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Research Paper

Functions of Reporting Verbs in the Result and Discussion Section of Research Articles over Sciences

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Abstract
The interaction between the writers and the experts while using citations is one of the main features of academic texts. For the integration of external experts into the text, writers usually use reporting verbs, which seem to function differently. Furthermore, selecting reporting verbs (RVs) by the researchers of disciplines seem to vary. This paper explored the functions of RVs across two disciplines of hard and soft sciences. To this end, a total number of 200 "Results and Discussion" section of research articles from the four sciences categories, namely Life Sciences, Social Sciences and Humanities, Physical Sciences and Engineering, and Health Sciences were gathered and used as the data, and their functions of RVs were analyzed based on Hyland's framework (2002). Hyland (2002) considered three basic RV types based on their function, including research, cognitive, and discourse acts, subsequently dividing each category into several subcategories. The results showed that the writers in Life Sciences used more research acts in comparison to the other disciplines. In terms of cognition acts, the rates of tentative verbs were high in all sciences since the researchers tried to report the results with caution as they were uncertain about the findings. The results approved this claim, indicating the high frequency of tentative verbs under the category of discourse acts, across disciplines using verbs like *hypothesize, indicate*, and *suggest* to show doubt with different rates. The obtained results can guide novice writers of the above-mentioned four disciplines to advance an authorial perspective and adjust to the expert conventions of the relevant research areas.

Keywords: *Functions of RVs; Reporting Verbs; Result and Discussion Section; Research Articles*

نقش گفتمانی افعال گزارشی در قسمت نتایج و بحث مقالات علوم مختلف
اثر متقابل در روابط بین متخصصان و نویسندگان متون دانشگاهی در استفاده از نقل قول بعنوان یکی از ویژگی های مهم متنی ، نشان داده می شود. برای درگیر کردن متخصصان خارجی با متن نوشتاری، نویسندگان از افعال گزارشی که نقشهای گفتمانی متفاوتی را ایفا می کنند، استفاده می کنند. علاوه بر این، انتخاب افعال گزارشی توسط نویسندگان رشته های تحصیلی مختلف، متفاوت است. این تحقیق به بررسی نقش گفتمانی افعال گزارشی در علوم مختلف می پردازد. برای همین منظور، در مجموع ۲۰۰ قسمت نتایج و بحث مقالات از چهار علوم مختلف که توسط ساینس دایرکت ارایه شده اند جمع اوری و بر اساس مدل تحلیلی هایلند (۲۰۰۲) بررسی وتحلیل شدند.علوم شامل زیستی، انسانی واجتماعی، سلامت و فنی و مهندسی می شوند. مدل تحلیلی ارایه شده توسط هایلند (۲۰۰۲) ، افعال را به طور کلی به سه نقش گفتمانی : تحقیقاتی، شناختی، و گفتمانی تقسیم می کند. نتایج نشان دادند که در قسمتهای بحث و نتایج مربوط به علوم زیستی از افعال گزارشی با نقش تحقیقاتی بیشتر استفاده شده است. در زمینه افعال گزارشی شناختی، این نوع از افعال در تمامی علوم بطور گسترده استفاده می شد که بیانگر احتیاط نویسندگان در بیان نتایج و بحث انها دارد. در مورد افعال گزارشی گفتمانی، افعالی مانند "فرض کردن" ، " نشان دادن"، و " پیشنهاد کردن" برای بیان شک و عدم اطمینان در بیان نتایج استفاده می شدند. نتایج بدست امده در این تحقیق می توانند به عنوان الگو برای نویسندگان تازه کار در علوم بررسی شده استفاده شوند و انها را با نحوه استفاده از افعال گزارشی توسط نویسندگان در رسته ها و علوم مرتبط اشنا کنند.
کلمات کلیدی: نقش های گفتمانی افعال گزارشی، افعال گزارشی، قسمت نتایج و بحث، مقالات علمی

Introduction

One of the main social practices in the academic context is citation (Friedman, 2019). According to Bakhtin (1981), professional research on citation has focused on the intertextual and dialogic features of academic writing, with new texts responding to previous ones and anticipating the subsequent responses (Hyland, 2013; Sowden, 2005). Citations reflect a form of what Fairclough called intertextuality manifestation, marking the text's associations with other texts (Fairclough, 1992). One important rationale of citation is the heteroglossic nature of academic texts, necessitating the effective integration of voices of prominent intellectuals into the newly produced texts (Boyack et al., 2013; Ding & Cronin, 2011; Swales, 2004). In academic persuasion, reference to the works of other scholars through reporting verbs (RVs) has particular importance because of situating the writers in a disciplinary framework and establishing their voices as reliable or "insider" (Hyland & Salager-Meyer, 2008)). For Hyland, the citation is the ratification social process, accepting "the cachet of a claim" (342) just when considerable negotiations are made with a large number of professionals (Hyland, 1999). In such a process, predicting the reaction of the audience to the writer's work seems necessary, reflecting the importance of the academic writing learners' mastery of the RV applications in making citations (Clugston, 2008).

