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THE IMPLICATIONS OF IDEATIONAL METAPHORS ON GRAMMATICAL INTRICACY AND LEXICAL DENSITY IN ACADEMIC WRITING: A SYSTEMIC FUNCTIONAL LINGUISTIC APPROACH

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Abstract

This study aims at investigating the types of ideational metaphor used in scientific texts and analyzing its implications on grammatical intricacy (GI) and lexical density (LD). The data are limited to the scientific articles published on International Journal of Scientific and Technology Research (IJSTR) Volume 10 - Issue 5, May 2021 Edition. This journal aims to promote the theory and practice of sciences, technology, innovation, engineering and management. A qualitative descriptive methodology is applied to this study. In analyzing the data, there are two grand theories used; Halliday's Systemic Functional Linguistics (1985) to analyze the ideational metaphors and LD & GI formula proposed by Gerot, Linda, and Wignel (1995). An electronic based is also applied to count number of words and clauses containing in the discourse chosen which can be downloaded from http://www.usingenglish.com/resources/. This study found that ideational metaphor impacted on lexical density by showing the dense information conveyed through nominalization and condensed complex clauses. The lexical density found from the data (three representative articles) is 36.75, 49.48 and 40.51. Ideational metaphor also impacted on the grammatical intricacy shown from the lower rate which is 1.29,1.31, and 1,24. Ideational metaphors characteristic are shown in the nominalization formed from the condensation of subordinate clauses into phrases, the change of process to noun dominated by relational process to goals or agent. This study is expected to be beneficial to lecturers and writers to consider applying ideational metaphors in their academic writing and to English teachers and lecturers to (re)consider the LD and GI of textbooks readibility for students.

Keywords: Ideational Metaphor, SFL, Scientific Text, Lexical Density, Grammatical Intricacy

INTRODUCTION

Writing academic articles becomes a compulsion in educational institution for both lecturers and students. Then, writing becomes one of productive skills expected to be conducted especially in producing academic articles published on journals or other media. Writing, especially academic discourses, is more complex than spoken languages because it has to meet rigid structure and grammatical system. An academic discourse contains dense information which is made of complex sentences, contain more noun or nominalization and lexically dense. "Nominalizations decrease longer phrasal compounds and structures in scientific registers, making it more packed, more practical, pragmatic and direct to the experts (Kazemian, Biok, Naser, 2012). This means that when writing scientifically, the writers have to pay attention to the dense packed of the sentences, consider the choice of word domination and the intricacy of clauses they should made. Linguistically this is categorized as main features of academic writing. Furthermore, scientific texts are generally concentrated on highly technical terms though it sometimes becomes troublesome to understand due to their complexity in forms and meanings. But have writers, especially non-linguistics, condisered these features in the

discourse? This is one of the objective of the study thay will be investigated in the discourses written academicians.

Scientific writing is expected to shift from spoken mode to written mode as they are different in the structure in use. Liardét (2016) stated that the main characteristic of academic writing is those that are dominated by noun or nominalization. Academic writing is not only found in writen text but also in spoken discourse. Gerot and Wignell (1994) stated that spoken and written language are both complex but in different ways. Spoken language tends to be complex grammatically and written language tends to be complex lexically. Spoken language tends to be grammatically intricate whereas written language tends to be lexically dense. To make a discourse, one of the way is to nominailze the lexical which is called nominalized. Nominalization is a a process that is a part form ideational metaphor. Ideational metaphor is derived from the grammatical metaphor. Halliday (1985, 1994) classified Grammatical Metaphor (GM) into Ideational Grammatical metaphor (IGM) and interpersonal Grammatical metaphor, which IGM includes process types and nominalization. Halliday also states that ideational metaphor is the characteristics of all adult discourse. In this way, it can be concluded that one of reasons that scientific writing can be lexically densed due to the presence of nominalization which comprised form grammatical ideational metaphor. Then, adults or professional writers have to consder about applying IGM in their writing. The following research questions will be analyzed through Systemic Functional Linguistic which is a useful and powerful tool for the analysis of text.

