

## Mechanisms for Establishing and Explaining Scientific Terms in The Books of Natural and Life Sciences for Secondary Education-Experimental Sciences Field

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**ABSTRACT:** *Terms are considered keys of science, that understanding and assimilating them in a particular field or science implies understanding that field or that science. For this reason, the issue of “term” occupies a large part of linguists’ thinking in both ancient and contemporary periods, as it plays a great role in communication and transferring knowledge from one generation to another. In this article entitled “Mechanisms for Establishing and Explaining the Scientific Terms in the Books of Natural and Life Sciences for Secondary Education-Experimental Sciences Field”, we will try to classify the scientific terms included in these books, in which Arab linguists and scientists used several means to generate new terms through various methods such as translation, localization, and derivation. Next, we will outline the mechanisms that elucidate these terms, commonly referred to as the mechanisms of teaching scientific terminology. These mechanisms facilitate the learner’s understanding of scientific terms. Therefore, the authors of those books used a variety of them, as the synonym, the contrast, the educational explanation, the image, and the idiomatic phrase mechanisms. In this article, we will also point out some scientific terminology problems, such as terminological chaos and multiple terms for the same meaning.*

**KEYWORDS:** The Scientific Term, Term’s Establishment, Term’ Explanation, Term Problems, Natural and Life Science Books

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## Introduction

The last century witnessed a boom in various fields of knowledge, which generated more attention and interest in terminology. So, after the saturation of sciences and the multiplicity of arts, it was necessary for Arabs to develop a new terminology; by using a number of mechanisms; for instance, derivation, generation, translation, and Arabization or localization. These mechanisms were one of the reasons for the expansion of the Arabic language and its assimilation of various sciences and literatures.

The scientific term is considered one of the research tools that still needs more care and auditing in the Arab world. One of the challenges encountered in scientific research is the adverse effect caused when the scientific terminology fails to establish unified terminological fields, hindering the establishment of a common ground for scientific collaboration.

The educational system has witnessed several reforms, and the latest were the second-generation reforms which have affected all the educational levels (primary, middle, and secondary schools). The book of Natural Sciences and Life, like the other books, has been reformed, in that it gave attention to methods and mechanisms for explaining scientific terminology in order to facilitate the learner's understanding and comprehension. Among these educational mechanisms are the contrast mechanism, the image mechanism, the synonymy mechanism, and educational recognition.

The scientific educational terminology faces several problems, such as the confusion of terminology and the failure to put the term in Arabic or in a foreign language.

Based on the above, this research aims to show the mechanism used for establishing scientific terminology in Natural and Life Science books in the secondary education, experimental sciences field, in addition to the mechanism of explaining and teaching these terms. This research also aims to examine some problems related to scientific terminology, by identifying the causes of these problems and trying to suggest some appropriate solutions. Therefore, this research is guided by the following research questions

- How is the scientific term created in Natural and Life Sciences books for the secondary education level?
- What are the mechanisms used to explain and teach scientific terminology in Natural Science books?
- What are the most important scientific terminology's problems in these books?

To address the aforementioned inquiries, we have chosen to adopt a descriptive approach, which is most suitable for research endeavors aiming to enhance scientific terminology and its development mechanisms in the Arabic language.

## Literature Review

**Terminological Concept:** Terms are the keys to science that enable researchers to understand the various definitions that are derived from science. Therefore, we will try to define the main concepts used in this article:

**1.The Term Concept and Features:** Terminology is one of the branches of language, as this science lays out the theoretical and applied foundations for work in the fields of terminology<sup>1</sup>.It deals with the scientific principles and foundations for establishing and developing the term. Therefore, the primary objective of terminology is to precisely define concepts and maintain accurate control over them. Furthermore, it seeks to standardize terminology by meticulously examining each word, discerning its value and meaning within the term, devising methods to meet the

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<sup>1</sup>Hegazy, M. F. (n.d.). *Linguistic foundations of terminology* (p. 18). Dar Gharib.

demands of society, and seeking solutions to contemporary issues to establish guidelines for terminology control and foster its unification and advancement.

Due to the importance of scientific terminology in understanding science, many studies are interested in this issue so as to solve scientific and methodological problems faced by many. Thus, understanding any science is bound to a good understanding of its terminology since this latter is the cornerstone of all sciences. Hence, terminological research is not a recent or haphazard development. Instead, it emerges from the accumulation of scientific and conventional knowledge, compelling scientists and researchers to undertake the collection, classification, and study of terminological data. There are many examples of terminological research among the Arabic works, such as *Mu'jam al-Ayn* by al-Khalil, *al-Khayl* by al-Asma'i, and *Lisan al-Arab* by Ibn Manzur etc. To delve into this topic necessitates a clear understanding of the concept of "term", whether in Arabic or Western dictionaries and studies.