As stated, RVs are citation tools that enable academic writers to provide relevant evidence and authorial stance, making arguments that appear objective but have a considerable bias due to positioning, emphasis, or omission (Liardét & Black, 2019). The importance of RVs, as an important signal for citation (Hyland, 2002; Thomas & Hawes, 1994; Thompson & Yiyun, 1991), is axiomatic as they are among the main methods to introduce evidence in academic contexts and become a successful academic arguer. Therefore, novice researchers and learners must increase their level of knowledge of citation, in general, and use of RVs, in particular, due to the following reasons:

The first reason is not to deviate from standard community practices. The second one is not to get involved in patchwriting (putting a source into the writer's own words with slight changes (Howard, 1995). Other reasons include avoiding the excessive use of quotations or the utilization of a limited extent of citation functions (Abasi & Graves, 2008; Davis, 2013; Mansourizadeh & Ahmad, 2011; Petrić, 2012; Samraj, 2013; Shaw & Pecorari, 2013) to locate the proposition, with explicit communication of different alignment degrees and assessment of the reliability and quality of the presented claims (Liardét & Black, 2019). Moreover, professional writers benefit from citations, RVs, and different stance markers to communicate with their audience while situating the produced works in the context of their relevant disciplines (Hyland, 2013). Since a lot of university students have problems in the appropriate integration of evidence and the voices of other professionals into the academic texts via citations and RVs (Borg, 2000; Kroll, 1990), the significance of the research on RVs is ensured.

There is a bulk of research in citation and RVs, and a majority of relevant literature has focused on the content analysis of citations at the level of documents in terms of citing papers to determine the functions, sentiments, and significance of citations (Abasi et al., 2006; Abasi & Graves, 2008; Harwood & Petrić, 2012; Jafarigohar & Mohammadkhani, 2015; Lu et al., 2021; Manan & Noor, 2014; Petrić & Harwood, 2013). Most of these studies have conducted comparative analyses of texts, including theses and dissertations, with the published research papers of disciplinary experts, consequently placing students in the position of novice members of the research communities. However, according to Petrić, citations may be used by the students for a variety of reasons according to a particular context or genre (Petrić, 2007). Hence, there is a necessity to explore the reporting verbs and their potentially different functions across the two soft and hard disciplines to make clear crystal how the authors of scientific research articles had

towards reporting the claims of the other scholars in discussing the results; thus, the current study aims to niche the gap in the literature.

As stated, the results and discussion sections were analyzed in terms of RVs functions, and these sections were merged into one section. The sections of results and discussion play a central role in the textual examination due to the significant function and contribution they have in writing research articles (Khedri et al., 2013). The researcher presents, highlights, and comments concerning the new findings in the results section of the study (Brett 1994) while comparing and contrasting the findings with those of others (Swales, 2004). On the other hand, the researchers focus on establishing the important contribution of their work (Ruiying & Allison, 2003) and integrating different sections of their research paper in the discussion section, which summarizes the main findings (Jalilifar, 2009).

Literature review

This study falls in the area of text analysis. Systemic Functional Linguistics (SFL) can be a useful and robust instrument used to analyze the texts (Banks, 2002). Firth contributed significantly to the advancement of functional linguistics in the area of SFL by contributing to the idea of language as a system (Young, 2011). Functional linguists do not view a certain clause element just based on the syntagmatic relation of form and function because they consider language as a paradigmatic system of resources, and understanding this complex system requires the intermingling of the elements of form and function. Thus, depending on the context, it is possible to analyze different items considering the SFL theory, an example of which is RVs in corpus-based studies encompassing scientific research articles.

Writing research articles (RAs) is one of the main methods to communicate between the members of disciplinary discourse communities, attracting significant attention to itself (Khedri et al., 2013). The genre of scientific RAs is a dimension of academic written communication, recently receiving considerable interest. Research articles are known as a genre because of their visible communicative goals (Swales & Swales, 1990). Several contextual factors may limit the communicative objectives of the discourse communities, leading to nearly fixed characteristics. However, some other features may change according to specific conditions of their occurrence (Myers, 1989). There have been recently various research viewpoints resulting from genre analysis.

Research articles use citations as a tool to represent propositional content from the source and encode the message in the target article (Bloch, 2010). Citations provide the readers with the required awareness of the prior research while enabling the writers to benefit from the existing literature to support the validity of their work. Scholars have examined various dimensions of citation in a variety of disciplines, including academic context in general and Second Language Acquisition (SLA) in particular (Hyland, 1999; Hyland & Jiang, 2018; Petrić, 2007). One of the substantial dimensions of citation in the academic context is the use of RVs to cite and refer to other studies, although non-native students are usually unsuccessful in their appropriate application. Kwon et al introduced RVs (such as *argue, find, show, and think*) as vital linguistic instruments used by writers for the effective synthesis and incorporation of the references into their works, making reporting verbs a fundamental dimension of larger citation techniques the student writers require to compose evidence-based argumentations (Kwon et al., 2018). Academic writers select between two extensive classes of reporting structures, including integral and non-integral, when they acknowledge and integrate the work of others. To put it another way, writers select between explicit naming and emphasis on the authors cited in their texts (integral) or merely referring to the cited authors in parentheses or using superscripts notations, with an emphasis on the reported content (Swales & Swales, 1990).

There have been extensive investigations of RVs application in the academic context in recent years. Thompson and Ye proposed a framework to analyze the contextual value of reporting verbs (Thompson & Yiyun, 1991). The threefold analysis performed by them showed how reporting verbs demonstrated the writer's viewpoint concerning the report (positive, negative, or neutral), how these verbs constructed the author's perspective towards the cited reference (accepting, neutral, or rejecting), and how reported verbs divulged the writer's interpretations (or non-interpretations) of the discourse, behaviors, and status of the author. In another study, Thomas and Hawes classified the reported verbs based on the type of activities referenced into real-world or experimental (such as *find, demonstrate*), discourse (such as *suggest, hypothesize, argue*), and cognition (such as *view, conclude, regard*) activity verbs (Thomas & Hawes, 1994).

