the difficulties faced by EST (English for Science and Technology) students in comprehending scientific texts and experimented with certain teaching techniques to overcome them, no such endeavour is made in the field of writing scientific texts in Iraq. Hence, the present study is hoped to fill in the gaps in this important field.

1.3 The Aim

The study chiefly endeavours to achieve the following objectives:

1. Identifying linguistic difficulties that hamper the post-graduate students from well-formedly writing scientific texts.
2. Explaining the identified errors in the light of psycholinguistic theories.

1.3 The Hypotheses

The study will verify or refute the following assumptions:

1. Syntactico-morphological errors are more common in scientific writing.
2. Interference of the mother tongue is potentially the major possible source of difficulty.

1.4 The Limitations

The data used in this study is based on 10 theses and dissertations written by male and female postgraduate students of the University of Technology. These pieces of writing represent different fields of specialisations such as civil and architectural (structural) engineering, computer engineering, mechanical engineering, applied sciences, electrical and electronic engineering, laser engineering and chemical engineering. On the other hand, spelling and punctuation errors are out of the limits of the present study.

1.5 The Value

Through good grammar and style, students can well-form their scientific writing. Analysis of these students' errors in this ESP branch is a topic that has not been touched upon before, at least, in the ELT situation in Iraq, to the best of the researchers' knowledge. Therefore, research in this area is both justifiable and worthwhile to all those involved in teaching EST from syllabus designers down to students.

1.6 Definition of Basic Terms

1.6.1 Error

An error is "a deviation in learner language which results from lack of knowledge of the correct rule" (Corder, 1967 as cited in Ellis, 1994: 700). Corder (1973: 259-60) also defines errors as 'breaches of the code' and refers to them as "those features of the learner's utterances which differ from those of any native speaker".

1.6.2 Error Analysis

Error analysis "involves a set of procedures for identifying, describing and explaining errors in learner language" (Ellis, 1994: 701). It provides a comparison of the language of the learner at some particular point in his course with the target language (Corder, 1973: 149).

1.6.3 Scientific Writing

The researchers define scientific writing as a type of formal writing that characterizes the language of science and technology.

SECTION TWO: SCIENTIFIC ENGLISH

2.0 An Introductory Note

There is no theoretical limit to the number of special purposes to which language can be put. As the scientific knowledge is broadening in our contemporary world, people resort to language to develop special varieties associated with the fields of religion, law, science, politics, computing,

broadcasting, medicine, etc. A detailed linguistic account of any one of these areas would itself require an encyclopedia, as the analysis of the language used would require an exposition of the conceptual system that gave rise to it. However, as far as science is concerned, one may observe an extraordinary relation that links it to language. This view is strongly supported by the following amazing statement quoted from Thonis (1970: 177): "science serves as an excellent vehicle for language as its content is drawn from the physical world with which pupils are generally familiar".

2.1 Special English vs. General English

ESP is oriented towards the needs of a specific group of people specialized in a certain field of knowledge. It is distinguished from other approaches to the teaching of English in the choice of 'specialized' vocabulary, 'limited' grammar and rhetoric (Wilkins, 1976: 73). As such, it stands in contrast to general English.

Since ESP has very much concern with the problems of learners in further and higher education who need to know the language to pursue their specialist studies, especially in the field of science and technology (Widdowson, 1979: 37), many studies have attempted to tackle this linguistic concept. However, one may safely say that the most recent comprehensive treatment is that of Dudley-Evans and St John (1998). They have recognized a number of absolute and variable characteristics.

As far as absolute characteristics are involved, they (ibid.: 4) have recognized the following:

- a. Designing ESP to meet specific needs of the learner.
- b. Making use of the underlying methodology and activities of the disciplines it serves.
- c. Focusing on the language skills, discourse and genres appropriate to these activities.

As regards variable characteristics, they have assumed the following points:

- a. ESP may be related or designed for specific disciplines.
- b. ESP may adopt, in certain situations, a different methodology from that of general English*.
- c. ESP is likely to be designed for adult, intermediate, advanced learners, or even beginners.
- d. ESP courses entail basic knowledge of the language system.

2.2 English for Science and Technology (EST)

Depending upon either discipline or professional considerations, ESP has been divided into two main fields: English for Academic Purposes (EAP) and English for Occupational Purposes (EOP). These in turn are classified into subcategories (see Robinson, 1981 as cited in Dudley-Evans and St John, 1998). However, EST has been the main area in EAP.