**1.1. In Ancient Arabic Dictionaries:** There are several definitions of "term" in ancient linguistic dictionaries. In Arabic dictionaries, the word term is pronounced *Mustala'h*, and its origin goes back to the verb *salaha* (to upright something), and it is the opposite of (to spoil something). However, through time due to the progress in different fields, scholars' awareness has grown, leading to the development of more accurate and comprehensive definitions. In *Lisan Al-Arab*, it is claimed that "righteousness is the opposite of corruption, and reconciliation means peace, like they have reconciled<sup>2</sup>. *Al-Muajam Al-Wassit* defines it as "righteousness, uprightness, and an upright person, which means a person with no corruption. It also says the people reconciled, and this means the disagreement between them disappeared, or they came to know something and agreed about it."<sup>3</sup> It is also claimed that they removed the dispute between them. There are scholars who have dealt with the subject of terms under the section of "Terminology." *Al-Muajam Al-Wassit* for instance, states that "Terminology is the source of terms and a sect's agreement on a specific thing, and every science has its terminology; besides, the concept of terminology is what is related to the term and its linguistic equivalent."<sup>4</sup> In *Mustadrak al-Taj*, it is mentioned that it is "an agreement of a specific sect on a specific matter. For example, the scholars upright on the symbols of chemistry; that is, they agreed on them, so, these symbols are agreed as terms"<sup>5</sup>. Now, all these Arabic definitions agree that the word (term) has its origin from the linguistic root (sa, la, ha), and all of them meet at a fundamental point, which is agreement. This means if this agreed matter is the meaning of a certain word, then the subject of the agreement is assigning the meaning of the word to this concept. On this basis, the agreed term:

- Performs a specific function in defining or clarifying a specific signifier for a specific signified.
- The use of this signifier for that signified should be invariable among all people, starting with those who created it, in order to protect it from confusion and error.

**1.2. In Modern Studies (Arabic and Western):** Many Arab researchers have dealt with the word (terminology) as "a scientific term that conveys clearly and precisely the meaning, and it might be often agreed upon by scholars in sciences and arts"<sup>6</sup>. However, the meaning of terminology in western dictionaries is defined as a term: "A word or an expression with a specific meaning in some uses, science, art, profession, or a subject"<sup>7</sup>. Therefore, we can deduce that "term is a linguistic sign based on two pillars, and there is no way to separate its expressive meaning from its content meaning, nor its definition from its concept; one of them is the form or designation, and the other is the meaning or concept or perception, defined by definition, that is, the verbal description of the mental image"<sup>8</sup>. So, the term consists of two basic elements: the word and the concept, hence, the first defines the second.

<sup>2</sup> Al-Shihabi, M. (1995). Scientific terms in the Arabic language: Ancient and modern (p. 5). Dar Sader

<sup>3</sup> Arabic Language Academy. (2004). Intermediate dictionary (4th ed., p. 520, Article: sa, la, ha). Al-Shorouk International Library.

<sup>4</sup> Ibid., p. 520

<sup>5</sup> Ibn Manzur. (2005). *Lisan al-Arab* (4th ed., p. 265, Article: sa.la.ha.). Dar Sader.

<sup>6</sup> Yaqoub, E. B. (1979). Dictionary of linguistic and literary terms (p. 58). Dar Al-Ilm Lil-Malayin.

<sup>7</sup> Youssef, A., & Ghalisi, M. (2008). Terminology in the new Arab critical discourse (1st ed., pp. 22–23). Dar Al Arabiya for Science.

<sup>8</sup> Al-Khattab, A. (1995). Scientific terminology and its importance in the field of translation: Natural sciences as a model (p. 186). In Symposium of the Arabic Language Committee of the Academy of Morocco in Scientific Translation. Publications of the Academy of Morocco.

Terminology has been and remains one of the foremost linguistic concerns for Arabic linguistic academies, given its definition as “a scientific and technical research concerned with the accurate study of scientific and technical terms in a way of naming concepts and evaluating them; it is also defined as a branch of linguistics,”<sup>9</sup>. The study of terms has a recent origin and is considered a branch of applied linguistics, which is terminology. Although its basic principles differ from the general principles of basic linguistic research, they all meet common goals.

**2. The Concept of the Scientific Term:** The definition of the term does not differ much from the definition of the scientific term. Fahmi Al-Hijazi defines it by presenting its features and limiting them to clarity of understanding and precision, he states that: “The scientific term should be a word or a structure, not a long phrase that describes or suggests something, and it is not necessary for it to carry all the characteristics of the concept it denotes [...]through time, the linguistic origin diminishes, so that the cognitive significance becomes a terminological direct indication of the concept”<sup>10</sup>. He also defines it as “a group of words that have been agreed upon to be used by a group of researchers to perform the function of embodying the research results and placing them in a linguistic form that ensures effective and useful communication between different categories of users”<sup>11</sup>. In other terms, it is “a word that has been agreed upon to be used to express one of the scientific meanings. Escalation is a chemical term, cytoplasm is a philosophical term, surgery is a medical term, and vaccination is an agricultural term [...], a term used by specialized scholars to understand and communicate between each other”<sup>12</sup>. This definition refers to the scientific specialization of scientific terms that have been agreed to be used in every specialization. The scientific term is also defined as “the sum of technical words that belong to a science, an art, an author, or a social group, for instance, “the terminology of medicine or the terminology of informatics”<sup>13</sup>. He also defines the scientific term as “a group of linguistic symbols that indicate concepts related to a branch of science or technology”<sup>14</sup>.

In light of the previous definitions, we can conclude that the scientific term is a term used by specialists in a particular specialty to communicate with each other. This is what makes their language a special language of their own, given that they are the creators of those keys that distinguish their language from other languages. In other words, it is the word or compound word that specialists in a given science have agreed upon to express a specific scientific result.

It is inconceivable to have a special linguistic system without a specific terminology, as it stands as one of its the fundamental components. So, it is necessary to distinguish between the scientific term and the word in order to distinguish between specific and general language. Although this distinction has existed for a long time, discussion about it has only appeared in the past few years, when some scholars began to talk about two inseparable languages, in which one contains the other or a general language contains the specific one, so that they cannot be separated due to the containment’s relationship. Thus, after the modern technological revolution and the increase in the number of scientific and technical terms, talking about the two languages has become more than necessary, where a special language was formed, with its own terms, abbreviations, symbols, and even structures, but within a general framework, which is the general language. As a general language, and within its framework, the Arabic language formed special languages, such as the language of physics and chemistry, the language of medicine and sciences, etc.