There are three previous studies conducted with the same theme with this current study as to show the importance of conducting reseacrh about ideational metaphor. The first study was conducted by Sara Shahab and Hanieh Davtgari AslIdeational (2015) entitled Ideational Grammatical Metaphor in Pharmaceutical Research Articles. This study used Systemic Functional Linguistics (SFL) proposed by Halliday and Matthiessen (2004) theory. The study found that the processes occuring in the ideational metaphor were the material process type which implies acting and doing, and then relational types, which represents being and having permeated the discussion sections. IGMs with nominalizations may lead to text difficulty and complexity but IGMs may help them better develop their arguments in the discussion sections. The second study was conducted by Sirait, A (2016) entitled Spoken and Written Language: Functional Grammar Approach. This study analyzed texts of national examination texts and found that the higher lexical density, the lower grammatical intricacy. The thir study was conducted by Ngongo, M. and Benu, N. (2020) entitled Interpersonal and Ideational Metaphors in the Writing of Thesis Texts of Undergraduate Students of English Study Program: A Systemic Functional Linguistic Approach. This study found that Interpersonal metaphor was realised in mood system and modality which then suggested educators should consider the use of ideational and interpersonal metaphors in their teaching. The current study used the same approach, however the data of the study will focus on engineering texts and also the investigation to the ideational impact on lexical density and grammatica intricacy of the text using electronic based lexical density measurement.

In line with the background of the study, the writers formulate two questions that will be accomplished in this study; they are: What are the types of ideational metaphor used in scientific articles published on International Journal of Scientific and Technology Research (IJSTR) Volume 10? What are the implications of ideational metaphor on grammatical intricacy (GI) and lexical density (LD) on the published articles on the International Journal of Scientific and Technology Research (IJSTR) Volume 10?

This study is expected to meet some relevances in the consideration to the application of ideational metaphors in writing academic writing in forms of nominalization to increase the lexical density of the discourse. In addition, this study is also expected that writers realize that written languages must be lexically dense and less intricate while spoken languages must be grammatically intricate and lexically low. For English Teachers or lecturers, understanding lexical density and grammatical intricacy will help them (re)consider the readibility of textbooks used at schools.

Systemic Functional Linguistics

Systemic Functional Linguistic or SFL was primarily the work of a British linguist of the 30s, 40s, and 50s, JR Firth which was then popularly known to be developed by MAK Halliday. Systemic functional linguistics is defined as the study of the relationship between language and its functions in social settings. This theory is also familiarly called as systemic functional grammar, Hallidayan linguistics, and systemic linguistics. This approach has widely used to analyze various language use including language use contextually and co-textually. SFL approach is recently used world-wide, especially in language education, and for a number of purposes like discourse analysis (Abdulrahman, 2016) which is also supported by Eggins, S (2004). A fundamental perception about this systemic theory the element of grammar both form and function hold an important role in the creation a discourse and lexical choice to meet social need. Therefore the writer will use this theory to analyze the how language is used on academic writing of academician from the mode they use in form of written language. This is in line with Hallidayan stating that because of the concern of SFL with the use of language, great importance is placed on the function of language, such as what language is used for, rather than what language structure is all about and the manner by which it is composed (Matthiessen & Halliday, 1997).