*For more information on the differences between ESP and general English, see Patzold and Gramely (1992: 246).

Before going further, it is of significance to explain the term EST. In this respect, Strevens (1977: 90) and Robinson (1989: 395) confirm that EST is distinctly characterized by selected terminology, syntactic and morphological constructions (especially affixes) which are related to the study of science and technology. Heavily supporting the above point of view, Kennedy and Bolitho (1984: 6 as cited in Al-Samarrai, 2003: 40) claim that EST "presupposes a stock of vocabulary items, grammatical forms and functions which are common to the study of science and technology".

2.3 Linguistic Features of EST

Many linguists such as Savory (1967: 18), Eskey (1975: 211) and Crystal (1997: 384) stress that EST, being an area of ESP, is linguistically characterized by the following significant features.

2.3.1 Features at the Sentence Level

Most published studies concerned with EST point out the following syntactic characteristics:

2.3.1.1 Nominalisation

By and large, EST has the tendency of appealing to nominal structures. It makes use of combinations of function verb - nouns instead of simple verbs. In this kind of structure, function verbs (general purpose verbs such as *give, make, do, investigate*, etc.) are of low communicative value; e.g.

to work → *to do some work*

to investigate → *to make an investigation*

Linguistically speaking, nominalisation refers to the placement of clauses containing finite verbs with complex structures consisting of verbal nouns usually ending in suffixes such as *-ation, -ity, -ment* or *-ness* (Dudley-Evans and St John, 1998: 77); e.g.

(1) *Because the surface of the retinal is spherical.....* ⇒
Because of the sphericity of the retinal surface

2.3.1.2 Passive Voice

The verbs in EST frequently occur in the passive voice. This may be due to the fact that in such kind of writing we place the 'works' or 'things' at the centre of attention and the person or author who performs the action steps back; e.g.

(2) *Several interviews were conducted to substantiate this hypothesis.* ('We conducted several interviews.....')

However, deciding to use active or passive voice is influenced, to some extent, by functional considerations (Beier, 1980: 79).

2.3.1.3 The Use of Tenses and Modal Verbs

Like any other kind of writing, scientific writing exploits different tenses. Yet, the simple present tense is the most common one as it can be used for

describing scientific apparatus, definitions, statements of cause and effect, etc. Moreover, though less common, the simple past and the present perfect tenses also appear in EST writing.

Modal verbs are frequently used in EST writing. They may entail different meanings which are relatively rare in general English, such as the non-standard uses of 'should' and 'may'. Consider the meaning of these two modals in the following examples quoted from Trimble (1985: 119 as cited in Al-Mousawi, 2005: 59):

- (3) *Steel weld backing should be [=must be] sufficiently thick so the molten metal will not burn through the backing for steel thickness other than gage material, a relief groove may be necessary [=must be used].*

2.3.1.4 Relativisation

Broadly, EST writing employs relative clauses to define or describe the shape, structure, properties, function or process of certain objects (العاني، et al. 1990:48). Relative clauses may be divided into two types: defining or non-defining. Defining (restrictive) clauses modify the noun (antecedent):

- (4) *The man who teaches physics is a graduate of Baghdad University.*

Non-defining (non-restrictive) clauses, on the other hand, add some information to the antecedent which is already known to the hearer or reader. This type of clauses occur with commas; e.g.

- (5) *Those levels at the bottom, where the oil enters, are the hottest.*

Very often relative clauses may be reduced:

- (6) *Pieces of iron which are left in the air become rusty ⇒ Pieces of iron left in the air*

2.3.1.5 Articles

Knowing perfectly the English article system helps one to develop a good awareness of how to use a particular article (or not to use an article at all). Significantly, certain uses of articles play a special role in EST, chief among which is the absence of an article (zero article) in general statements with an uncountable noun; e.g.

- (7) *Oil is a mixture of different chemicals.*

More interestingly, in EST 'the' is used with named methods, procedures, formulae, graphs, cycles, etc.; e.g.

- (8) *The time-sharing concept is very common in the computer system.*

Those two aspects of article usage should be given special attention because they seem to cause particular difficulties for non-native speakers (Dudley-Evans and St John, 1998: 77).