Although Thompson and Ye primarily focused on the use of reporting verbs when signaling evaluations, Thomas and Hawes provided a systematic network reflecting the alternatives for reporting verbs and particularly, discourse implications associated with them. According to such frameworks, Hyland classified reporting verbs based on the activity types they referred to and introduced three further classes of Research (such as *observe, discover, or show*), Cognition (such as *analyze, calculate and explore*), and Discourse (such as *discuss, state or hypothesize*) Acts (Hyland, 1999). The above categories were mapped into research, cognition, and discourse acts based on the research activities of the original author and the evaluations of the writers of their statements (Hyland, 2002). Researchers used frameworks on citation and reporting verbs as classification; for instance, Un-udom and Un-udom sought to investigate the category of RVs utilized with the highest frequency in applied linguistics papers and how it was used in the process of citation (Un-udom & Un-udom, 2020). Accordingly, they analyzed 52 articles from three journals of applied linguistics by Antconc software's concordance tool. The researchers considered RVs utilized in the section of the literature review because they expected this section to have more RVs. Analysis of the RVs was conducted into a concordance line, followed by their classification into Hyland's Framework of RVs (2002). Their findings indicated research, discourse, and cognition acts as the three classifications of RVs applications, with research acts showing the highest frequency.

Reporting verbs have been studied from various angles; for instance, the difference between novice and experienced writers' use of RVs is one of the fields. Pickard analyzed the citation practices of professional users in a corpus of articles in applied linguistics (Pickard, 1995). The research sought to compare expert writers' practices with those of inexperienced writers overusing reporting verbs, including say. As indicated by the research findings, the professional writers used more various reporting verbs, including *argue, suggest, propose, report, point out, and call*, using the reporting verb of say four times throughout the corpus. Similarly, Bloch claimed that students could receive explicit teaching on the application of reporting structures to obtain the desired rhetorical objectives and establish a concordance of reporting verbs from professional RAs to utilize as a pedagogical instrument towards these goals (refer to Swales & Feak 2004 for more details) (Bloch, 2010). More recently, Liardét and Black examined English as an Additional Language (EAL) learners' and English L1 learners' utilization of reporting verbs and performed comparisons with that of expert writers to provide a corpus-assisted comparative analysis (Liardét & Black, 2019). The researchers used the resources of Appraisal Theory, particularly the Engagement system, and concluded that expert writers were more willing to approve dialogically contracting reporting verbs (such as *show* and *find*) endorsing the proposition, while novice writers were considerably dependent on the development of reporting verbs entertaining the evidence as options to take into account (such as *suggest*) or merely attributing it to an external professional writer (such as the verb *state*). Particularly, the EAL and English first language learners were both heavily dependent on more "neutral" features of

acknowledgment (such as *state, according to*), proposing no explicit indications as to their intersubjective viewpoint on the evidence. The authors believed that the results of the comparisons provided the inexperienced writers with a roadmap to establish an authorial viewpoint and adjust to the professional principles of their relevant discipline.

The challenges faced by EAL learners in the use of reporting verbs is one of the areas attracting considerable attention. Several studies have concluded that these learners strive to select appropriate reporting structures but merely use a limited range, restricting the possibility of their involvement in research and effective construction of arguments (Davis, 2013; Thompson & Yiyun, 1991). As an instance, according to Petrić, both high- and low-rated master's theses were considerably dependent on attributive reporting structures, illustrating the usage of citations by the students to express knowledge (Petrić, 2007). As indicated by Pecorari, EAL learners are usually indiscriminate in selecting reporting verbs and feel free when they substitute one RV for another regardless of the effects of their choice on their viewpoint toward the reported evidence (Pecorari, 2008). Current research on Vietnamese Master's theses supported this finding, indicating that writers were more willing toward the random application of reporting verbs with no awareness of their rhetorical function (Nguyen & Pramoolsook, 2015). Overall, students gain better scores when synthesizing evidence through critical analysis and utilization of the arguments of the source into their work (Petrić, 2012). Nevertheless, inexperienced EAL writers cannot usually present cohesive discussions of their sources and default to what Swales knows as "parenthetical plonking" (p. 135) (Swales, 2014). Related to this field, Kwon et al examined the RV practices of the second language (L2) writers in a first-year writing program in North America (Kwon et al., 2018).

The literature review assignment from Corpus and Repository of Writing (Crow) was used to examine the application of RVs by this population in an academic genre incorporating different sources to illustrate a topic selected by them. Their study reported on the frequency of application of various verb forms and the way writers used verbs from specific established semantic classes (such as *Argue, Think, Find, Show*) and rhetorical functions (Reporting from text (R), Self-referential (S), Uncited Generalization (U)). As found by the study, the first-year second language writers mainly used similar patterns selected by upper-level undergraduates to cite external sources. Nevertheless, pedagogical attention to the instruction is necessary to enable this group to utilize greater variety and academic vocabulary in citation and help them figure out various rhetorical functions of RVs and the respective impacts of such functions on evidence-based arguments.