Ideational Metaphors

Metaphor is a kind of figurative language which is widely used in writing. This object is interesting to study as it gives dynamic meaning to the context of passage. There are two divisions of metaphors; lexical metaphor and grammatical metaphor. These two divisions of metaphors were different in use. Lexical metaphor was proposed by Lakoff and Johnson which related more to the literature which while grammatical metaphor, created by Halliday, much refers to text and and context, two terms that are very popular in SFL theory. Metaphor is a word which is used for something resembling that which it usually refers to (Halliday 2004). Grammatical metaphors are divided into two kinds; interpersonal and ideational metaphors. This study focuses on ideational metaphors in accordance to the topic of the research about academic writing. The application of ideational metaphor in academic writing will play important part in the formation of discourse. The use of ideational metaphor in writing will improve the dense packaged information as it emphasizes on the use of nominalization instead of the use of intricate grammar. There is a huge correlation between nominalization and lexical density. The grammatically metaphorical nature of the written version is largely the result of nominalization, turning verb to noun, adjective to noun, and conjunction to noun (Gerot and Wignell, 1994:148). The example can be seen below;

a. *Can't get at → the absence of access*
b. *To read → a reading, actual reading*
c. *To find out → for the purpose of rendering, etc.*

The importance of nominalization in academic writing is significant which therefore demanding a necessity to be applied to discourse in academic mode.

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Grammatical Intricacy

Grammar is a theory of language, of how language is put together and how it works. Grammar rules the structure of words in a sentence (Gerot and Wignel, 1994:2). It is also called the study of wordings. In Oxford Advanced Learner's Dictionary, intricacy is the complicated parts or details of something or the fact of having complicated parts, details or patterns. In linguistics, grammatical intricacy refers to the frequency complex clause occurrences compared to those of simplex clauses. This will illustrate the complexity and density of information conveyed in one discourse. It can also be said that there are more clause complexes than simple clauses, the text is more complex in the sense that it presents more information in a condensed way. Intricacy or complexity of languages for both written and spoken varies in different way. In written languages, a sentence is condensed so it contains dense information. In spoken language, the content tends to be spread out over a number of clauses which complex logico-semantic relation among them. The work of the meaning spread out. The characteristic of spoken language can also be showed by the low presence of content words in a clause but the presence of clauses in one clause complex is high. There also tends to be high proportion of grammatical word per clause. What is meant by content words are the main words in part of speech like noun, verbs, adjectives and adverbs. Grammatical words on the other hand are functional words like prepositions, conjunctions, auxiliary verbs, modal verbs, pronouns and articles. The meaning they encode tend to support the experiential content of the clause. The pattern to calculate grammatical intricacy is Grammatical Intricacy = amount of clause is divided by amount of sentence.

Lexical Density

According to Halliday, "Lexical density is the proportion of lexical items (content words) to the total discourse. It can be measured in various ways: the ratio of the lexical items either to the total running words or to some higher grammatical unit, most obviously the clause (Halliday, 1987:60). Gerot and Wignel stated that lexical density is a measure of the amount of content information in a clause (or in a text). The pattern is by dividing the number of content words in a clause complex by the number of clauses in the complex.

Here are the examples of contents words which are in bold and grammatical words in italic. This example is in spoken language (Gerot and Wignell, 1994).

I can't **mind** *the* **kids today**
Because I must **go** *to* **football training**
And *I can't* **leave early**
Because we've **go**t *an* **important game** *on* **Saturday**
And if we **win** *it*
We **go** *into the* **finals**
But **Wednesday's fine**
Because I don't have **training**
so I can't **mind** *them then*
If that's **ok** *with you.*

From the example above, it shows that there is one clause complex of ten clauses with quite complex logical relations among them. The content information is spread out over those ten clauses. So, Lexical Density of the text can be calculated as 20 content words divided by 10 clauses equal 2.

The comparison can be made to the following example which tends to be denser or refers to written language (Gerot and Wignell, 1994):

> Due to the importance (of a win (in Saturday's football game (as a prerequisite (for a final's appearance)))), the necessity of my training attendance diminishes my child-minding capacity tonight. However, the lack of an attendance requirement on Wednesday allows my availability consequent upon your approval.