2.3.1.6 Noun Modification

All in all EST adopts the following structures to achieve noun modification:

- a. noun compounding which is the most productive and highly used in EST writing as new concepts and objects are often created; e.g.

- (9) *The plan-table is out of order.*

b. *adjective*; e.g.

(10) *Artificial intelligence is receiving much concern.*

c. *relative clause*; e.g.

(11) *The rate at which work is being done is called power.*

d. *the use of -ing* which is considered one of the important constructions related to modification. Words ending in this suffix may have one of the following functions in EST:

1. *verbal noun*; e.g.

(12) *The programming of computers is a business problem.*

2. *adjective*; e.g.

(13) *Sounding balloons filled with hydrogen penetrate the stratosphere.*

3. *verb*; e.g.

(14) *Engineers working (who work) to solve these unexpected problems are very experienced.*

For more on constructions modifying nouns, see الواسطي et al. (1983: 37-9) and العاني et al. (1990: 46).

2.3.1.7 Adverbial Clauses

'Adverbial clauses' is a widely recurrent structure in EST. It is used to express different functions such as purpose, cause, result, condition, time, comparison, contrast, etc.; e.g.

(15) *Fire extinguishers are painted red so that people can see them easily.*

(16) *After the steam leaves the boiler, it enters the turbine.*

What is noticeable about adverbial clauses is that the tense used in these genres is the simple present in both verbs, the main and the subordinate. This, of course, eases the burden on behalf of both the teacher and the learner since they need not get entangled with the thorny area of time sequence, a subject which has proved extremely difficult for Iraqi learners to master especially at the production level*.

2.3.2 Features Beyond the Sentence Level (Contextual Features)

Writers have to do more than connect clauses within sentences. They must also connect sentences across whole texts. The task of textual analysis is searching for the grammatical devices writers use to create such connections. These grammatical devices are called cohesive devices. In this regard, Halliday and Hassan (1976), Quirk et al. (1985) and Crystal (1997) have recognized the following main devices:

* The researchers, through their experience as teachers of different English subjects in different colleges and through continual discussions with other teachers and scholars, have noticed that most of their students could not succeed in using correct tenses, particularly in complex sentences where they should pay special attention to time sequence.

2.3.2.1 Reference

This is a semantically based device; it points to the referent of a linguistic sign. Reference can be made by using the following expressions: nouns, pronouns, articles, demonstratives and comparison; e.g.

(17) *Yesterday I went to the market. I bought a computer. The computer is not in a good shape. I think I will take it back to the computer dealer and exchange it for a larger one.*

2.3.2.2 Ellipsis and Substitution

These two grammatical devices contribute to cohesion by means of formal relation rather than semantic relations as the case in reference. Both of these processes are used basically to avoid repetition and to give prominence to new information. Let's study the following examples:

(18) *Will you fill the test tube with water? Yes, I will* (fill the test tube)

(19) *Have they performed the complex arithmetical information? No, but they are doing it now.*

In (18) the elements between brackets are ellipsed. They help to establish a cohesive relationship with the previous text, since they can be retrieved only by referring to the preceding sentence. A typical example of substitution appears in (19), where 'doing' is substituted for 'performing the complex arithmetical information'. The meaning of 'doing' can only be determined by referring to the previous text.

2.3.2.3 Discourse Markers

'Discourse markers' is an essential feature of EST. They have been overemphasized in EST materials. Crystal (2003: 141) defines them as "sequentially dependent elements which demarcate units of language (speech and writing)". They are numerous words and expressions which introduce notions such as addition, summary, contrast, transition, result, etc. In this respect, it has been noticed that discourse markers such as '*however*', '*moreover*', '*therefore*', '*for example*', '*since*', '*yet*' and '*on the other hand*' have always had a high profile in EST.

SECTION THREE: DATA COLLECTION PROCEDURES

3.0 An Introductory Note

To achieve the aims of the present study and to have a clear idea of the errors committed by postgraduates in their scientific writing, an error analysis procedure was adopted. The detailed steps of this procedure as well as the sample involved are explained below.

3.1 The Sample

The sample of the present study is represented by eight MA theses and two Ph.D. dissertations written by eight male and two female postgraduate students at the University of Technology for the years 2004 – 2006.

3.2 The Instrument (Error Analysis Procedure)

3.2.1 Collection of a sample of learner language

The postgraduate students involved in this study are Arabic-speaking for whom English is a foreign language. The language medium is clearly written, and the language used is formal and scientific. The type of sample used is what Ellis (1994: 49) calls 'a specific sample' which consists of one sample of language use collected from a limited number of learners.