There is also some research examining RV rhetorical functions. As an instance, Hyland and Tse (2005) discussed how RVs were utilized to express a variety of stances. According to Petric, second language writers of higher-rated theses employed a much more extensive range of functions (to evaluate or establish links between sources), whereas the lower-rated dissertations included mainly simple citations (Petrić, 2012). Parkinson examined second language writers during their first year of undergraduate education, comparing their writings with those of experts in the same field (Parkinson, 2013). As Parkinson concluded, in addition to clauses containing RVs that performed the same functions as those in expert research articles, including citation of prior research and affirmation of the authors' claims, the students utilized RVs and related that-clauses to state common knowledge. Similarly, Charles a coding scheme aimed at connecting the form and function while identifying the source of reported content in the master's theses according to the grammatical subject (human, non-human, or it), source (self or others), and type of source (how explicit is the reference to the source of the cited content by the writer) (Charles, 2006). Later, Charles identified generalizations (such as many have argued) as a subcategory of other-sourced content. Hence, the scheme introduced by Charles provided insights into the rhetorical functions of RV application.

As an instance, other-sourced content with explicit identification of the source can be used to accomplish textual attribution. Self- and other-sourced information utilized for reference to common knowledge performs distinct functions. Despite the examination of these different functions in articles written by experts and professional L2 writers, there is not enough information on the use of RVs by the first-year L2 writers to benefit from such functions when writing in the academic context. Furthermore, Liu and Wang, more recently, tried to investigate the forms and sentence patterns, functions and classifications, and frequency distributions of Chinese reporting verbs, introducing four RV forms, including verbs, verbal phrases, discontinuous constructions, and lexical chunks in Chinese (Liu & Wang, 2019). The results confirmed the characterization of Chinese reporting verbs through four forms and five substantial sentence patterns. In terms of function, there were three categories, reflecting the referrer's attention to the work performed by the referee and showing the evaluation stance of the referrer. As revealed, discourse verbs had a frequent application to convey the writers' concerns on the interactive communication of the author and the academic community, in which they usually express their evaluations. Cognition Verbs, utilized by the writers to postulate on the mental and cognitive practices of the cited author had the lowest frequency.

There are also studies on a variety of citation methods in various scientific fields to represent and establish knowledge, investigating the adoption of reporting verbs and a variety of citation structures to reflect the ideologies and epistemologies of their field (Charles, 2006; Dressen, 2003; Hyland, 1999; Hyland & Jiang, 2018; Thomas & Hawes, 1994; Thompson & Tribble, 2001). As an instance, Charles (2006: 310) collected a sample of theses compiled by native speakers in politics/international relations and materials sciences and compared their utilization of reporting practices. As indicated, the highest frequency of RVs throughout both corpora belonged to argue (*argue, note, suggest*), while the materials sciences represented many occurrences of the find/show reporting verbs (such as *find, observe, show*). Interestingly, Hyland and Jiang studied diachronic changes in citation practices of research articles within four fields of applied linguistics, biology, engineering, and sociology, indicating less dependence of the writers on integral citations, lower frequency of RV utilization for information evaluation, and selecting more "neutral" research reporting structures (such as *describe*) when they did so (Hyland & Jiang, 2018).

Despite the substantial role of RVs in source-based writing, there is scant quantitative research on their application and functions by the authors of scientific research papers in the four disciplines of Life Sciences, Social Sciences and Humanities, Physical Sciences and Engineering, and Health Sciences, introduced by Sciencedirect web of science. The present paper has focused on diminishing the gap in the literature through an examination of RV functions by the authors of the above-mentioned disciplines to find the similarities and differences and identify areas for pedagogical interventions. Our close investigation of the RVs application by experts aimed to determine patterns of RVs' functional uses. Accordingly, it is possible to illuminate the role of RVs in the meaning delivery to the readers of academic texts via interactions with pedagogic and other information sources. Overall, the study aims to answer the research questions below:

RQ1: What are the RV functions in each discipline?

RQ2: What are the similar and different RV functions across disciplines?

Research method

Corpus

The present study is a corpus-based study. The corpus of the current study was a total number of 200 "Results and Discussion" sections of RAs consisting of 50 excerpts from each science introduced by science webs, namely Life Sciences, Social Sciences and Humanities, Physical

Sciences and Engineering, and Health Sciences. Convenience sampling was performed to select RAs from leading journals in the selected disciplines, published during 2015-2020. The articles were chosen randomly from different journals, including Radiotherapy and Oncology, Advances in Digestive Medicine, System, European Journal of Medical Genetics, Cancer Genetics, Life Sciences, Ocean & Coastal Management, Engineering Software, Case Studies in Construction Materials, Advances in Accounting, and Australasian Marketing Journal. The reason behind selecting the source journals only from one database is that the Science Direct web of science provided sufficient empirical RAs for the study period from 2015 to 2020 with the required format for further sampling. After gathering the data, the number of words was estimated in each discipline as shown in the following:

Health Sciences: 45460, Physical Sciences: 65085, Social Sciences: 48741, and Life Sciences: 53133.The whole corpus consisted of 212492 words (about 50,000 words for each discipline). Then, frequencies of each function were investigated, and their relative frequency ratio per 10,000 words was estimated and reported. The data of the study were small and specialized as justified by the writings of several authors like (Flowerdew & Forest, 2009) and (Ghadessy & Gao, 2001), who suggest that the corpus, which includes the texts of the same genre and discipline may provide enough data for the analysis, regardless of their size. Limiting data to a specific genre within a particular discipline also controls possible disciplinary variations (Kanoksilapatham, 2005). Besides, a small corpus enables some analyses that require the hand-coding of RVs, which otherwise cannot be handled manually within large data (Flowerdew & Forest 2009). Therefore, to meet the requirements for the more reliable data, the researcher of the present study chose the results and discussion sections of the RAs with which she tabulated and categorized the desired sections.