This part contains more or less the same information as presented in the previous datum, however, this part is denser in the information where there are two clauses found. So, the lexical density of the text can be measured as 24 content words divided by 2 clauses equal 12. What can be concluded from the two examples is that there are three characteristics: 1) the way the information is distributed, the first part conveyed rather spread-out information through its intricate grammatical features while the second part conveyed rather dense information in two clauses. 2) The dramatic rising of number of content words per clause. This characteristic is seen in the second part where in the second part contain 24 content words from two clauses. 3) The rising of lexical density in the written language. This characteristic refers to the second part.

Electronic Based Lexical Density Measurement

Besides measuring the lexical density through counting manually, internet offers a way to measure or to count the lexical density of a text. The link can be accessed through http://www.usingenglish.com/resources/.

METHOD

This study applied a qualitative descriptive method as it is support how researcher is able to do the exploration towards a given topic (Given Lisa, M., 2008). The data are taken from an international journal with three selected papers publised articles written by academicians from International Journal of Scientific and Technology Research (IJSTR) Volume 10 - Issue 5, May 2021 Edition.

Technique of Data Collection and Analysis

In collecting the data, the writers would do the following algorithms.

1. The intended articles were download form the sources.
2. The classification of the data was done to determine the use of ideational metaphors which were then analyzed using Systemic Functional Linguistics (SFL) proposed by Halliday (1985).
3. To see the implication of ideational metaphors in the discourse on lexical density (LD) and grammatical intricacy (GI), the writers will use computational way through Electronic Based Lexical Density Measurement which can be downloaded from **http://www.usingenglish.com/resources/.** This application is indeed very helpful in counting the total numbers of words, content and functional words, and also the total clauses found in the text.
4. Because this computational method only works in calculating the tota number of words and clauses, the next step to see the rate of LD and GE, the writers will apply the formula proposed by Gerot and Wignel in Functional Grammar Approach as has been elaborated in chapter 2.

5. After finding the LD and GI rate, suggestions about the relevances and significances of ideational metaphors will be made for the sake of the improvement of writing academic discourses.

RESULTS AND DISCUSSION

Results

The analysis of ideational metaphor uses would be provided in this section along with the result of the impact of using ideational metaphors academic writing.

The types of Ideational Metaphor in Scientific Articles

There are three articles selected as the representative of the ideational metaphors in academic writing of engineering texts. The data were then analyzed using the types of ideational metaphors and predicted congruence which could be seen in the table provided. It is noted in the analysis that M stands for metaphorical and C stands for congruent.

Datum 1:
M: … and resistance to change which can lead to ineffectiveness of the supply chain.
Congruent: …. and resistance to change which can lead to supply chain which is ineffective.
In this clause, a shift from an adjective to a noun or quality to thing exists. The word '*ineffectiveness'* is congruent to *which is ineffective* 'ineffective'. Besides changing the types of the word, in metaphorical expression, one dependent clause has been reduced to a noun phrase. In congruence, a process from relational process has changed to function as an attribute or as a circumstance of the dependent clause.

M	which	can *lead*	*to ineffectiveness of the supply chain.*
	conjunction	Process: material	Attribute

C	which	can *lead*	*the supply chain*	*which*	*Is*	*ineffective*
	conjunction	Process: material		Attribute	Relational process	circumstance

Datum 2:
M: Quality and regulation adoption increase reliability and acceptance of the automotive parts.
C: Quality and regulation adoption increase the automotive parts to be reliable and acceptable.

Similar shift, quality to thing, occurs to this datum. The transitivity change can be seen as follow:

M	Quality and regulation adoption	Increase	*reliability* and *acceptance* of the automotive parts.
	Actor	Process: material	Attribute

C	Quality and regulation adoption	Increase	so the automotive parts are reliable and acceptable.
	Actor	Process: material	Hypotactic clause: circumstance

From the table, it can be seen the shift from an adjective 'reliable and acceptable' to nominal group 'reliability and acceptance'. Further change can be seen from the table that a hypotactic clause is condensed to a noun. The analysis shows that the process and the actor stay unchanged; however, a change happens to the clause functioning as a circumstance becoming a nominal group which functions an attribute.

