SYNTACTIC AND SEMANTIC ANALYSIS OF VERBS IN CHEMISTRY RESEARCH ARTICLE INTRODUCTIONS: CASE OF PAPERS PUBLISHED IN AN ALGERIAN JOURNAL OF MULTIDISCIPLINARY RESEARCH

تحليل صرفي ودلالي لأفعال مقالات البحث الكيميائية: دراسة حالة للأوراق البحثية المنشورة في مجلة جزائرية للبحوث المتعددة التخصصات

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Abstract:

This study is concerned with the analysis of the semantic and syntactic features of verbs used in the introduction section of Chemistry research articles published in a multidisciplinary Algerian Journal and in an International Journal of Chemistry. A corpus of 24 research article introductions (12 from each journal) was selected. The corpus was analyzed for semantic meaning of verbs and their syntactic features. Semantically, existence verbs were the predominant class in research articles from the Algerian journal followed by activity and mental verbs respectively. Nevertheless, existence and activity verbs occupied the head of the rank followed by causative verbs. Syntactically, for both group it was found that the verbs of different tenses, aspects, and voices were used with mainly the same tendency to present tense, simple aspect and active voice. Statistically, means, standard deviation and t-test were used. Calculations have proven the heterogeneity between and inter the two corpora and due to unpaired t-test values, mainly the null hypotheses were rejected (H0). As implication, a proposal was made for using these findings in a more practical manner by novice non native writers and by ESP designers for material designated to

those novice scholars from Chemistry and Physics that helps them to write more appropriate research article introductions.

Keywords: verb, research article, introduction section, semantic meaning, syntactic analysis.

ملخص باللغة العربية:

تعنى هذه الدراسة بتحليل السمات الدلالية والنحوية للأفعال المستخدمة في قسم مقدمات المقالات البحثية في مجال الكيمياء المنشورة باللغة الإنجليزية لدى مجلة جزائرية متعددة التخصصات وفي مجلة دولية للكيمياء. تم اختيار عينة من 24 مقالا بحثيا (12مقالا من كل مجلة). تم تحليل العينات لمعرفة المعنى الدلالي للأفعال وخصائصها النحوية. فمن الناحية الدلالية ، كانت أفعال الوجود هي الفئة السائدة في المقالات البحثية من المجلة الجزائرية تليها أفعال النشاط فالأفعال العقلية على التوالي. ومع ذلك فبالنسبة للمجلة الدولية، فقد احتلت أفعال الوجود والنشاط رأس المرتبة تليها الأفعال السببية. من الناحية البنائية او الصرفية ، وجد في كلتا المجموعتين أن الأفعال تم تصريفها في أزمنة مختلفة يتصدرها الزمن المضارع الى جانب مظهر البساطة و البناء للمعلوم. إحصائيا ، تم استخدام الإحصاء الوصفي والاستنتاجي باستخدام المتوسط الحسابي والانحراف المعياري واختبار ستودنت الفارقي. لقد أثبتت الحسابات عدم التجانس في العينات بين المجموعتين كما أظهرت انه تم رفض الفرضيات الصفرية في جل الحالات. لقد تم اقتراح استخدام هذه النتائج عمليا من قبل المؤلفين ومصممي المقررات و الباحثين في مجال الانجليزية لأغراض خاصة لإنتاج مستندات تعين الباحثين المبتدئين في مجال العلوم و بخاصة في مجال الكيمياء على تحرير مقدمات المقالات العلمية بشكل يحترم المعاييرالتعارف عليها عند المختصين

الكلمات المفتاحية: الفعل ، مقال بحثي ، قسم مقدمة مقال بحثي ، المعنى الدلالي ، التحليل النحوي , الكيمياء

Introduction

Since the 1950s from the 20th century, English has been the *lingua franca* of the scientific literature such as physics, chemistry, biology and medicine in the Western World. On another hand, research articles are the most important communicative tool of the discourse community of scientific experts all disciplines combined (Swales , 1990).

According to Frank (1972) and Biber (1999, 2002) verbs can be of two types : lexical verbs which carry out the main content of the meaning and auxiliary ones that function as helpers of the lexical verbs by appending some grammatical elements to mention tense, voice, mood, and aspect, or by signalizing the negative and interrogative sentences or by marking semantic meaning of modality.

Concernig the lexical issue, Faber and Mairal use the Functional-Lexematic Model (FLM) to study the primary lexicon of English verbs. They propose the following lexical domains:

EXISTENCE, MOVEMENT, ACTION CONTACT, POSITION, CHANGE, PERCEPTION, COGNITION, SPEECH, SOUND, LIGHT, POSSESSION and FEELING.