Theoretical Model

Hyland's model (2002) for function analysis of RVs

For the aim of functional analysis of RVs, the researcher used Hyland's (2002) model for function analysis. Many studies have introduced standards to determine and categorize RVs in the academic context (Hyland, 1999; Thompson & Yiyun, 1991). Hyland classified RVs based on the functional applications of the verbs into three main categories of research, cognitive, and discourse acts, presenting one of the most profound concepts (Hyland, 2002). The research act RVs are further classified into the procedure and finding, with the former presenting methods utilized in the cited works, including the verbs *analyze, calculate, assay, explore, plot,* and *recover*. However, through the latter, the authors use factive verbs (such as *demonstrate, establish, show, solve,* and *confirm*) to support the results of other writers, counter-factive verbs (e.g., *fail, misunderstand, ignore, and overlook*) to reject the results, and non-factive verbs (e.g., *find, identify, observe, obtain*) to indicate their neutral stance concerning the results.

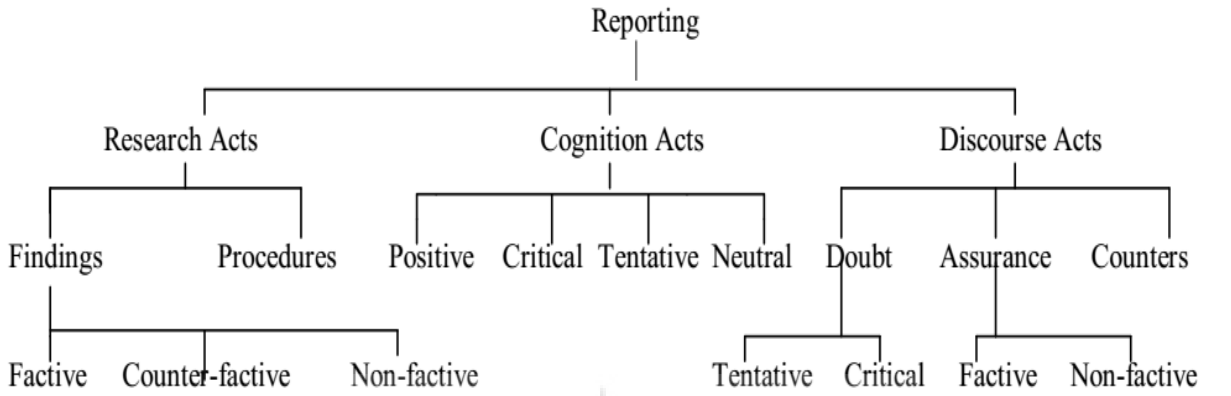
On the other hand, the writers utilize the RVs of the second category to demonstrate the authors' stance toward the cited information. There are four sub-categories of positive attitudes (*agree, concur, hold, know, think, and understand*) to show acceptance of the truth of the data, tentative views (*believe, doubt, speculate, suppose, suspect*), critique (*disagree, dispute, or no think*), and neutral stance (*picture, conceive, anticipate, reflect*).

Finally, the writers use the RVs of the discourse acts to represent the citation evaluations. The writers are responsible for the interpretations and representation of uncertainty or assurance while assigning certain qualifications to the author. More specifically, the categories of doubt and assurance include the verbs directly expressing the authors' views. Verbs in the doubt category include two subcategories of tentative (*postulate, hypothesize, indicate, intimate, and suggest*) and critical (*evade, exaggerate, not account, and not make a point*). However, verbs in the assurance category include the subcategory of non-factive (*state, describe, discuss, report,*

answer, define, and summarize) and active (*argue, affirm, explain, note, point out, and claim*) verbs. It is also noteworthy that the verbs of the counter-category (e.g., *deny, critique, challenge, attack, question, warn,* and *rule out*) express the objectives of the author referred to. The following figure shows a summary of Hyland's (2002) framework.

Figure 1

Hyland's Framework for RVs (2002, P. 122)



Procedure

At the onset of the study, first, the articles were downloaded, followed by extracting the results and discussion sections and converting them into Plain Format because this format can be used easily in other programs. To achieve the research objectives, frequent RVs in the research articles understudy were determined and compared to provide a list of RVs and contrast their uses. Therefore, the study followed the process of collecting the frequencies and percentages of RVs and contrasting their uses in terms of functions of RVs. Qualitative analysis of the collected data was performed in terms of the frequencies of RVs in research articles according to the Hyland's framework (2002) on RVs' functions and its different sub-categories as explained above.

The researcher analyzed the collected corpus based on the framework understudy, while a second researcher who was familiar with the data analysis of RVs performed independent rechecking and reanalysis of 10% of the data for functions of RVs based on the sane framework to ensure the reliability of the analysis in the process of data categorization. The second rater, whose field of study was discourse analysis, coded 10% of the data, taken randomly from the corpus, finally estimating and reporting the inter-rater reliability. The inter-rater agreement, measured using Cohen's Kappa formula, was Kappa = 0.89, p = 0.000.

Results

Answering the first research question

The first research question focused on the functions of the RVs used in each discipline. Based on the results obtained from the data analysis, a total number of 212492 words were obtained (about 50,000 words for each discipline). Calculation and distribution of the RVs frequencies were according to Hyland's framework on the categories of research, cognition, and discourse acts, reported in frequencies, percentages (%), and the relative frequency ratio per 10,000 words

within the parenthesis after the percentage. For example, 2.4 shows the relative frequency ratio per 10,000 words for the function of the *procedure* in *Life sciences*. The research act was divided into findings and procedures, whose distributions across different sciences are provided in Table 1.