Datum 3:

Ml: *... it is a requirement* to establish an excellent network between recycling *industries to establish regulation centers for quality analysis*

C : An excellent network requires an excellent network to be established between recycling industries to establish regulation centers for quality analysis.

The shift from verb to noun happens to this clause in which 'is required' as verbal group nominalized to 'requirement'. This process is also called a shift form process to thing.

M	*It*	*is*	*a requirement*	to establish	an excellent network	between recycling industries to establish regulation centers for quality analysis
	Identifier/token	Process: relational (identifying)	Identified/ value	Material process	goal	Circumstance

C	*An excellent network*	*Requires*	an excellent network	to be established	between recycling industries to establish regulation centers for quality analysis
	Token	Process: relational (possession/)	Attribute	circumstance	Circumstance

The process changes from relational process, a possession/attributive, to relational identifying process. Here, nominalization occurs from is required' to 'requirement'. Even though no condensation of a clause or change in the process type, information here is denser by changing verb to noun.

Datum 4:

M: ... the progress to improvement in the automotive sector is slow in different countries

C: ... the progress they improve in the automotive sector is slow in different countries

M	*The progress to improvement* in the automotive sector	*Is*	Slow	in different countries
	Identifier/token	Process: relational (identifying)	Identified/value	Circumstance

C	*The progress*	they	improve	in the automotive sector	*Is*	slow	in different countries
	Identifier/token	Goal	Process: material	circumstance	Process: relational (identifying)	Identified/value	circumstance

The shift from verb to a noun can be seen in 'they improve' to 'improvement' causing a process shifts to goal. This shift only changes a clause to a prepositional phrase that condenses a clause in the sentence. In the part of the congruent sentence, there are two clauses which is then condensed to one clause. This condensation leads to the characteristic of an academic writing that concisely and densely conveys information to the readers.

Datum 5:

M*: Due to the increase in the market of cars* and *changes in their specifications* and different components per specific type, …

C: *Because market cars increase* and *different components per specific type change, ….*

M	*Due to*	*the increase in the market of cars*	And	*changes in their specifications* and different components per specific type	
	Conjunction	Actor	Conjunction	Actor	

C	*Because*	*market cars*	*increase*	and	*their specifications* and different components per specific type	Change
	Conjunction	actor	Process: material	Conjunction	Actor	Process: material

In this clause, there are two nominalizations occur. The first part '*Due to the increase in the market of cars'* shows a shift of a clause to a phrase which is congruent to '*Because market of cars increases* and specifications' as a dependent clause. A process named material process shifts to a noun or noun phrase functions as a circumstantial element through a nominalization. The second part experiences the same shifting where '*changes in their specifications'* is derived from a clause '

There are some data found from three selected articles. The summary of ideational metaphors used the three texts can be seen in the following table.

Table 1

Summary of ideational metaphors in article 1 (Barriers Analysis in Effectiveness of Automotive Supply Chain by Using Analytical Hierarchy Process)

No	Metaphorical wording	Congruent wording	Process type
1	it is a *requirement* …	it is *required* …	mental process

2	like *selection* among alternates, the *ranking* of alternatives, *prioritization* of alternates, etc	… like *they select alternates, rank alternates, prioritize alternatives*	Relational processes
3	Due to *the increase in the market of cars* and *changes in their specifications* and different components per specific type,	Because *market cars increase* and specifications and *different components per specific type change*	material process
4	… each car has different specifications and *demand* seasonality in the automotive sector	and *it seasonally demands*	verbal process
5	Despite these *barriers*	although *there are barriers*	material process
6	the progress to *improvement* in the automotive sector is slow in different countries	the progress *that they improve* in the automotive sector is slow in different countries	material process
7	Management also lacks in the vision of *supply chain integration and resistance to change … .*	Management also lacks in the vision *how supply chain is integrated and resisted* to change	material process
8	… which can lead to *ineffectiveness of the supply chain*	… which can lead *the supply chain which is ineffective*	Relational process
9	*the weightage of all the criteria and sub-criteria … .*	*All the criteria and sub-criteria are weightaged*	Material process
10	The toxicity of these elements is because of its ability to oxidative stress and damage to living tissues in animals	These elements *are toxic* because *they are able* to oxidative stress and damage to living tissues in animals	Relational process