Later on, L. Rodriguez (2002) used these lexical domains proposed by Faber and Mairal to study how verbs activates conceptual areas in rhetorical sections of research articles (i.e., *Introduction, Methods, Results* and *Discussion* sections). Her study tagged abstracts of articles on oncology. In order to learn more about the lexical characteristics of medical English, Reimerink (2006) used the same lexical domains as Rodriguez. Results show that the lexical domains are distributed differently in each section of the article. Author's results shed light on the complexity of relationship between a research article and its abstract.

On another hand, Biber et al. (2002) states that lexical verbs express many meanings, which can be classified into seven major semantic classes: ACTIVITY *verbs,* COMMUNICATION *verbs,* MENTA*L verbs,* CAUSATIV*E verbs, verbs of* OCCURENCE*, verbs of* EXISTENCE *or* RELATIONSHIP*, and verbs of* ASPECT. It is worth to be noted that reporting verbs, which are defined as the verbs used to convey the language of others in strict sense or verbs that report the speech of others, fall mainly in the third three first semantic classes proposed by Biber (activity, communication and mental verbs).

Recently, E. Ebrahimi et al. (2018) studied syntactic and semantic features of verbs in problem statement section of master theses using Biber's et al. classification as frame work. Active voice and present tense were predominant as expected, given that they are the preferred tone in thesis writing. Three kinds of verbs were used especially frequently: mental,

activity, and communication in their corpus. These results joined the distribution of these features found previously by the same authors (2017) concerning Introduction sections in research article from Applied Linguistics genre.

To the best of our knowledge, so far no study has been conducted to investigate Algerian corpora from all domains combined, especially in the field of Chemistry and Physics. So that, this study aimed to investigate the syntactic and semantic features of verbs used in introduction sections of research articles from Chemistry discipline written by Algerian researchers who are mostly francophone and/or arabophone scholars.

Based on these linguistic backgrounds, we can hypothesize that the introductions written by Algerian chemist researchers differ from those written by Anglophone ones.

Consequently, this study addressed the following questions:

(1) What are the syntactic features of verbs used in the RAIs written by Algerian writers of English?

(2) What are the semantic meanings of verbs used in the RAIs written by Algerian writers of English?

2. Methodology

The study concerns a corpus linguistic analysis so that it's a descriptive method

2.1. Corpora of study

Three reasons backed up the choice of the journal, in general, and the papers concerning Chemistry in particular. Firstly, the Journal of Fundamental and Applied Sciences (JFAS) is the quasi unique national journal written in English and ranked B available for Algerian researchers. Secondly, the researcher himself is an Algerian full Professor of Chemistry also in charge of teaching English modules in Chemistry and Physics departments. Finally, in the best of our knowledge, there have not been any studies on Algerian English corpora especially in the domain of Chemistry and Physics.

In order to ensure the homogeneity of the corpus and that the articles reflect the best practice in scientific writing, some criteria were established for the journal taken as reference, the following criteria were applied in the selection of the articles:

- Citation index of the journal;
- Subject of the journal: Chemistry;
- Availability of complete articles on Internet;
- The article must have IMRAD format, be experimental, and not be an article review or theoretical one.
- Subject of the article: analytical chemistry, environmental chemistry, or photochemistry;
- Date of publication.

The first and second criteria were ensured by using the *Journal Citation Reports* web page (JCR Web; http://jcrweb.com/jccr_selection.pl, last accessed February 13, 2023). The JCR Web provides a list of the most cited journals according to citation index and subject of the journal asdefined by the JCR Web. Between others, we found that Chemosphere Journal met all criteria mentioned above and then was chosen as reference. It had an impact factor up to 8.9 (2023). Unfortunately, JFAS registered an impact factor of 0.0032 at the beginning of this work (2020). Actually, it became non-classed journal according to lists provided by the Algerian Ministry of High Education and Research (2023). Twelve articles from Chemistry field were selected from this journal.

2.2. Corps processing

A corpus of twelve article introductions sections was collected from the Journal of Fundamental and Applied Sciences, written between 2019-2021 and twelve other articles from Chemosphere Journal. They were chosen purposefully in order to fit the established criteria (be in the domain of experimental chemistry, follow IMRAD plan..etc). The research articles

introductions were coded to ARAI1, ARAI2, ARAI3…..for JFAS articles and IRAI1, IRAI2……for the International Journal (Chemosphere)

As one purpose of this work was to classify verbs semantically according to Biber's classification (1999, 2002), auxiliary verbs were eliminated. In this case only the main verb is considered. Participles which were part of a phraseological unit, were eliminated as well since these participles function as adjectives rather than verbs. DOIs of the whole corpora are given in Appendix1 and 2.