From the above discussion, we can deduce that the term belongs to a specific language, where it is agreed and adopted by specialists in a specific specialty to be their own, as it is “a coloration that is used only by individuals or subgroups

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<sup>9</sup> Al-Qasimi, A. (2008). *Terminology: Its theoretical foundations and scientific applications* (1st ed., p. 193). Lebanon Publishers Library..

<sup>10</sup> Dowidi, R. W. (2010). *Scientific terminology in the Arabic language: Its traditional depth and contemporary dimension* (1st ed., p. 21). Dar Al-Fikr

<sup>11</sup> Hegazy, M. F. (n.d.). *Linguistic foundations of terminology* (p. 15). Dar Gharib Printing.

<sup>12</sup> Youssef, A., & Ghalisi, M. (2008). *Terminology in the new Arab critical discourse* (1st ed., p. 27). Dar Al Arabiya for Science.

<sup>13</sup> al-Arif, A. R. H. (2002). *Tammam Hassan, a pioneer linguist* (1st ed., p. 294). Alam al-Kutub for Publishing, Distribution and Printing.

<sup>14</sup> Al-Hamzawi, H. (2000). *Biology from science to educational material: A didactic epistemological study* (1st ed., p. 45). Dar Al-Thaqafa Publishing and Distribution Foundation.

placed in special circumstances.”<sup>15</sup>. It is used in a specific field of knowledge and understood only by specialists in that field of knowledge. It is "the set of linguistic means used in a specific subjective field to ensure communication in that field, such as the language of physics, chemistry, or medicine"<sup>16</sup>. So, each field or scientific field has its own language, while the word belongs to the general language because it is known by all the users of that language.

**2.1. Definition of Scientific School Term (Educational):** Despite the importance of the academic or the scientific school term, it has not received a definition even in the literature dealing with terminological studies. This is what prompted us to conduct research on such topics due to their extreme importance in the context of transferring knowledge and concepts to learners. Talking about knowledge gives a way to distinguish between two types, which are: “General knowledge: is expressed in the common language that is based on the word (mots). Every word refers to a concept, and the words combine to form sentences (phrases) that carry specific connotations. Scientific knowledge: It is expressed in a specialized language based on terminology. Each term refers to a concept, and the terms combine to form issues (hypotheses, laws, principles, and theories)”<sup>17</sup>. The scientific educational or school term does not differ from the term agreed by specialists, whether in terms of structural or functional unity, yet what differs is only the mechanism of presentation and function. Specialized dictionaries define the term (morphine) as “a narcotic substance”<sup>18</sup>, while schoolbooks define it by mentioning its uses, as “morphine is used in the medical field to relieve pain, but its uses are in limited quantities to avoid its side effects”<sup>19</sup>. The process of explaining how synaptic transmission occurs in the presence of a drug and showing how drugs affect humans’ nerve centers forced the authors of the book to go into some types of drugs, such as: enkephaly, morphine, and others<sup>20</sup>. So here, the scientific concept is the same; the only difference is in how this scientific concept is presented in the schoolbook, which attempts to simplify the concept by presenting the conceptual aspects of the term morphine and the areas of its uses in relieving pain in specific quantities. It also points out the possibility of causing addiction, in addition to providing an illustrative picture of the stereoscopic structure of morphine and indicating how structural integration occurs between the molecules of this substance and the membrane receptors in the synapses.

In light of these previous statements, we can define the scientific school/educational term as: the linguistic symbols that express a set of concepts related to one of the sciences and are agreed upon by their owners or their specialists. These linguistic symbols moved from the scientific laboratory environment, which defined them very precisely, to the school environment, provided that during this transfer, their approach gradually moved from simple to complex terminology and from general to specialized or specific concepts.

**3. The Concept of Didactic:** The term Didactics is a modern term that appeared in the second half of the twentieth century. According to *Bourseau*, “Didactics is a scientific study of organizing learning situations so that the student achieves cognitive, mental, emotional, or psychomotor goals”<sup>21</sup>. *The Unified Dictionary of Educational Linguistic Terms* defines Didactics as “a scientific study that aims to develop an educational program to facilitate teaching language to young people”<sup>22</sup>, or “the scientific study of the teaching methods and their techniques, and the forms of organizing the learning situations in order to achieve the desired goals”<sup>23</sup>. Didactics is concerned with building

<sup>15</sup> Pavel, S., & Noli, D. (2016). Terminology guide (K. Al-Ashhab, Trans., 1st ed., p. 19). Dar Al-Kunoz Al-Ma'rifa.

<sup>16</sup> Sassi, A. (2009). *A term in the Arabic tongue: From the mechanism of understanding to the tool of industry* (p. 94). Modern World of Books.

<sup>17</sup> Qarmadi, J. (1990). *Sociolinguistics* (H. Khalil, Trans., 1st ed., p. 53). Al-Tali'ah Publishing House.

<sup>18</sup> Arabization Coordination Office. (2002). *The unified dictionary of linguistics terms (English, French, Arabic)* (p. 15). Al-Najah New Press.

<sup>19</sup> Bouchlagham, A., et al. (2009). *Natural and life sciences, part 3: Experimental science field* (p. 155). National Office of School Publications.