Table 1
The frequencies and percentages of research acts throughout sciences

Research Section		Disciplines			
Procedure		***Life Sciences***	***Social Sciences***	***Physical Sciences***	***Health Sciences***
		13 (2.2%/2.4)	9 (4.8%/1.8)	23 (10.7%/3.5)	24 (8.7%/5.2)
Findings	*Factive*	337 (57.4%/63.4)	110 (58.8%/22.5)	106 (49.5.5%/16.2)	170 (62.4%/37.3)
	Counter-factive	1 (0.1%/0.1)	1 (0.5%/0.2)	0	0
	Non-factive	236 (40.3%/44.4)	67 (35.9%/13.7)	85 (39.8%/13)	79 (28.9%/17.3)
Total		587 (100%/110.2)	187 (100%/38.2)	214 (100%/32.7)	273 (100%/59.8)

As it is clear, the frequency of the findings sub-category is higher than the procedure sub-category in all disciplines, and the distribution of factive in the findings sub-category is higher than non-factive in all sciences. Counter-factive is the least-frequent one in Life and Social Sciences and absent in Physical and Health Sciences. Surprisingly, the frequency of the research category in Life Sciences is higher than the Health Sciences, and the distribution of research category in Social Sciences is the lowest one in comparison to the other disciplines.

According to the second category, writers utilize RVs for the illustration of the authors' viewpoints concerning the reported statements. The four sub-categories included positive attitude, tentative view, critique, and neutral stance. Table 2 presents the rates and distribution of cognition act in four disciplines.

Table 2
The frequencies and percentages of cognition act throughout sciences

Cognition act	Disciplines			
	Life Sciences	***Social Sciences***	***Physical Sciences***	***Health Sciences***
Positive attitude	0	2 (18%/0.4)	2 (16%/0.3)	3 (20%/0.6)
Tentative view	11 (92%/2)	7 (64%/1.4)	10 (84%/1.5)	8 (54%/1.7)
Critique	0	0	0	1 (6%/0.2)
Neutral stance	1 (8%/0.1)	2 (18%/0.4)	0	3 (20%/0.6)
Total	12 (100%/2.1)	11 (100%/2.2)	12 (100%/1.8)	15 (100%/3.1)

Based on the results, although no positive attitudes are observed in Life Sciences, it has the same distribution in the rest of the three disciplines (between 16% to 20%). The tentative view covers more than half to about 90% of the corpus in all disciplines. The sub-category of critique

is absent in all disciplines except for the Health Sciences observed just in one instance. The rate of natural stance is high in Health Sciences (20%) and low in Life Sciences (8%), but not observed in Physical Sciences. In total, the frequencies of tentative view in all sciences are high, and the rates of critique are low across disciplines. Reporting discourse acts, utilized to reflect the citation evaluation, is another category that needs to be reported. Table 3 indicates the frequencies of discourse acts across sciences.

Table 3
The frequencies and percentages of discourse acts throughout sciences

Discourse acts		Disciplines			
		Life sciences	***Social sciences***	***Physical sciences***	***Health sciences***
Doubt	*Tentative*	135 (50.8%/25.4)	85 (57%/17.4)	14 (28.6%/2.1)	99 (37.4%/21.7)
	Critical	0	0	0	0
Assurance	*Factive*	7 (2.6%/1.3)	30 (20.2%/6.1)	12 (24.5%/1.8)	7 (2.6%/1.5)
	Non-factive	124 (46.6%/23.3)	34 (22.8%/6.9)	23 (46.9%/3.5)	161 (60%/35.4)
Counters		0	0	0	0
Total		266 (100%/50)	149 (100%/30.4)	49 (100%/8.4)	267 (100%/58.6)

As the results in Table 3 show, the rate of discourse act of tentative is 57% and 50.8% in Social and Life Sciences, respectively. Moreover, the rate and percentage of tentative as reporting verb signifying doubt is about 37% and 28% in Health and Physical Sciences, respectively. As it is evident, the sub-category of critical under the doubt category is not indicated in any of the sciences. Factive and non-factive reporting verbs under the category of assurance are distributed at different rates across disciplines. The authors of Physical Sciences used more factive verbs (24.5%), and the authors of Social Sciences used factive verbs 30 times (20.2%), while the researchers in Life and Health Sciences used factive verbs at about the same frequencies (2.6%). The high-frequently used non-factive verbs were related to the Health Sciences; whereas, the least frequent non-factive verbs belonged to the articles of Social Sciences. Based on the results, the researchers of Life and Physical Sciences used non-factive verbs at about the same rate (46%). Finally, similar to critical reporting verbs, counters were absent in all disciplines.

Answering the second research question

The second research question focused on comparing and contrasting the RV functions used across disciplines. Based on the results shown in Table 1, the frequency of finding sub-categories is higher than the procedure sub-category in terms of research acts in all disciplines, which shows the common facts and similarities of all disciplines. Furthermore, the rate of factive in the finding sub-category is higher than non-factive in all sciences. In terms of differences, although counter-factive is the least-frequent one in Life and Social Sciences, it is absent in Physical and Health Sciences. In general, the frequency of research category in Life Sciences is higher than the Health Sciences and the lowest in Social Sciences. Looking from the relative frequency ratio per 10,000 words' angle, it can be observed that the rates of factive and non-factive subcategories are high in Life Sciences when compared with the other disciplines. As mentioned, research acts are sub-

categorized into the procedure and finding sections. Based on the results, the distribution of the procedure was less than the finding section in all of the sciences. Showing non acceptance of the results in the form of counter-factive verbs by the authors of Social and Life Sciences, just once, can indicate the assurance of Social Sciences about the results. The following example can clarify this claim:

Example 1: Up to now, however, many studies analyzing demographic diversity in top management teams have ***ignored*** the effects of gender.