2.3. Frame work of the study

Regarding the syntactic analysis of the corpora, for semantic analysis of the data, Biber's et al. (1999) classification was chosen to analyse semantically the data. This classification includes seven following classes:

2.3.1. Activity verbs which are concerned with what people do (e.g. use, give, make, build, perform, and measure) and the list of such verbs is endless.

2.3.2. Communication verbs involve such communication activities as speaking and writing. These verbs are described by Gropen et al. (1989) as "verbs of type of communicated message. (e.g. describe, discuss, debate, argue, introduce, suggest, ask, cite, demonstrate, dictate, explain, explicate, narrate, read, recite, relay, show, teach, tell, write, quote.

2.3.3. Mental verbs They describe cognitive states and activities (i.e., these verbs refer to cognitive states that are generally unavailable for outside evaluation. (e.g. know, *think,* believe, remember, *recognize*, understand, consider, design, study, *learn,* investigate), which also include attitudinal or emotional states (e.g. prefer, love, *feel*, *guess*, enchant, *wish, hope, decide*).

2.3.4. Verbs of existence or **relationship** denoting a relation or a state exists between entities. (e.g., exist, coexist, flourish, persist, stay, remain, prevail, survive, correspond, depend, include, represent, define, link, associate, relate, influence).The verb 'to be' is the most common state of being verb. It can be used in the present or past tense to link the

subject of the sentence with a subject complement, such as a noun or adjective, to give us more information about the subject's state of being.

2.3.5. Verbs of facilitation or **causation** indicating a new state of affairs brought about (e.g. cause, allow, require, need, influence).

2.3.6. Verbs of simple occurrence reporting the occurrence of events. In determining what verbs to include in this class, a rather broad definition of the notion "verb of appearance" is used. This class includes verbs such as: appear, arise, break, burst, derive, develop, emanate, emerge, erupt, evolve, exude, flow, grow, rise, spread, increase, and change.

2.3.7. Aspectual verbs denoting the stage of progress of events or activities. In other words, they describe the initiation, termination, or continuation of an activity. Some members of this class are: begin, cease, commence, continue, end, finish, halt, keep, hold, proceed, repeat, resume, start, stop, terminate. Verbs like hold describe prolonged contact with an entity, but they do not describe a change of possession or a change of location. However, verbs such as keep relate to maintaining something at some location. They do not describe the actual putting of an entity at this location (Beth Levin, 1993).

2.4. Statistics calculations

Statistics can be classified into two categories - descriptive and inferential statistics. Descriptive statistics organizes and summarizes data so that it gives some meaning to it. This category includes the most basic components of statistics such as *proportions*, measures of ***central tendency***, measures of ***variability*** or spread of the data and ***graphical representation*** (bar diagrams, pie charts, scatter plots, etc.). Measures of central tendency provide the central or average value of the data, whereas measures of variability or spread focus on the dispersion of values in the data set. As far as descriptive statistics is concerned, the *mean* ($\bar{}$) is chosen to measure central tendency, *Standard Deviation* (SD) and Coefficient of Variability (CV) are selected to test the dispersion of data, and *bar diagrams* displayed percentages of gathered data. On another hand, inferential statistics provide conclusions about a population based on sample data drawn from the population. It includes a large number of statistical tools such as probability distributions (Normal, Poisson, Student-t, F, Chi-square distributions),

testing of hypotheses, correlation and regression analyses, analyses of variance, etc. In this study Student-t test is used to test hypotheses (null and alternative hypotheses) in here Student t-test was chosen to test the hypotheses (null and alternative one (Sapra, 2022).

3. Results

Figures 1, 2, and 3 provide a comprehensive overview of the data distribution in both corpora, shedding light on their respective characteristics. The striking qualitative resemblances observed between the two sets of articles underscore the consistency in their linguistic patterns. The percentages presented in these figures are calculated by comparing the cumulative occurrences of the targeted issue, be it a specific tense, voice, or lexical class, with the total count of all similar items found within the introduction sections of the articles. By doing so, we can gain a deeper understanding of how these linguistic elements are employed within the corpora. To enhance clarity and facilitate a direct comparison, the results for both journals are depicted on the same Figures (1, 2, and 3). This side-by-side presentation allows for a more immediate assessment of the similarities and differences in data distribution between the two corpora. Our analysis yields several key findings:

3.1. Tense

The ***Figure1*** reveals that both corpora exhibit consistent patterns in the use of various tenses. This suggests a shared stylistic approach in the introduction sections of the articles. Concerning JFAS journal, the results from the ***Figure 1*** indicate that simple present is the predominant tense and aspect (about 75%) followed by the present perfect and simple past with a percentage up to 11.5%. All other tenses can be neglected due to their very low proportion that does not exceed 2%.