Table 2

Summary of ideational metaphors in article 2 (Microelement Analysis in Edible Muscle of Oreochromis Niloticus From Two Different Age Of Reclaimed Post Coal Mining Ponds)

1	an open-pit *after completion* of extraction operations ….	...an open-pit after *they complete* the extraction operations is left.	material process
2	which is cheap for humans that *have very significant importance*	which is cheap for humans *that is very significantly important*	Relational processes (the process of being --> intensive)
3	because of its economic value and sensitivity against pollutants.	*because they are economically valuable and they are sensitive* against pollutants	Relational processes (the process of being --> identifying)

4	by the deliberate and controlled manipulation of *their rates of growth, mortality, and reproduction,* with the ultimate objective of harvesting products of commercial value	by the deliberate and controlled manipulation of the rates of *which they grow, they are mortal, and they reproduce* , with the ultimate objective of harvesting products of commercial value	material process and existential processes
5	*The persistence of heavy metals in the food chain and the difficulty of their elimination* from the environment is the major problem	*The major problems is heavy metals are persistent and they are difficult to eliminate from the environment*	Relational processes (the process of being --> identifying)
6	*The toxicity of these elements* is *because of its ability to oxidative* stress and damage to living tissues in animals and humans	These elements *are toxic* because *it is able* to oxidative stress and damage to living tissues in animals and humans	Relational processes (the process of being --> identifying)
7	Elemental analysis spectrum shows *appearance of Cu* in weight percentage …	Elemental analysis spectrum shows *Cu appear* in weight percentage …	existential processes
8	It is the nature of this *accumulation* that causes *its effects to be even more dangerous for humans.*	It is the nature *they accumulate* that causes it *dangerously effects* humans	behavioural process

From the article, there were found eight ideational metaphor representative to show that academic writing contains ideational metaphor. The congruent is dominated by relational process.

Table 3

Summary of ideational metaphors in article 3 (The Devil's Pride: A Conceptual Paper on Corporate Psychopaths and Emotions of Pride)

1	*… due to their economy, performance, and robustness.*	*… because they are economical, well-performed and robust.*	Relational processes
2	Condition based maintenance is applied to make proactive maintenance decisions based on data collected from CM [3].	Condition based maintenance is applied to make *they proactively decide to maintain* based on data collected from CM [3].	Mental process

3	Bearing failure can be caused by various factors, including cracks, mechanical damage, wear and tear, corrosion, insufficient lubrication, and so on	Bearing failure can be caused by various factors, including *when they are cracked, mechanically damaged, worn and torn, corroded, insufficiently lubricated, and so on*	Relational process & material process	
4	*because of a deficiency of lubrication or compression.*	*because lubrication or compression are deficient.*	Relational process	
5	… or *a rapid change* in operating temperature.	… or *rapidly chan*ge in operating temperature	material process	
6	… there is a great deal of interest in *productivity, and safety* against catastrophic failure.	… there is a great deal of interest *in which they are productive and safe* against catastrophic failure.	Relational process	
7	In figure 3 we can see the basic principle of *vibration measurement procedure.*	In figure 3 we can see the basic principle of how *vibration is procedurally measured*	material process	
8	The term "frequency domain" refers to *the visualization or analysis of vibration* data in terms of frequency	The term "frequency domain" refers to how *data are visualized and analyzed* in terms of frequency.	material process	
9	*The ball spin frequency* (BSF) can be calculated in the following manner	*That the ball spins frequently* can be calculated in the following manner.	material process	