The researcher used the counter-factive verb of ignoring to approve the lack of studies on the gender effects on demographic diversity in top management teams. Furthermore, one of the researchers in Life Sciences reported about their study's failure to reflect any significance in the differences of malignant change rates in every sub-classification (We *failed* to indicate any significant differences of malignant change rates in every sub-classification, possibly because of the small sample size) using the counter-factive reporting verb of *fail*.

In terms of cognition acts, the rates of tentative verbs were high in all sciences since the researchers tried to report the results with caution because they were uncertain about the findings, as the following two examples represent:

Example 2: Hence, the behavioral abnormalities observed in the current research are *speculated* to be associated with the disruption of the BBB and alterations in the level of the neurotransmitters in brain.

Example 3: …thus, we *suspected* that circLMTK2 overexpression may possess the anti-tumor function.

This claim was approved by the results of Table 3, indicating the high frequency of tentative verbs under the category of discourse acts across disciplines using the verbs like *postulate, hypothesize, indicate, intimate,* and *suggest* to show doubt. The following examples clarify the results:

Example 4: As wave decay investigations *indicate*, generally, even small (<9 m) power boats traveling within 150 m of the shore can generate wave heights that are capable of causing erosion of vegetated marsh shorelines (Zabawa & Ostrum, 1980; Coops et al., 1996; Coops et al., 1996, 1996; Schafer et al., 2003; Roland & Douglas, 2005).

Example 5: However, Rosenberg (1995) *suggested* that 0.20 of fishing rate of current level is suitable to avoid the decline of fisheries following maximum harvest.

Example 6: As recent literature *suggests*, EGFR GCN, evaluated by FISH, can be a suitable tool for the evaluation of the EGFR expression (17-19,24-33).

Example 7: We *hypothesize* that this may occur because of centrosomal dysregulation.

Example 8: Previous studies *indicated* miR-143 as a functional factor in KRASmediated colorectal tumorgenesis (41)

Table 2 shows the authors' viewpoints concerning the reported statement (cognition act). Based on the results, the frequencies of the tentative view (*believe, doubt, speculate, suppose, suspect*) are high, and the rates of critique are low across disciplines. Moreover, the distributions of positive attitudes and neutral stances are about the same in the data. The category of discourse acts, utilized to reflect the citation evaluation, is another category that needs to be reported, as shown in Table 3. The rates of tentative in Life and Social Sciences are more than 50% while distributed in low-frequency in Physical Sciences. Two sub-categories of critical and counters are absent in all disciplines, representing another similarity. The sub-category of non-factive within the category of assurance is used at the same rate (about 40%) in two disciplines of Life and Physical Sciences; however, it is used in low frequency in Social Sciences and high frequency in Health Sciences. To sum up, in terms of discourse acts, the relative frequency ratio per 10,000 words is about 50 in the two disciplines of Health and Life Sciences and the lowest in Physical Sciences.

Discussion

Discussion of findings on the first research question

In this part, further explanations concerning the results of the analyses are put forward in addition to justifications of the findings taking into consideration the previous studies. As stated, the present study aimed to examine the RV functions used by the researchers of different sciences based on Hyland's taxonomy (Hyland, 2002). Accordingly, 200 "Results and Discussion" sections of RAs consisting of 50 excerpts from the four science categories introduced by Science direct web of science, including Life Sciences, Social Sciences and Humanities, Physical Sciences and Engineering, and Health Sciences, were selected to represent the distinctions made by writers when selecting RVs and their functions. As shown, the writers in Life Sciences used more research acts in comparison to the other disciplines. As already stated, research acts are sub-categorized into the procedure and finding sections. Based on the results, the distribution of the procedure was less than the finding section in all of the sciences. One reason can be the reluctance of the researchers to report the methods used in the cited works in the sections of results and discussion, on which the current study focused. On the other hand, the researchers desired to report the results obtained by others in the results and discussion sections using factive reporting verbs to confirm the results of other experts and non-factive reporting verbs to reveal neutral comments concerning the results rather than counter-factive ones. One justification is the fact that the nature of the results and discussion sections revolves around accepting the results of others or showing neutral comments on the results. Showing non acceptance of the results in the form of counter-factive verbs by the authors of Social and Life Sciences, just once, can indicate the assurance of Social Sciences about the results.

Reporting verbs and their different functions can be associated with researchers in various sciences; however, as the results of this study indicated, the use of RVs is inevitable in each research. As Hyland claims, RVs facilitate the establishment and continuation of the connection between the writers and their audiences while also enabling them to express their attitudes concerning the quoted content (Hyland, 2005). Even though it may be suggested that many researchers in different sciences adhere to certain and somewhat conscious patterns for citation and reporting the results, some may have utilized the verbs semi-automatically with no certain objectives behind their choices (Swales, 2014). Nevertheless, it is not possible to verify such a claim without interviews with the authors of the texts, which was impossible for the researchers. On the other hand, such interviews are not always useful or revealing (Harwood, 2008, 2009). According to Thompson and Ye, the selection of RVs is one of the main features enabling the writers to place their works along those of others in the same field (Thompson & Yiyun, 1991). Thompson and Ye classified RVs into three categories of textual, mental, and research verbs based on the process performed. The first category included an obligatory component of verbal expressions, while the second category referred to mental processes, and the last one referred to processes forming part of research activities. Other researchers, including Thomas and Hawes and Hyland, used this classification, even though Hyland replaced the terms textual and mental with discourse and cognition (Hyland, 2002; Thomas & Hawes, 1994).