To elicit the best results of an error analysis procedure a number of factors need to be considered. Some of these factors are related to language medium (oral or written), genre (a conversation, a lecture, an essay, etc.), content (the topic the learner is communicating about) and the learner's level, mother tongue and language learning experience (classroom, naturalistic or a mixture).

3.2.2 Identification of Errors

Errors cannot be identified unless one decides on what constitutes an 'error' and establishing a procedure for recognizing one. The definition of 'error' cited in Section One is adopted by the researchers; namely, an 'error' is a deviation from the norms of the target language. Since the sample involved is a formal, scientific one, the norm selected here is the standard written dialect. On this basis, the researchers surveyed the ten theses and dissertations involved in the present study and detected their errors.

It is worthy to note that the theses under study are not the final versions. They were linguistically assessed by one of the researchers before being exposed to examination.

3.2.3 Description and Classification of Errors

In this stage a comparison is made between the learner's idiosyncratic utterances and a reconstruction of those utterances in the target language. This entails the need for descriptive taxonomies of errors that focus only on observable surface features of errors, as a basis for subsequent explanation (see *ibid.*: 54). In this study, errors are classified into syntactico-morphological, lexico-semantic and stylistic errors.

3.2.4 Explanation of Errors*

After identifying and describing the study sample's errors in detail, the next important step is making an attempt at explaining them. The purpose behind such explanation is establishing the source of the errors; i.e. the

* Some specialists in the field of error analysis suggest two further steps: evaluation of errors and correction of errors, which are beyond the scope of this study.

processes responsible for foreign language acquisition.

The results of the third and fourth stages of error analysis; i.e. description and explanation, are presented in detail in the next section (Section Four).

SECTION FOUR: RESULTS

4.0 An Introductory Note

As mentioned earlier, the description, classification and explanation of the errors committed by postgraduate scientific students in the ten theses under study are detailed here. The total number of these errors is 1318 representing miscellaneous categories as shown below. Categories and subcategories of errors are presented descendently according to their ranking orders; i.e. beginning with the highest-frequency errors. In addition, samples of the study subjects' errors are provided. Finally, an explanation of errors is attempted.

4.1 Description of Errors

4.1.1 Syntactico-Morphological Errors

This category constitutes the largest type of errors with a total of 1211 errors and a percentage of 91.881%, which means that the first hypothesis is verified. It is further divided into the following subcategories as shown in Table 1.

Table 1
Analysis of the Subcategories of Syntactico-Morphological Errors

No	Type of Error	Frequency	Percentage		Rank
			Out of total	Out of this category	
1	Tenses	283	21.472	23.369	1
2	Articles	187	14.188	15.442	2
3	Active & passive voice	160	12.140	13.212	5
4	Prepositions	45	3.414	3.716	7
5	Relative clauses & pronouns	32	2.428	2.642	9
6	Verb groups	180	13.657	14.864	3
7	Lack of concord	179	13.581	14.781	4
8	Plural morphemes	93	7.056	7.680	6
9	Parts of speech	37	2.807	3.055	8
10	Comparative&superlative	15	1.138	1.239	10
	Total	1211	91.881	100.00	

4.1.1.1 Errors in the Use of Tenses

These errors are the most recurrent ones in this category. The total number of errors here is 283 with a percentage of 23.369. They are represented in four main areas as follows.

- a. Lack of the third person singular morpheme 's' when using the simple present tense; (173 errors) e.g.
 *.....*this circuit hold the current of the starter.*
 *Finally, press the button which show the received message.
- b. Using simple past instead of simple present; (59 errors) e.g.
 *Figure 4.11 illustrated the scheme of the CTFI generator.
- c. Using present continuous instead of simple present; (38 errors) e.g.
 *.....*we are depending on the idea of using statistical fractal concepts.*
 *This system is consisting of three stages as shown below.
- d. Using simple present instead of simple future; (13 errors) e.g.
 *After the voltage reaches its final value, the system begins to reduce the field current.

4.1.1.2 Errors in the Use of Articles

These errors occupy the second rank in this category. Their total number is 187 with a percentage of 15.442. They are represented in five main areas as follows.