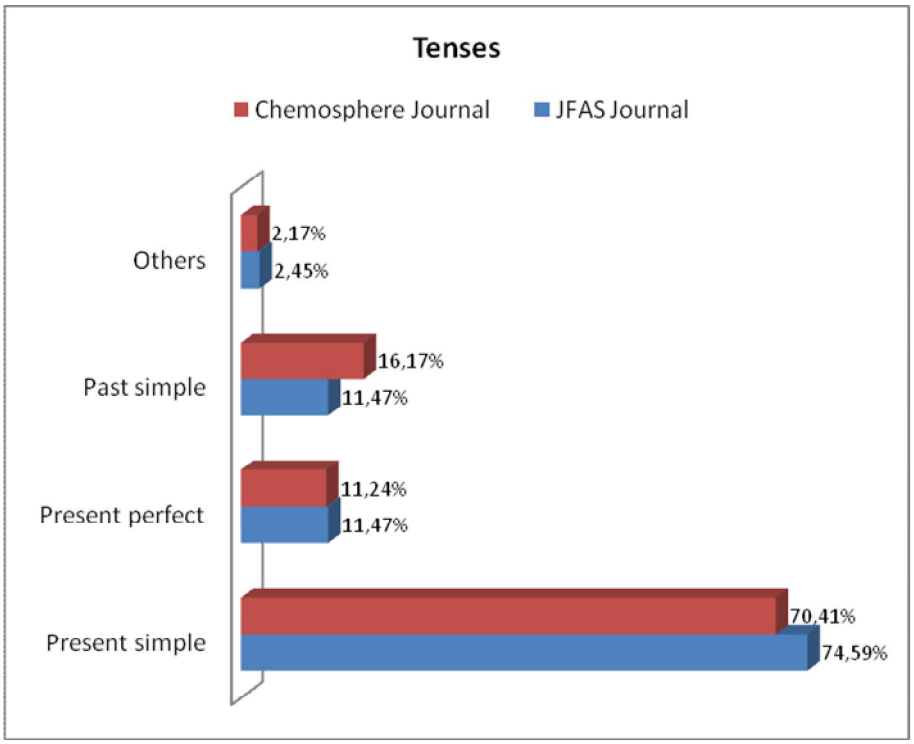

Fig1. Comparison of tense use in JFAS and Chemosphere

Besides, results from Chemosphere Journal are quasi similar to those found in JFAS Journal.

3.2. Voice

As expected the active voice was the majority throughout the corpus (about two third). The greater use of the active than the passive voice was evident in both sets of corpora with approximately, two third against one for the passive voice (***Figure2***). The data distribution also illustrates that the choice of active and passive voice is notably similar in both corpora. This observation implies a common trend in how authors structure their sentences.

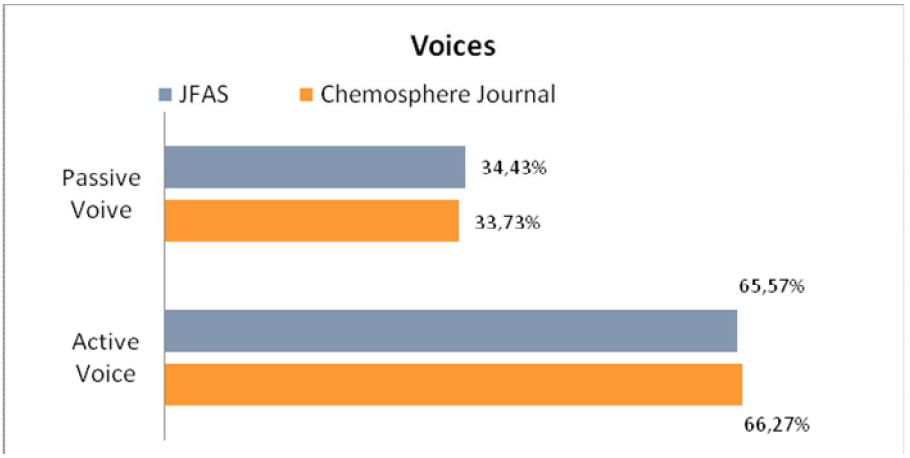

Fig 2. Comparison of voice use in JFAS and Chemosphere data

3.3. Aspect

It is apparent from the data displayed in ***Figure1*** that the simple aspect is predominant (86.06%) followed by the perfect aspect followed by the perfect aspect (11.47%). Spectacularly, the results regarding the aspect are almost identical to those found from the JFAS journal, namely, 86.57% and 11.24% for simple and perfect aspects respectively.