Discussion of findings on the second research question

The second research question focused on comparing and contrasting RV functions used across disciplines. As the results showed, it is possible to divide the research act RVs into procedure and finding. Based on the results obtained from Table 1, in terms of the research acts, the frequency of the finding sub-category is higher than the procedure sub-category in all disciplines, showing the common fact and similarity of all disciplines. The reason for this result is clear, as the focus of the current study was on the results and discussion sections of the articles, which mostly report

on the findings rather than other sections such as methods; hence, the frequency of the procedure sub-category is low in all disciplines.

Furthermore, the rate of factive (accepting the results of others) in the finding sub-category is higher than non-factive (expressing neutral comments on the results) in all sciences. One justification for this can be the nature of citation and research articles. In citations, the authors try to accept the results of the other researchers to strengthen their results; however, most authors are reluctant to take a neutral position. It is worth noting that this is a hunch, and its validity can be estimated via online protocols and interviews with authors. In terms of differences, although the counter-factive is the least frequent in Life and Social Sciences, it is absent in Physical and Health Sciences. Showing the unacceptance of the results in the form of counter-factive was not common in Social Sciences; however, it was used in a higher frequency in Life Sciences than the Health Sciences. The findings are in line with the results obtained by Jarkovská and Kučírková (2020), exploring the RVs application in EFL learners' Master's theses. Their findings revealed a significant predominance of discourse acts verbs over the other two categories, with the verbs of the latter category the least frequent.

In terms of the authors' attitudes towards the reported statements, the frequencies of tentative view are high, and the rates of critique (e.g., *disagree, dispute, no think*) are low across disciplines. Moreover, the distributions of positive attitude and neutral stance are nearly the same in the data. Again, the results are in line with the findings of Jarkovská and Kučírková, reporting on the high frequency of tentative view in the corpus (Jarkovská & Kučírková, 2020).

The category of discourse acts, utilized to represent the citation evaluation, is another category of the framework under study. The distribution of tentative in Life and Social Sciences is more than half of the occurrences; however, it has a low frequency in Physical Sciences. The two sub-categories of critical and counters are absent in all disciplines, which can be another common similarity. The two disciplines of Life and Physical Sciences use the same rates of the non-factive sub-category within the category of assurance. However, the non-factive sub-category has a low frequency in Social Sciences and a high frequency in Health Sciences. The findings, thus, contradict those of Manan and Noor whose analysis of Literature Reviews in Master's theses revealed higher familiarity of the Master's students with the Research Acts verbs than Cognition or even Discourse Acts, which were the least frequent (Manan & Noor, 2015). Such diverse results may be due to different corpora in terms of size and research material, as well as the differences in the initial language background knowledge of the researchers in our study with those of the students whose writings were analyzed by Manan and Noor (Manan & Noor, 2015). Thus, the findings mainly agree with those of Agbaglo, in whose analysis of RA Literature Review sections written by lecturers from the Department of English, Discourse Acts verbs prevailed over the Research Acts and Cognitive Acts category (Agbaglo, 2017). The reason for this congruency can be the expert authors in both studies.

Conclusion and Implications

The main focus of this study was to analyze the RV functions based on Hyland's (2002) taxonomy in the sections of results and discussion of scientific research articles while providing some instances of authentic applications of RVs to help inexperienced researchers in each science. The results showed that the writers in Life Sciences used more research acts in comparison to other disciplines. In terms of cognition acts, the rates of tentative verbs (*hypothesize, indicate,* and *suggest*) were high in all sciences since the researchers tried to report the results with caution due to their uncertainty about the findings. As mentioned, this study's secondary aim was to present some examples of the texts from the disciplines in order to increase the students and authors' knowledge in the use of different RVs that this awareness raising can be resulted in the pedagogy. From the pedagogical perspective, we aimed to teach learners about

engagement with the results and discussion in citing the experts' views while referring to different researchers and presenting arguments according to the evidence taken from others. Accordingly, students require familiarity with the meanings of various reporting structures and have to enhance their capabilities in the conscious selection of reporting verbs. They should also understand the language delicacies to place the claims of experts based on their desired arguments via function-based analysis of RVs and compare researchers' reactions to RVs in various disciplines. Even though communicating the authorial stance is possible using a variety of strategies in terms of the scope, the present work has focused on the inter-textual analysis of RVs in terms of function analysis.

The results reinforce the idea that making references and incorporating evidence need something beyond the simple application of suitable citations, and writers should be able to represent their authorial stance or scrutinize the functions of RVs (Huang, 2022). Hence, the methods used to reference and cite require consideration as a component of a comprehensive approach, which needs further examination by the researchers of different sciences, because knowledge of where and when to reference enables student learners to prove their capabilities in the integration of the obtained information from other experts into their ideas when writing (Hendricks & Quinn, 2000). Overall, despite the clear differences in the selection of reporting verbs by expert writers across disciplines while citing, student learners can take advantage of more straightforward insights into how such an RV choice communicates to the audience. The study has also several implications for non-native postgraduate students to enhance their texts when writing their proposals or dissertations.

As is the case with all human production, this study has some limitations, which need consideration before making any interpretations. In this study, the written medium was used to investigate the types of RVs in written texts. Therefore, for further research, interested researchers could investigate the functions of the reporting verbs in the spoken medium instead of writing medium, too. Moreover, for future studies, the reporting verbs can be studied in research articles and in different genres.

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