- a. Omission of the definite article 'the'; (81 errors) e.g.
 *The parameters are derived from equation of motion after making linearization and approximation.
 *System is stable at time = 187.2 second.
- b. Omission of the indefinite article 'a/an'; (69 errors) e.g.
 *This is commonly used convention.
 *In other words, the exponent is stored in offset.
- c. Erroneous use of the definite article 'the'; (13 errors) e.g.
 *The appendix J illustrates its VHDL source code program.
 *The efficiency and flexibility are the most basic concepts of the DDB.
 *The first module is the best one because the it is better in angle measurement.
- d. Erroneous use of the indefinite article 'a/an'; (13 errors) e.g.
 *They are a combinations of two or three methods.
- e. Wrong use of articles (11 errors):
 - (1) 'the' instead of 'a/an'; (7 errors) e.g.
 *To start the aircraft engine, it is necessary to set its shaft.
 *Each fragment is obtained as the result of applying either the horizontal or vertical fragmentation on relation.
 - (2) 'a/an' instead of 'the'; (4 errors) e.g.

**The result of an addition operation is used as*

4.1.1.3 Errors in the Distribution and Use of Verb Groups

These errors occupy the third rank in this category. Their total number is 180 with a percentage of 14.864. They are represented in four main areas as follows.

- a. Omission of copula 'be'; (86 errors) e.g.
**The colorfulness of an area relative to its brightness.*
- b. Wrong use of infinitives and gerunds; (47 errors) e.g.
**We can classified the heterojunction into two types.*
**The channel of is tested by built a new program.*
- c. Wrong retention of copula 'be'; (32 errors) e.g.
**For example, figure 2.5 is clearly shows that*
- e. Wrong construction of verbs and participles; (15 errors) e.g.
**Then by taken all parameters into consideration, it can*

4.1.1.4 Errors Due to Lack of Concord (Subject-Verb Agreement)

These errors occupy the fourth rank in this category. Their total number is 179 with a percentage of 14.781. The following are examples of the subjects' errors in this subcategory.

- *Two relays has been used.*
- *The two Bits (M1, M2) gives four possible control actions.*
- *Body panels and wake panels is needed.*

4.1.1.5 Wrong Use of Active and Passive Voice

These errors occupy the fifth rank in this category. Their total number is 160 with a percentage of 13.212. They are represented in three main areas as follows.

- a. Using wrong structure to form the passive; (121 errors) e.g.
**This done by using XOR gates instead of NOT gates.*
**The power will be reduce.*
**It can been increase*
- b. Using active voice instead of passive voice; (27 errors) e.g.
**Four factors are necessary to take them into consideration.*
- c. Using passive voice instead of active voice; (12 errors) e.g.
**The static power converter must be changed the armature voltage.*
**This section is introduced the remaining chapters and is given as follows.*

4.1.1.6 Wrong Use of the Plural Morpheme

These errors occupy the sixth rank in this category. Their total number is 93 with a percentage of 7.680. The following are examples of the subjects' errors in this subcategory.

**This means that 16 byte are hidden in one segment.*

**Not all instruction have to go through all stages.*

4.1.1.7 Wrong Use of Prepositions

These errors occupy the seventh rank in this category. Their total number is 45 with a percentage of 3.716. They are represented in two main areas as follows.

a. Wrong choice of prepositions (38 errors) e.g.

**The analysis for these models must be considered in this approach.*

b. Redundant use of prepositions; (7 errors) e.g.

**Current variation affects on the batteries life.*

**In this work, using of computer software for processing will*

4.1.1.8 Wrong Use of Parts of Speech

These errors occupy the eighth rank in this category. Their total number is 37 with a percentage of 3.055. The following are examples of the subjects' errors in this subcategory.

**.... there is no different between these images.*

**The using of this design shows the effect of*

**The proposed system is more flexibility because*

4.1.1.9 Errors in the Use of Relative Clauses and Relative Pronouns

These errors occupy the ninth rank in this category. Their total number is 32 with a percentage of 2.642. They are represented in two main areas as follows.

a. Retention of subject pronouns (18 errors) e.g.

**The first transformation which it has some properties*

**The upper limit which it must be equal to the rated voltage of the starter.*

b. Retention of direct object and possessive pronouns (14 errors) e.g.