Discussion

The Implications of Ideational Metaphors on Grammatical Intricacy (GI) and Lexical Density (LD) of Scientific Articles

As stated in the previous elaboration that one of academic writing characteristics is its tendency to the highly dense sentences. To measure the average rates of GI and LD of the three selected paper, the writer would use two kinds of measurement methods; using electronic application through **http://www.usingenglish.com/resources/** and using Halliday's perspective on lexical density (LDH) and Grammatical intricacy (GI). These two methods are considered to see the similarity rate of the two way-measurement.

Grammatical Intricacy

Accomplishing a project through electronic application would benefit researchers in terms of efficiency and effectiveness. In this section, with the expectation of concise result, the writer limits the word counted to only 1,000 (one thousand) words per paper. Grammatical Intricacy of each text is gained by using Halliday's approach 'GI equals amount of clause is divided by amount of sentence'. Article 1 contains

Text 3 contains 46 simplex sentences, 33 complex clauses and 102 clauses. Based on Halliday's formula, the grammatical intricacy of the text is 1.29.

Table 4
Summary of Grammatical Intricacy Calculation

	Article 1	Article 2	Article 3
Total clauses	102	54	66
Total sentences	79	41	53
GI	1.29	1.31	1,24

An academic writing belongs to written discourse where the grammatical structures are less intricate compared to those of spoken language. This finding shows that the score of GI is low. This is relevant to the characteristics of academic where the lowest grammatical intricacy, the higher the text tendency to written form.

Lexical Density (LD)
The first table shows the result of lexical density rate gained through electronic-based tools.

Table 5
Summary of Lexical Density through Electronic-based Tools

	Article 1	Article 2	Article 3
Total Word Count:	1,045	**1,061**	1,045
Word Count (Excluding Common Words):	628	**639**	634
Number of Different Words:	**384**	**525**	425
Readability			
Hard Words (?):	**279** (26.70%)	**199** (18.76%)	235 (22.40%)
Long Words (?):	**397** (37.99%)	**300** (28.28%)	377 (35.94%)
Lexical Density (?):	**36.75**	**49.48**	40.51
Lexical Density (without Stop Words) (?):	60.10	60.23	60.44

Based on electronic-based analysis, lexical density of the three articles is above 36,75%, 49,48& and 40,51% while without stop words is averagely 60%. This shows that the use of nominalization in academic writing impacts on lexical density rate.
However, it is suggested in further studies to find out more rigid rate of lexical density of text specified to young readers and adult readers so the writer can adjust the readability of a text depending on the readers' level.

CONCLUSION

Having analysed the three representative articles from the engineering field, it is found that the use of ideational metaphors on scientific writing impacts on lexical density and grammatical intricacy rate in different ways. Ideational metaphors Nominalization in academic texts aims to express knowledge more concisely and densely. Hence, applying nominalization in academic text is significant as it becomes one features of academic discourse. From the analyses, some conclusion toward the use of ideational metaphors on scientific writing can be seen as follow;

1. The use of ideational metaphor changes the subjectivity to objectivity of the text. In this text, there are found a lot of passivation due to the tendency of the emphasis on the

object not the doer. It is shown in the rare occurance of human subject in the sentence but thing-subject.
2. The formality of the text is high due to the use of specific terms and hard words as seen in the counting of electronic based analysis. This adds the lexical density of the text.
3. Ideational metaphor which is seen in mostly in the shift of verb to noun helps the writers to convey dense and concise information in one clause through nominalization.
4. Lexical density of academic themed texts is denser due to the condensation of complex sentences to simplex sentence in forms of reduced clauses and prepositional phrases
5. GI is lower because of the presence of complex clause which has been condensed.

It is suggested that writers consider applying ideational metaphor in their writing. However, writers had better pay attention to the lexical density rate of produced to text based on learners' level.

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