3.4. Lexical semantic verbs

In the *JFAS*, the lexical class of EXISTENCE *or* RELATIONSHIP verbs amounts up to 42.21% of the area, and is followed by the following semantic lexical verbs ordered according to their prominence (i.e. frequency of occurrence): ACTIVITY *verbs*, MENTA*L verbs*, *verbs of* OCCURENCE, CAUSATIV*E verbs* , COMMUNICATION *verbs*, and *verbs of* ASPECT.

EXISTENCE and ACTIVITY *verbs* occupied the head of the rank with a percentage of about 29% each class, followed by CAUSATIV*E*, COMMUNICATION, simple OCCURRENCE, MENTA*L*, and ASPECTUAL verbs (***Figure3***).

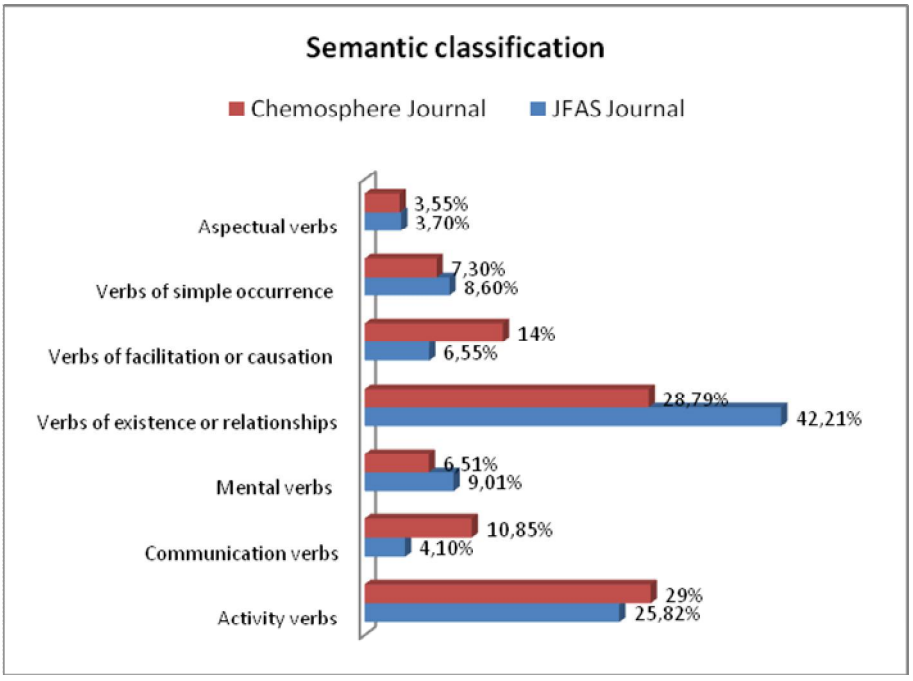

Fig3. Comparison of distribution of semantic verbs according to Biber's et al. classification (1999, 2002) within JFAS and Chemosphere RAI.

Finally, as expected, the indicative mood was the only one used in the whole corpora.

3.5. Statistics calculations

Table1: Descriptive statistics of Semantic features for corpus 1 (JFAS journal) and corpus2 (CHEMOSPHERE journal):

	Class1 ; SD ; CV	Class2 ; SD ; CV	Class3 ; SD ; CV	Class4 ; SD ; CV	Class5 ; SD ; CV	Class6 ; SD ; CV	Class7 ; SD ; CV
JFAS	5.25; 3.41; 0.65	0.83; 0.94; 1.12	1.83; 1.34; 0.73	8.58; 5.02; 0.58	1.33; 1.15; 0.87	1.75; 1.60; 0.92	0.75; 1.22; 1.62
Chemosphere	12.5; 6.68; 0.53	4.42; 3.15; 0.71	7.75; 12.81; 1.65	12.08; 5.21; 0.43	5.92; 3.87; 0.65	3.08; 2.87; 0.93	1.5; 1.88; 1.26

Note. PrS: present simple; PrP: present perfect; PS: past simple; AV: active voice; PV: passive voice; ; SD: Standard Deviation ; CV: Coefficient of Variation