**This model of 4-bit register which we use it is made of subsystems.*

**.... there are four factors which are necessary to be taken them into consideration.*

**.... to check the frequency of the detected signal whose its frequency is stored in (DTO).*

4.1.1.10 Wrong Use of Comparative and Superlatives Structures

These errors occupy the tenth and lowest rank in this category. Their total number is 15 with a percentage of 1.239. The following are examples of the subjects' errors in this subcategory.

**The time of texture when using Fourier approach is shortest than the time of generation.*

**The structural description is more near to the classical design.*

4.1.2 Stylistic Errors

This category includes a large number of errors with a total of 81 errors and a percentage of 6.146%. The following are examples of the subjects' errors in this category.

- *In the following, some conclusions about the work that deserved to be mentioned.*
- *G. H. Dohler in (1974) evaluated the fraction of the total*
- *In this work we have investigated on two transformation methods.*
- *There are great interest in real time reconnaissance/ESM system in many years ago and its implementations was limited in few famous companies and in many researchers studied and built different specific units that placed in that systems.*
- *This part is divided into several units to complete the integration of the hardware system it is divided into three units.*
- *Know back to the sub program (Sub 2) a condition statement is checking for the value of (Global) will be set to 1, if (No) the program escape from the (compute fine frequency) sub program and will increase the value*
- *To solve this problem is by using two*

4.1.3 Lexico-Semantic Errors

This category includes the least number of errors with a total of 26 errors and a percentage of 1.973%. The following are examples of the subjects' errors in this category.

- *HDL is similar to a typical computer programming language expect that ...*
- *The system of matching procedure contained from four reference images.*
- *The vision system contains the ability of*
- *It will effect the center of gravity.*
- *Finally, in SECTION seven the conclusions are described.*

Table 2 below gives a brief summary of the major categories of the errors committed by the study sample. It provides evidence that verifies the first hypothesis stating that syntactico-morphological errors are more common in scientific writing.

Table 2
Frequencies and Percentages of the Major Categories of Errors

Error category	Error frequency	Error percentage
Syntactico-morphological	1211	91.881
Lexico-semantic	26	1.973
Stylistic	81	6.146
Total	1318	100

However, it should be borne in mind that the frequencies of errors displayed in this section reflect the actual occurrence of their subcategories in scientific English in particular and the English language in general. In other words, tenses, articles, verb groups and lack of concord are more common and recurrent in scientific English than relative clauses and comparative and superlative structures.

4.2 Discussion of Results (Explanation of Errors)

On the basis of the explanation of errors suggested by several scholars such as Corder (1973) and Ellis (1994), the researchers attempt to account for the errors committed by the study sample. More specifically, they adopt Ellis's (1994: 58-9) scheme of error sources. In general, two global causes of errors are distinguished: transfer (interference) errors and intralingual errors.

Transfer errors can be further subdivided into three categories:

1. 'Overextension of analogy' occurs when the learner misuses an item because it shares features with an item in the L₁. Under this category lie the following errors: redundant use as well as wrong choice of prepositions (43) and wrong use of the plural morpheme (93).
2. 'Transfer of structure' arises when the learner utilizes some L₁ feature rather than that of the target language. The following errors may arise from 'transfer of structure': erroneous use of the definite article 'the' (13), omission of the indefinite article 'a/an' (69), wrong use of articles (11), retention of direct object and possessive pronouns (14), and omission of copula 'be' (86).
3. 'Interlingual/intralingual errors' arise when a particular distinction does not exist in the L₁. This type of errors is manifest in the lack of the 3rd person singular morpheme 's' when using the simple present tense (171).

Intralingual errors are also subdivided into four categories:

1. 'Overgeneralization errors' arise when the learner creates a deviant structure on the basis of other structures in the target language. This category is responsible for the following errors: retention of subject pronouns (17), wrong construction of verbs and participles (15), wrong use of infinitives and gerunds (47) and some of the lexico-semantic errors (26).
2. 'Ignorance of rule restrictions' involves the application of rules to contexts where they do not apply. This category may account for the following errors: using simple past instead of simple present (59), using present continuous instead of simple present (38), using simple present instead of simple future (13), using active voice instead of passive voice (27), using passive voice instead of active voice (11), wrong use of comparative and superlative structures (15) and lexico-semantic errors (26).
3. 'Incomplete application of rules' involves a failure to fully develop a structure. This category may be the reason behind the following errors: lack of the third person singular morpheme (s) when using the simple present tense (171), omission of the indefinite article 'a/an' (69), using wrong structure to form the passive (121), retention of direct object and possessive pronouns (14) and wrong use of parts of speech (36).