<sup>20</sup> Laqad, S., & Kahil, S. (2020). Mechanisms for explaining scientific terms in natural and life sciences books for the secondary education level in Algeria. *Arabic Language Journal*, 22(49), 337

<sup>21</sup> Masbah, M. (2014). Teaching the Arabic language according to active approaches from objectives to competencies (n.e., p. 101). Taxid.com for Studies and Publishing.

<sup>22</sup> Muhammad, A. D. (2003). *Introduction to pedagogy* (p. 15). University Book House.

<sup>23</sup> Oudi, A. (2010). *Dictionary of scientific and technical terms: English, Arabic* (p. 489). Modern Book Foundation.

curricula, preparing courses, and evaluating them. As for the term Didactics of languages (didactique des langues), we mean the specialty that covers the scientific approaches to teaching languages, and it is a connecting point between linguistics, sociology, psychology, and didactics<sup>24</sup>. The Didactics of Languages is the study of the language in an objective and a systematic way. It seeks to develop the linguistic content in a compatible way with the learner's academic stages by taking into consideration the progression in the presentation of the material, the learner's needs, and the practical time of the study to master the target language. The concept of didactics is linked to the scientific field that is concerned with teaching and learning languages within a regular framework according to certain conditions, governed by fixed laws, specific programs, and effective methods, that are able to achieve the set goals and objectives of education.

**3.1. Mechanisms and Methods for Establishing the Scientific Term:** In case there is no equivalent for the foreign term in the Arabic language, Arab linguists adopted several mechanisms and methods to establish that scientific term in Arabic. These mechanisms and methods are represented in derivation, translation, carving, Arabization, and others.

**3.1.1. Derivation:** Derivation is a mechanism as old as the Arabic language. Arabs have known derivation since ancient times as a mechanism of terminological generation due to the fluency of their language and its ability to derive. Derivation is defined as "taking one form from another while they agree in meaning, the original material, and the form of the structure, to indicate the meaning of the original with the second, with an addition that differs in letters or form, such as (the hitter- *dhaarib*) from (to hit- *daraba*), and (a cautious person- *hadhir*) from (to caution- *hadharra*)"<sup>25</sup>.

Contemporary scholars characterize derivation as the process of creating words from each other, specifically those sharing a common origin from which they were derived or generated. This entails extracting one or more words from another word. For derivation between two or more expressions to be valid, three essential elements must be present:

- Sharing the same number of letters, which in the Arabic language are three.
- These letters have to be arranged in the same order in these words<sup>26</sup>.
- These words should have a common meaning

Thus, the study of derivation is the search for the formulas according to which terms are derived, what they signify, and the terminology used to describe them.

Derivation plays a crucial role in advancing language by addressing its shortcomings in scientific, technical, technological, and cultural domains. This makes it one of the most dependable mechanisms for creating terminology within the Arabic language.

**3.1.2. Carving and Combination:** It is the extraction of a word from two or more words, by merging or combining their letters to form a unique and single word. This latter has the same meaning as the original words, and the pronunciation fits the meaning between the carved word and the one from which it was carved. *Al-Khalil bin Ahmed* (175. Hijri) is the first to discover the phenomenon of sculpting or carving in the Arabic language, he said: "The letter (ع) does not combine with the letter (ح) in one word due to the closeness of their pronunciation; unless a verb is derived from combining two words, such as (حَيَّ عَلَيَّ)" (Hayya Alaa) means in English (Hasten to), and it is used to call Muslims to pray, as the poet says:

أقول لها ودمع العين جار ألم يحزنك حيلة المناد

"I'm telling her with tears in eyes,  
didn't the call of prayer make you sad?"

The word حيلة is pronounced (hay'ala), and it is derived from (hayya) and (alla), which can be used in the past, present, and imperative tenses<sup>27</sup>. This expression is used to call Muslims to pray, and in English, it means (Hasten

<sup>24</sup> Al-Sharni, F. F. M. (2003). *Introductions to teaching the Arabic language* (p. 23). Muhammad Ali Publishing House.

<sup>25</sup> Al-Suyuti, J. al-D. (1998). *Al-Mizhar in sciences of language and its types* (F. A. Mansour, Ed.; 1st ed., Vol. 1, p. 275). Dar al-Kutub al-Ilmiyyah.

<sup>26</sup> Mubarak, M. (n.d.). *Philology and characteristics of Arabic* (pp. 78–79). Dar Al-Fikr for Printing and Publishing.

<sup>27</sup> Al-Amayra, MS. A. (2002). *Research in language and education* (1st ed., p. 283). Wael Publishing House.

the prayer and Hasten to Success) Nihad Al-Mousa defines carving as “constructing a new word from two or more words or from a sentence, in which they differ in meaning and form, so that the new word takes from them all in pronunciation and indicates them all in meaning.”<sup>28</sup>. This definition is considered the most comprehensive definition of carving, and Nihad Al-Mousa derived it previous definitions.

Ancients linguists also used carving in: “The basmalah, from bismi 'llah, in English means (in the name of God). The hamdala, from alhamdu'lillah, in English means (Praise be to God), and the hauqala, from lahouala wala quata illa' billah, in English means (there is no power nor strength except in God).