Table2: Results of inferential statistics: Student t-test for the whole corpora

	Concerned feature	Result of Student t-test	Conclusion
JFAS and Chemosphere syntactic features	PrS	The difference is very statistically significant.	Null hypothesis H_0 is rejected
	PrP	The difference is statistically significant	Null hypothesis H_0 is rejected
	PS	The difference is statistically significant	Null hypothesis H_0 is rejected
	others	The difference is not statistically significant	Null hypothesis H_0 is accepted
	AV	The difference is extremely statistically significant	Null hypothesis H_0 is rejected
	PV	The difference is statistically significant	Null hypothesis H_0 is rejected
JFAS and Chemosphere semantic features	Activity verbs	The difference is very statistically significant.	Null hypothesis H_0 is rejected
	Communicative verbs	The difference is very statistically significant.	Null hypothesis H_0 is rejected
	Mental verbs	The difference is not statistically significant	Null hypothesis H_0 is accepted
	Existence verbs	The difference is not statistically significant	Null hypothesis H_0 is accepted
	Occurrence verbs	The difference is extremely statistically significant	Null hypothesis H_0 is rejected
	Causation verbs	The difference is not statistically significant	Null hypothesis H_0 is accepted
	Aspectual verbs	The difference is not statistically significant	Null hypothesis H_0 is accepted

4. Discussion

We are strongly convinced that the syntactic features are closely related to the rhetorical functions assigned to each rhetorical element in the RAIs of scientific articles by reference to the CARS model established by Swales (Fig.4) and the different moves and steps related to it.

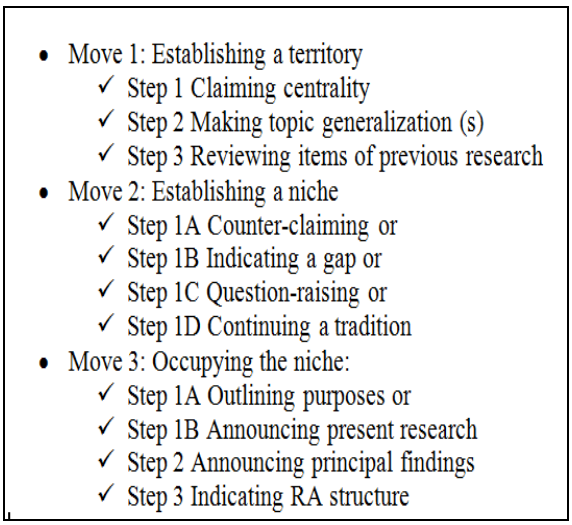

Fig. 4 Swales' CARS model. (Swales, 1990: 80)

The predominance of the simple tense could be due to realizing steps in RAIs, such as making topic generalizations (step1; move1), indicating the research gap (step 1B; move2), outlining purposes (step1B, step2, and step3; move3), outlining principal findings, and indicating the research article structure (step3; move3). All these elements need the use of present simple as it is shown in examples below:

Example1: "Iron minerals such as ferric iron ……., *play* a crucial role in the biogeochemical cycling and mobility of nutrients,…etc…" (IRAI12)

Example2: "Here, we *investigate* the impact of the adsorption and ….etc.." (IRAI12)

Example3: "Our results *show* a subtle impact of oxyanion coprecipitation on FeOx structure," (IRAI12).

Example4: "Ferrocene *stands* behind the tremendous growth of organometallic chemistry because of its fascinating sandwich structure. " (ARAI8).

Example5: "In this paper, we *carry out* a study of the molecular structure of three substituted N-ferrocenylmethylamides…etc.." (ARAI8).

Example6: "This system *measures* the concentrations of carbon monoxide in the first step. It *may*, thereafter, *incorporate* other electrochemical sensors for the main pollutants." (ARAI12).

However, the present perfect is used essentially when, reviewing previous works (step3; move1). It refers to events that started in past but are still ongoing or recently completed:

Example7: "This method, which ***has been described*** as quick, easy, cheap, effective, rugged and safe (QuEChERS), ***has been proven*** to have several advantages due to its excellent capacities of recovery, enrichment and extraction of the analyte of interest [26-27]." (ARAI10).

Example8: "Although several harmful effects of tannery effluent (TE) ***have been described*** in different aquatic species, studies about how these pollutants affect the health of terrestrial species ***have focused*** on mammalians." (IRAI11).

On another way, even though it is not conform to the instructions given theoretically to post graduates and researchers in general, simple past can be found in several parts of the introduction when reference is made to the methods used in a previous works or likewise when it is about statements that are no longer considered true. Also we can notice from the corpora, that simple past is mutually used with present simple by some authors when the aim of the study is expressed.

Examples9: "The objectives of the present study ***were to investigate*** the total flavonoid contents of stems of *Solanum nigrum* and the evaluation of the antioxidant activity by cyclic voltametry assay of different crude extract, the electrochemical behaviour ***was investigated*** at a glassy carbon electrode. (ARAI5).

Example10: “In this sense, the present work ***aimed to develop*** advanced adsorbents by the green synthesis method, using pomegranate (Punica Granatum), Eucalyptus, and….etc…” (IRAI5).