4. 'False concepts hypothesized' arise when the learner does not fully comprehend a distinction in the target language. For example, omission of the definite article 'the' (81), redundant use of the indefinite articles 'a/an' (13), using active voice instead of passive voice and vice versa (38), wrong choice of prepositions (38), wrong construction of verbs and participles (15), wrong use of infinitives and gerunds (47), retention of copula 'be' (32), errors due to lack of concord (subject-verb agreement) (181), wrong use of the plural morpheme 's' (93), and wrong use of parts of speech (36).

Concerning stylistic errors, they are the result of miscellaneous factors since no one reason can account for all of them.

It is obvious from the above discussion that some types of errors are attributed to more than one source. It is not always easy to distinguish transfer and intralingual errors or to identify the different types of intralingual errors. However, the postulated explanation of errors introduced in this section provides evidence that refutes the second hypothesis of the study stating that 'interference of the mother tongue is the most possible source of difficulty'.

Further inspection of the findings confirms the availability of most of the features of scientific English (see Chapter Two above) in the works of the study sample. For instance, the recurrent use of passive voice is evident in the number of errors committed in this area (160) occupying the fifth rank. The prevalence of the simple present tense in scientific writing is clear in the high number of errors in the use of the third person singular morpheme 's' (173) and the lack of concord (179). Relativisation is also the field of 32 of the sample's errors.

The use of articles constitutes a big problem for the EST sample as shown in their 187 errors in the second rank. More specifically, the absence of an article (zero article) in general statements and the use of '*the*' with named methods are reflected in the 13 and 81 errors committed in this area, respectively. Noun modification by the use of *-ing* which characterizes scientific English is partly highlighted in some of the 47 errors in the use of gerunds and infinitives by the study sample.

A final note should be made here. Although the context of situation in which the theses under study were written may affect their linguistic choices in one way or another, this aspect is not tackled in the present study because it is beyond its scope.

SECTION FIVE: CONCLUSIONS, RECOMMENDATIONS & SUGGESTIONS

5.1 Conclusions

In the light of the study findings, the following conclusions are drawn:

1. Scientific English is a variety of English in which Arabic-speaking learners of English face great difficulties.
2. Iraqi postgraduate students of EST in the University of Technology do not master scientific English well in their formal writing.
3. Analysis of postgraduates' errors in scientific English writing is important to reveal the areas of difficulties they suffer from and to choose or design relative teaching techniques accordingly.
4. Syntacico-morphological errors constitute the majority of errors committed by postgraduate students in the University of Technology, followed by stylistic and lexico-semantic errors.
5. Within the category of syntacico-morphological errors, errors in the use of tenses are the highest ones, followed by those in the use of articles, verb groups and lack of concord.
6. The areas which witness the highest percentages of errors are mostly those characterizing scientific English.
7. It seems that intralingual errors, especially incomplete application of rules and false concepts hypothesized, interpret the highest proportion of errors made by the postgraduate EST students understudy. These errors outweigh transfer or interference of errors which come in the second place in the explanation of errors.

5.2 Recommendations

On the basis of the available results and conclusions, the following recommendations are put forward:

1. Scientific English writers should be made aware of what syntax, lexis and stylistic conventions contribute to an informative and impressive piece of writing.
2. Teachers should perceive the importance of emphasizing the linguistic properties of scientific texts to achieve optimal understanding and production of such texts.
3. Analysis, identification and explanation of errors EST students make are to be taken into consideration when designing ESP courses.
4. EST students, especially postgraduate ones, should be exposed to extensive training and practice in the techniques of writing good scientific English.
5. EST students have to pay close attention to the linguistic features of scientific English, especially problematic ones, since such knowledge enables them to render good pieces of scientific writing.

5.3 Suggestions for Further Studies

In the light of the study findings, the following studies are suggested:

1. A similar study to analyze the errors of undergraduate science students when they write their assignments or papers in English.
2. A similar study to analyze errors in the scientific writing of undergraduates and postgraduates in other colleges and universities.

3. A study to identify the differences between the errors committed by male and female EST students in their scientific writing.
4. A study to identify the specialized vocabulary as well as non-linguistic features that characterize the scientific writing of EST students.

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