It is worth mentioning that carving originated in the Arabic language as a response to a rhetorical and deliberative necessity imposed by linguistic motives and also by social and intellectual influences. Carving is one of the abbreviations' types, in which two words or sentences become one word, so its purpose is to concisely facilitate the expression. Recently, carving has been used to generate scientific terms, for example: (amphibian animal, or what is called barmaai in Arabic). It is taken from the words albar, almaa, and in English, it means an animal that lives on land and in water. Other examples: Indo-European from India and Europe and Afro-Asian from Africa and Asia. Carving is also valid if the foreign term is composed of two words, such as (kahro and manzili) instead of (kahraba and manzil); in English, it is home and electrical, which gives the term of home-appliance.

However, compounding terms in Arabic is when putting two words together to form a new word<sup>29</sup>, such as postman, barometer, etc.

**3.1.3. Localization:** Localization or Arabization, is the transfer of a word from a foreign language to the Arabic language without making a change or with some change to harmonize it with the Arabic language systems (phonetics and morphology). It is known as “Arabizing the non-Arab name so that the Arabs pronounce it according to their methods”<sup>30</sup>. Arab linguists' opinions differed about the importance of Arabization in establishing terminology. While supporters see it as an interaction between the Arabic language and its counterparts in other languages, opponents see it as an infringement on the Arabic language because “whenever this type of quotation increases, the language diminishes, and this may lead to its decline”<sup>31</sup>. So, they believe that the excessive Arabization of strange words leads to the risk of disappearance and extinction of the Arabic language, where Arab terminologists are accustomed to relying on the ready-made without searching for Arabic terminology, and this kills the spirit of research in this language. However, we have to recognize that so we should not resort to Arabization except when necessary and when there are no other solutions. This means making this mechanism the last resort for establishing terms, or it can also be considered a temporary solution while waiting to find the actual term that conveys the meaning of the concept.

**3.1.4. Translation:** Considering translation as a cultural linguistic behavior, it is a prominent and important means of communication and cultural exchange between nations by transferring knowledge and being a link between civilizations and cultures. Translation in dictionaries means interpretation and clarification<sup>32</sup>. It is said: “I translated the matter for him, means I explained it. Therefore, clarity is one of the basic conditions for good translation”<sup>33</sup>. From that, we can say that translation means explanation and clarity.

In terminology, translation is the act of expressing meanings from one language to another, or the process of transferring meaning from the source language to the target language. In this context, translation is the transfer of a foreign term by selecting the Arabic term that is supposed to convey its meaning and cover its concept. Since the Arabs began to transfer sciences into Arabic, translation has been the preferred method among terminologists, as they are not permitted to resort to other mechanisms unless translation is insufficient”<sup>34</sup>.

<sup>28</sup> Al-Farahidi, A. A. (1980). (M. Al-Khazoumi & I. Al-Samarrai, Eds.; Part 1, p. 60). Dar Al-Rushd.

<sup>29</sup> Al-Masadi, A. S. (1994). *The critical terms* (p. 29). Abdul Karim Bin Abdullah Publishing.

<sup>30</sup> Al-Mousa, N. (1984). *Sculpture in the Arabic language* (p. 67). Dar Al-Ulum for Printing and Publishing.

<sup>31</sup> Al-Qahtani, S. bin H. (2002). *Arabization and the theory of linguistic planning* (p. 47). Center for Arab Unity Studies.

<sup>32</sup> Abdel Khaleq Rasheed. (2012). Controlling terminology in the Arab world. *Terminology Magazine*, (8), 137. Abi Bakr Belkaid University of Tlemcen. /

<sup>33</sup> Al-Didawi, M. (2000). *Translation and communication: A practical analytical study of the problem of terminology and the role of the translator* (1st ed., p. 71). Arab Cultural Center.

<sup>34</sup> Al-Zubaidi, M. (1984). *The bride's crown from the jewels of the dictionary* (Article: Radjem). Arab Heritage Revival House.

## The study

As previously stated, the main aim of the present study is to examine the methods used to generate scientific terms in books designed for students of natural and life sciences and experimental sciences fields at the secondary educational level, thus they constitute the corpus of this research.

## Research questions

The study at hand aims to answer the following research questions:

- How is the scientific term created in Natural and Life Sciences books for the secondary education level?
- What are the mechanisms used to explain and teach scientific terminology in Natural Science books?
- What are the most important scientific terminology problems in these books?

## Research design and methodology

The descriptive method was adopted to conduct this research. Therefore, after collecting the corpus from the books mentioned above, an analysis of the different terms was established according to the various methods used to generate terms. The main results are displayed in the following tables.

## The results

Term in Arabic	Foreign counterpart (in French )	Page	Meaning / Concept	Mechanism used
الانتاش Intaacch <b>Germination</b> in English	Germination	13-54	The transition of seeds from slow to active life	Derivation of (verbs) from the verb natacha in Arabic/ to germinate in English
التيرب <b>Potting soil</b> in English	terreau		Soil with more than 50% organic matter	Generation
مغزل الانقسام <b>Mitotic spindle</b> in English	Fuseau mitotique	24	It consists of tubules that form between the two poles of a eukaryotic cell during mitosis)	(Translation)+ Combination
سكروز <b>Sucrose</b> in English			Sugars: a disaccharide consisting of dextrose and fructose	Localization or Arabization

Table N°1: Mechanisms used for generating the terminology for the book of first-year secondary education, common stream technology