About other tenses and aspects: 50% of ARAIs use exclusively the three tenses major tenses. Besides, the rest of corpus shows few cases of present continous, single case of simple future, and sigle case of past future. In addition, from IRAIs, the haf of article uses also exclusively the three mentionned tenses (only PrS, PrP, and PS). Few cases of present continuous, one case of simple future, and single case of present perfect continous. it shows that something started in the past and is continuing at the present time.

Example11: "Nowadays, the development of nanoproducts for environmental applications ***has been increasing***.” (Present perfect continuous) (IRAI5).

Example 12: “Indeed, some say that in third millennium, it ***will be*** as much a stake in wars as oil still is today.” (ARAI6).

Example13: “Pesticides ***will continue*** to be used as an effective means of controlling pests and increasing agricultural production.” (IRAI7).

However, semantic features analysis shows that two semantic classes of verbs occupied the head of the rank namely:

Class4: existence or relationship (JFAS: 28.79%, Chemosphere: 42.21%)

Class1: activity verbs (JFAS; 25.82% and Chemosphere: 29%). These results are in close relation to rhetoric function of the introduction as a macrostructure of the article.

In contrast with those similar tendencies that appears from percentages, descriptive and inferential statistics (table1 and table2) reveals net differences. In fact, the standards deviations and coefficient of variability let suppose the heterogeneity of samples. Moreover, t-test indicates clearly that the null hypothesis in almost series is rejected which means that the behaviour of the two corpora is quasi different. Explicitly, the wording (or length) is quasi different from the two sets : the number of word tokens is 3861 which gives a clear idea of the length of the JFAS

corpus. The number of word types exhibits the number of not repeated entries in the corpus. Similarly, Chemosphere data has 7638 as word tokens and 1213 as word types (table4).

In the same optic, The **T**ype-**T**oken **R**atio (TTR) which is defined as the number of types divided by the number of tokens.TTR is used to compare two corpora in terms of lexical complexity. The closer to 1 the greater the complexity, the closer to 0 the greater the repetition of words (Dewi, 2017). Our results for both data show that repetition is considerable (i.e., it constitutes 66% for JFAS and 77% for Chemosphere). Compared with the type token ratio of Chemosphere (0.23), the introductions of JFAS' type token the ratio is higher (0.34) which means that the researchers in JFAS journal employ number of different word types which are higher than those of Chemosphere researchers.

Table4: Type-Type Ration (TTR) of the two corpora

	Word types	Word tokens	TTR=Types/Tokens
JFAS	1372	4020	0.34
Chemosphere	2810	12079	0.23

5. Conclusion

This study inquired the semantic and syntactic features of verbs used in the research articles of Chemistry published in an Algerian local journal (JFAS) and an International journal (Chemosphere). As can be seen from the results there are certain commonalities and differences among the two groups of introduction sections. Syntactically, one of the commonalities is the predominance of present tense in both data. This behavior is in close relation with different moves and steps claimed in Introduction section. Rhetoric function of the introduction suggested by Swales in his CARS model, dictates the tense. For example, researchers have to state aims and outline purposes in RAIs then the present tense is motivated by these specific rhetorical functions.

In addition, writers tend also to cite earlier studies and more frequently use the simple past tense whereas, the present perfect tense constitutes another commonality between the samples.

When evoking previous works in one decade or more and when claiming centrality, the adequate tense is the present perfect which keeps contact with the present tense. As expected, active voice was largely used against passive voice. It is well known that this tone is the preferred one in the domain of academic writing. It helps in creation of structure where the subject should be the doer itself.

.Semantically, three types of verbs occupied the head of the rank in general, namely, activity, existence or relationship, and mental verbs always in close relation to rhetoric function of the introduction as a macrostructure of the article.

6. Implications and recommendations

Some implications have arisen from the scrutiny of results. For instance, EAP curriculum designers have to increase the awareness of novice writers especially of the importance of syntactic and semantic features in fostering the quality of their academic writing in order to fit the expectation of academic community. Specific material has to be designed emphasizing the problematic issues and shedding light on the significance to be attached to these features of academic writing.

It can be suggested to Algerian researchers belonging to the fields of experimental sciences such as chemistry or physics, to begin more studies in the first place on the syntactic and semantic aspects of the different types of content words such as verbs, adjectives or adverbs, on the introduction sections of scientific articles in the first place and to extend their investigation to other sections such as the abstracts, the method part or the results and discussion section.

The intervention of researchers and teachers from Applied Linguistics should be very fruitful**.** Finally more genres should be included such as PhD and master theses, research proposal and student's undergraduate projects.

Rerences

Biber, D., et al. (2002). Longman student grammar of spoken and written English. Longman.

Biber, D., Johansson, S., Leech, G., Conrad, S., Finegan, E., & Quirk, R. (1999). Longman grammar of spoken and written English (Vol. 2). MIT Press.

Cargill, M., & O'Connor, P. (2013). Writing scientific research articles: Strategy and steps (2nd ed.). Wiley-Blackwell.

Celce-Murcia, M., & Larsen-Freeman, D. (1999). The grammar book. Heinle & Heinle Publishers.

Dewi, R. (2017). Lexical complexity in the introductions of undergraduate students' research articles. Exposure Journal, 6(2).

Faber, P., & Catalina Jiménez, M. (Eds.). (n.d.). Investigar en Terminología. Comares.

Faber, P., & Mairal Usón, R. (1999). Constructing a lexicon of English verbs. Mouton de Gruyter.

Gropen, J., Pinker, S., Hollander, M., Goldberg, R., & Wilson, R. (1989). The learnability and acquisition of the dative alternation in English. Language, 65, 203-257.

Levin, B. (1993). English verb classes and alternations: A preliminary

Li, L. J., & Ge, G. C. (2009). Genre analysis: Structural and linguistic evolution of the English-medium medical research article (1985-2004). English for Specific Purposes, 28(2), 93-104.

Mohsenzadeh, M., & Ebrahimi, S. J. (2017). Verbs in applied linguistics research article introductions: Semantic and syntactic analysis. International Journal of Foreign Language Teaching & Research, 5(17), 1-9.

Mohsenzadeh, M., & Ebrahimi, S. J. (2018). The study of syntactic and semantic features of verbs in problem statement section of master theses. Issues in Language Studies, 7(2), 104-112.

Murcia, M. C., & Freeman, D. L. (1999). The grammar book. Heinle & Heinle Publishers.

Navarro, F. A. (2001). English, international language of medicine: Causes and consequences of a current phenomenon. Inter-American Doctor, 20, 16-24.

Reimerink, A. (2006). The use of verbs in research articles: Corpus analysis for scientific writing and translation. New Voices in Translation Studies, 9-27.

Ruminda. (2016). Semantic categories of reporting verbs in online news articles. Jurnal al-Tsaqafa, 13(1), 1-14.

Salager-Meyer, F. (1992). A text-type and move analysis study of verb tense and modality distribution in medical English abstracts. English for Specific Purposes, 11(2), 93-113.

Sapra, R. L. (2022). Understanding medical biostatistics. In S. Nundy, A. Kakar, & Z. A. Bhutta (Eds.), How to practice academic medicine and publish from developing countries? Practical guide (pp. xxx-ccc). Springer Nature Publications.

Swales, J. M. (1990). Genre analysis. Cambridge University Press.

Appendices

Appendix 1: References of JFAS articles
ARAI1 : https://doi.org/10.4314/jfas.v13i2.13
ARAI2 : https://doi.org/10.4314/jfas.v13i2.8
ARAI3 : https://doi.org/10.4314/jfas.v13i2.9
ARAI4 : https://doi.org/10.4314/jfas.v13i2.27
ARAI5 : https://doi.org/10.4314/jfas.v13i2.15
ARAI6 : https://doi.org/10.4314/jfas.v13i2.18
ARAI7 : https://doi.org/10.4314/jfas.v13i3.4
ARAI8 : https://doi.org/10.4314/jfas.v13i1.15
ARAI9 : https://doi.org/10.4314/jfas.v13i1.16
ARAI10 : https://doi.org/10.4314/jfas.v13i1.24
ARAI11 : https://doi.org/10.4314/jfas.v12i3.20
ARAI12 : http://dx.doi.org/10.4314/jfas.v13i3.22

Appendix 2: References of Chemosphere articles
IRAI1: https://doi.org/10.1016/j.chemosphere.2020.127679
IRAI2: https://doi.org/10.1016/j.chemosphere.2021.131107
IRAI3 : https://doi.org/10.1016/j.chemosphere.2021.131199
IRAI4 : https://doi.org/10.1016/j.chemosphere.2020.127684
IRAI5 : https://doi.org/10.1016/j.chemosphere.2021.131193
IRAI6: https://doi.org/10.1016/j.chemosphere.2021.131114
IRAI7: https://doi.org/10.1016/j.chemosphere.2019.125464
IRAI8: https://doi.org/10.1016/j.chemosphere.2020.128107
IRAI9 : https://doi.org/10.1016/j.chemosphere.2020.127762
IRAI10: https://doi.org/10.1016/j.chemosphere.2019.06.036
IRAI 11: https://doi.org/10.1016/j.chemosphere.2019.125403
IRAI12: https://doi.org/10.1016/j.chemosphere.2019.06.071