Term in Arabic	Foreign counterpart (in French )	Page	Meaning / Concept	Mechanism used
منعكس عضلي <b>Conditional reflex</b> in English	Reflex conditionnel	12	An involuntary reflex that is the contraction of a muscle in response to its stretching	Combination
التشلل <b>Paralysis</b> in English	Paralyisie		It is the inability of muscles to contract in a specific area	Derivation from the arabic verb challa/ or to paralyze in English
لوحة محركة <b>Motor plate</b> In English	Plaque motrice		The name given to the neuromuscular synapse	Translation + Combination
العفج <b>Duodenum</b> In English			The beginning of the small intestine	Generation
الألوكسان <b>Alloxan</b> In English	Alloxane مادة مشتقة من حمض اليولة	40	A substance derived from uric acid	Arabization

Table No. 2: Mechanisms for Establishing Terminology in the Book of the Second Year, Secondary Education

Term in Arabic	Foreign counterpart (in French )	Page	Meaning / Concept	Mechanism Used
الفطر السام <b>Amanita phalloides</b> in English	Amanita phalloïdes	17	This compound is an enzyme inhibitors	Translation
برنامج <b>Anagen</b> in English	Anagène	23	It is a program mainly used to display and compare...	Arabization
وسائط <b>Interface</b> In English	Interface		To connect receivers to the computer	Generation
برنامج <b>Software</b> In English	Logiciel		Allows calculation and display of results	Derivation
المستضد <b>Antigen</b> In English	Antigène*	85	Every foreign body enters the organ	Translation

Table No. 3: Mechanisms for Establishing Terminology in the Book of the Third Year, Secondary Education

Mechanism/ its frequency	First Year	Second Year	Third Year	Total
Translation	39	19	17	75
Derivation	20	12	9	41
Arabization	24	18	9	51
Generation	10	8	5	23
Carving	///	///	///	

Table N°4: Mechanisms' Frequency for Establishing Scientific Terminology

When counting the scientific terms, it is clear that the translation mechanism is the most used mechanism for placing scientific terms in Natural and Life Sciences Books for Secondary Education Level, Experimental Sciences Field. Then, it is successively followed by Arabization, derivation, and generation. However, it is remarkable that there is a complete absence of carving mechanisms.

## 2- Mechanisms for Teaching and Explaining Scientific Terminology in Natural and Life Sciences Books for Secondary Education Level, Experimental Sciences Field:

In the early 2000's, the educational system witnessed several reforms that aimed at improving the quality of education. These reforms occurred in all the modules and books, so that the book of Natural Sciences and Life, in which authors sought to produce it in a form that keeps it updated to the world' scientific and technological developments. This change was both in the aspects of form and content:

- 1- **The Aspect of Form:** It features the use of pictures, charts, and graphs to clarify most scientific terms and concepts.
- 2- **The Aspect of Content:** It includes organizing scientific activities gradually, trying to understand the scientific changes occurring in various modern scientific experiments, and explaining and approximating most scientific terms and concepts in the form of simplified educational definitions. The book's interest in scientific terminology is so clear in its attempt to simplify it and bring it closer to the minds of learners. Scientific terminology is taught according to a number of mechanisms that simplify both the term and its scientific concept for the learner. These mechanisms can be summarized in:

- A- **The Mechanism of Explaining One Scientific Term with Another:** The scientific term is often explained by another scientific term, and it may be an Arabic scientific term or a Western abbreviation, such as:

**A.1- Synonymy Mechanism:** It is introducing a second scientific term, where the two terms (first and second) have the same scientific concept. Despite the positive aspects of this mechanism, it contributes to terminological pluralism or terminological chaos. Some examples included in these books are:

The Scientific Term	The Synonym
Bread yeast <sup>35</sup>	Beer/ Barley Yeats
Female Sex Glands <sup>36</sup>	Ovaires
Voltage channels	Electrical classified channels

Table N°5: Samples of the Synonymy Mechanism

<sup>35</sup> Bouloudhainat Al-Saeed and others, Natural and Life Sciences, 1st year, Common Field Sciences and Technology, p. 211

<sup>36</sup> Bouzkaria Nasr al-Din and others, Natural and Life Sciences, 2nd year of secondary school, Experimental Sciences and Mathematics Division, National School Publications Department, Algeria, 2009, p. 60.

**A.2- The Mechanism of Equivalent:** It presents a second scientific term and its equivalent in a foreign language, whether French or English. Some examples included in these books are:

The Arabic Term	The Equivalent in French
<sup>37</sup> التخمير اللبني In English : Lactobacillus	Lactobacillus
<sup>38</sup> الاختلاط داخل صبغي In English : Intrachromosomal mixing	Brassage intra chromosomique
<sup>39</sup> الفطر السام In English : Amanita phalloides	Amanita phalloïdes

Table N°6: Samples of the Equivalent Mechanism

**A.3- The Mechanism of Explaining a Foreign Abbreviation with an Arabic Term:** In this mechanism, the scientific term is explained with a foreign scientific abbreviation:

Foreign Abbreviation	Foreign Scientific Term	Arabic Scientific Term
LH <sup>40</sup>	Luteinizing Hormone	هرمون LH
GnRH <sup>41</sup>	Gonadotropin Releasing Hormon	هرمون العصبونات تحت السريرية
ARNm <sup>42</sup>	////	الشفرة الوراثية

Table N°7: Samples of the Mechanism of Explaining a Foreign Abbreviation with an Arabic Term

**A.4- The Mechanism of Explaining a Foreign Symbol with an Arabic Term:** The books used many practical symbols as an alternative to foreign scientific terms. Some examples included in these books are:

<sup>37</sup>Bouchlagham Abdel-Aali and others, Natural and Life Sciences, 3rd year Secondary School, Experimental Sciences Field, p. 134

<sup>38</sup>Bouloudhainat Al-Saeed and others, Sciences of Nature and Life, 1st year, Common Field Sciences and Technology, National Office of School Publications, Algeria, 2013, p. 57.

<sup>39</sup>Bouzkaria Nasr al-Din and Others, Natural and Life Sciences, 2nd year of secondary school, Experimental Sciences and Mathematics Field, p. 126

<sup>40</sup>Bouchlagham Abdel-Aali and others, Natural and Life Sciences, 3rd year Secondary, Experimental Sciences Field, National Office of School Publications, Algeria, 2007/2008, p. 17

<sup>41</sup>Bouzkaria Nasr al-Din and others, Natural and Life Sciences, 2nd year secondary school, Experimental Sciences and Mathematics Field, p. 64

<sup>42</sup>Bouchlagham Abdel-Aali and others, Natural and Life Sciences, 3rd year, Secondary School, Experimental Sciences Field, p. 20.


Foreign Symbol	Foreign Scientific Term	Arabic Scientific Term
NO <sub>3</sub> <sup>43</sup>	////	الأسمدة النتراتية In English : Nitrate fertilizers
XX and XY <sup>44</sup>	////	الصبغي الجنسي للمرأة والرجل In English: Sex chromosomes for women and men
	////	روابط ببتيدية <sup>45</sup> In English : Peptide links

Table No. 8: Samples of the Mechanism of Explaining a Foreign Symbol with an Arabic Term

**B - The mechanism of the idiomatic phrase:** It is similar to the mechanism of synonymy (synonym), but the explanation in this case is not in the word, but in a phrase or sentence.

The Scientific Term	The Idiomatic Phrase Explaining it
Genotype <sup>46</sup>	Geno-group
Neural Connections <sup>47</sup>	Sensory nerve fiber, motor nerve fiber

Table N° 8: Samples of the Idiomatic Phrase Mechanism

**B- The Educational Definition Mechanism:** This means presenting the concept of the scientific term in a simple linguistic form that summarizes the essential features of the scientific term.

Term	Educational Definition
Breathing <sup>48</sup>	Breathing is a vital phenomenon that characterizes most living organisms, in which O <sub>2</sub> is absorbed and CO <sub>2</sub> is excreted...
Alloxan <sup>49</sup>	A substance derived from uric acid
Anagen program	It is a program used mainly for display and comparison

Table N°9: Samples of the Educational Definition Mechanism

**D - Image Mechanism:** The image is considered one of the most important educational and illustrative tools and means. An image may be a photograph, a diagram, a graphical form, or other forms that can highlight the essential characteristics of the scientific term. This mechanism was the most predominant one in these studied books because of its positive effects in simplifying the scientific concept and consolidating it in the mind of the learner.

<sup>43</sup> Bouloudhainat Al-Saeed and others, Sciences of Nature and Life, 1st year, Common Field Sciences and Technology, p. 129.

<sup>44</sup> Bouzkaria Nasr al-Din and others, Natural and Life Sciences, 2nd year of secondary school, Experimental Sciences and Mathematics Field, p. 120

<sup>45</sup> Bouchlagham Abdel-Aali and others, Natural and Life Sciences, 3rd year Secondary, Experimental Sciences Field, p. 49

<sup>46</sup> Al-Saeed Bouloudhainat and others, Sciences of Nature and Life, 1st year, Common Field Sciences and Technology, p. 145

<sup>47</sup> Bouzkaria Nasr al-Din and others, Natural and Life Sciences, 2nd year, secondary school, Experimental Sciences and Mathematics Field, p. 12

<sup>48</sup> Bouloudhainat Al-Saeed and others, Sciences of Nature and Life, 1st year, Common Field Sciences and Technology, p. 52.

<sup>49</sup> Bouzkaria Nasr al-Din and others, Natural and Life Sciences, 2nd year, secondary school, Experimental Sciences and Mathematics Field, p. 40


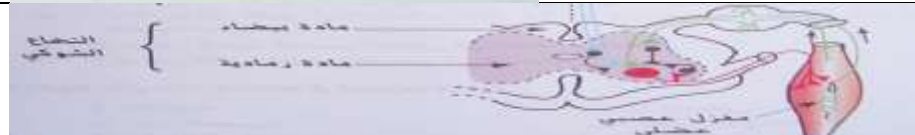
The Image	The Scientific Term
	Plasma membrane <sup>50</sup>
	Spinal Cord <sup>51</sup>

Table N° 10: Samples of the Image Mechanism

**E- Simile and Representation Mechanism:** It is the process of likening one term to another term that is clearer in the mind of the learner. Such as "vertebrates such as fish, invertebrates such as ammonites"<sup>52</sup>

#### Statistics of the Mechanisms for Explaining Scientific Terms in the Books:

Mechanism/Frequency	1.st year of secondary school	2.nd year of secondary school	3.rd year of secondary school	Total
Synonymy Mechanism	20	15	27	62
Equivalent Mechanism	84	101	121	306
Image Mechanism	105	133	149	387
Idiomatic-Phrase Mechanism	12	5	13	30
Educational-Definition Mechanism	195	150	112	457
Simile/Representation Mechanism	312	16	23	51

Table N° 11: Statistics of the frequency of mechanisms for explaining scientific terms

#### Discussion of the results and conclusion

From the above table, we have drawn the following conclusions:

**-The Synonymy Mechanism:** It is relatively rare, as it is repeated 20 times in the first-year book, 15 times in the second-year book, and 27 times in the third-year book as the highest percentage.

**-The Mechanism of Equivalent:** The third-year book is the one that most relies on this mechanism (121) times, and this may cause a decline in the use of the Arabic term and, in return, an expansion in the use of the foreign term. Then, it is repeated (101) times in the first-year book; however, it is only repeated (84) times in the third-year book, and this is mainly due to those who are in charge of the scientific writing. While some of them believe it is necessary to introduce the learner to the original term, others believe there is no need for that, except in a few cases. The

<sup>50</sup> Bouloudhainat Al-Saeed and others, Natural and Life Sciences, 1st year, secondary school, Common Field Sciences and Technology, p. 38

<sup>52</sup> Bouzkaria Nasr al-Din and others., Natural and Life Sciences, 2nd year, secondary school, Experimental Sciences and Mathematics Field, p. 29

<sup>53</sup> Bouzkaria Nasr al-Din, Natural and Life Sciences, 2nd year, secondary school, Experimental Sciences and Mathematics Field, p. 197

adoption of this significant amount of this mechanism in the third-year book is due to the fact that professors at this stage see it as a necessity. They justified that higher education depends entirely on foreign languages, where the teaching and learning process of different natural sciences is in foreign languages, especially in the French language.

- **Image Mechanism:** It is used progressively, starting from the first-year book (105) times, then the second-year book (133) times, then the third-year book (149) times. This increment can be attributed to the number of educational units in these books, which is increasing progressively. Another reason for focusing on this mechanism is also its importance, as it is mentioned that “the image that helps the student understand difficult or abstract information is classified as performing an explanatory function”<sup>53</sup>. Using the image mechanism in the teaching-learning process increases the learner’s understanding and remembering of the information that the image explains.

-**The Educational Definition Mechanism:** This mechanism is most present in the first-year book (195) times, followed by the second-year book (150) times, and then the third-year book (112) times. This is due to the fact that the learner in the first year is more in need of these definitions.

-**Simile and Representation Mechanism:** It is noticeable that this mechanism is mentioned very rarely in the books, despite its importance in explaining the terms and bringing them closer to the learner’s mind.

We can conclude from the table that the frequency of using the mechanisms of explaining scientific terms is uneven. The definition mechanism ranked first, in that it is more frequently used and repeated, because learners really need it to fix the scientific term in their minds. The image mechanism ranked second due to its ability to bring the concept closer to the learner’s mind, especially with its bright colors. The equivalent mechanism ranked third, followed by the synonym mechanism in the fourth place, and finally the mechanism of equivalent in the fifth place.

**3-Scientific Terminology Problems:** The problems of scientific terminology in Natural and Life Sciences Books for Secondary Education Level, Experimental Sciences Field, lie in:

- Multiple terms for one concept: For instance, the Arabic term *heooly* in the specialized dictionary means cytoplasm<sup>54</sup>. The term "BCG vaccine" is translated as "Bacillus of Calmette-Guerin"<sup>55</sup>. This is mainly because of the translation’s disorder, or because of the variation between mechanisms and methods used in establishing terminology; while some resort to derivation, others prefer Arabization.
- Multiple concepts for one term: For example, the term (thymus) is defined in the second-year book of secondary education as “an immune organ located in front of the trachea.” However, in the third-year book, it is defined as “it is located above the heart, and it is a central lymphatic organ...”. This is due to the multiplicity of scientific institutions that establish the scientific terminology, such as the linguistic academies and the translation and Arabization Committees.
- Preserving some foreign terms: Like the Anagene Program and the Feulgen Test, there are no equivalents for them in Arabic, but rather in a foreign language.
- Not putting a foreign equivalent for some Arabic terms: Such as the Arabic term *Mustadhaad*, which means in English (antigen), and the term *fasiila* which means (mycelium).
- Not providing concepts for some terms: like: (Chronic Myeloid Leukemia) and (Bovine Serum Albumin), so learners have to search for these terms in specialized or specific dictionaries, and this wastes their time.
- Some linguistic mistakes in foreign terms: such as (Mineral) and (Miniral)
- The difference in interviewing foreign voices: is that the sound (P) is sometimes translated as (ba) in Arabic, such as (pancreas), which becomes (bancreas). And the arabization of the sound (V) to (fa), such as in (vitamin), which becomes (fitamin)

To sum up, the answers to the research questions that guided this research are summarized in the following points:

- There are multiple mechanisms for establishing scientific terminology in the books of Natural and Life Sciences, Experimental Sciences Field, Secondary Education Level. The Translation Mechanism had the

<sup>53</sup> Al-Dajani, A. (Trans.). (2012). Designing effective instruction (J. E. Kemp et al., Original work, 1st ed., p. 322). Obeikan Publishing Library.

<sup>54</sup> Odeh, A. (2010). Dictionary of scientific and technical terms: English–Arabic (p. 568). Modern Book Foundation.

<sup>55</sup>The Supreme Council for the Arabic Language. (2012). School guide for natural and life sciences: Arabic-French-English dictionary (p. 125).

lion's share, followed by Arabization and Derivation Mechanisms, then Generation Mechanism, where there is a complete absence of Carving Mechanism, despite its importance in generating terms.

- There are several mechanisms for teaching scientific terminology in the books of Natural and Life Sciences- Experimental Sciences Field- Secondary Education Level. The Educational Definition Mechanism is the most used mechanism, because learners at this stage need such definitions with linguistic simplicity. This simplicity makes the concept close to the learners' mind, and also makes it easy to retrieve and remember.
- There are multiple terms indicating the same meaning in these books, or what is known as terminological chaos, despite the efforts made in the field of unifying scientific terms.

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