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THE PHENOMENA OF USING SCIENTIFIC TEXT AMONG UNDERGRADUATE STUDENTS

(A Study focused on Nominalisations in Scientific Text)

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Abstract

This paper reports the study of the use of language in scientific text. Some linguists argue that scientific text is difficult to read and to understand. Sometimes it demotivates students to read the text. A significant problem appears, enquiring the phenomena of using scientific text among under graduate students. This research was carried out among some Polytechnic students, majoring in engineering. In this study, qualitative approach was utilised even though some numerical data were also used. For the sake of triangulation the data were resulted by conducting an English test and interviewing some participants. The test, using a scientific reading text, was intended to see their understanding of nominalisation, since it characterises scientific text. The data were analysed using the framework of nominalysing metaphor. The findings reveal that their understanding was at the moderate level. In other words, it was a bit above the average. This study concludes that this level of understanding nominalisations is not high enough for undergraduate students to understand the text. That is why they meet some difficulties when reading scientific texts. This recommends that grammatical competence with the topic of nominalisation be given to Polytechnic students by practising an *explicit teaching* in English program.

Key words: scientific text, nominalisation, grammatical metaphor

1. Introduction

It is said that language plays very strategic roles in educational process. It is also stated that all use of language embodies a great deal of metaphor, and that written language is associated with the use of grammatical metaphor. The grammatical metaphor that dominates the language of science is nominalisation. Moreover it is mentioned that scientific texts are found to be difficult to read, and this is said to be because they are written in 'scientific language'. (Halliday, 1992; Halliday & Martin, 2005). In addition, technical terms are very often metaphorical (Ravelli, 1999).

There are some previous studies with the topic of nominalisation. Banks (2005) investigates the historical origins of nominalised process in scientific text. He found that nominalisation is an important feature of scientific writing. The same idea is reported by Holtz (2009). She studies scientific discourse in abstracts and research articles, finding that the complexity in scientific language is achieved and reconstructed through nominalisation. Parallel to these findings is done by Yuliana (2011) investigating grammatical metaphor in some postgraduate students' writing. She found that there is a high level of nominalisation in written academic texts.

However, the use of nominalisation in scientific texts among undergraduate students has not been researched. That is the reason for the researcher to study this topic among Polytechnic students majoring in engineering.

The purpose of this research is to portray the phenomenon of understanding nominalisation, as the result of derivation, in scientific texts among undergraduate students.

By understanding nominalisation well, it is assumed that the students will understand scientific text easier, as nominalisation dominates the language of science.

This paper is also intended to make the teachers aware that for most students scientific texts are difficult to read and to say. Because of that, the teachers should also realise that students need help to understand scientific texts, in which nominalisations and passive voices are mostly used, by giving their meanings and their basic forms.

This investigation is potential to contribute to the teachers of English, practically and professionally. Practically, the findings of this study might improve the educational practice, by implementing nominalisation into the teaching academic English. Professionally, the results of the study will not only improve the professional sources in the teaching profession in Polytechnic in particular, but also in teaching technical English in general.

2. Theoretical Review

The section is centered on the theories applied in this study, that is nominalisation. It involves a transference from a 'congruent' form of expression to a 'metaphorical', as mentioned by Veel (cited in Christie & Martin, 2000:184). Therefore, the next theoretical review is the brief description on grammatical metaphor before describing nominalisation, as the main theory.

2.1 Grammatical Metaphor

Grammatical metaphor is one of the characteristics of scientific English (Halliday & Martin, 2005). It is the key for entering into knowledge that is discipline-based technical. By using grammatical metaphor, a text can be developed in ways that highlight technicality, that allow for clear structuring a text, and that present the writer's point of view as something objective, not subjective (Halliday, 1998 as cited by Schleppergrell in Ravelli & Ellis, 2004).

In addition, it is stated that grammatical metaphor that dominates the language of science is nominalisation (Halliday & Martin, 2005), because it is the most powerful resource for creating grammatical metaphor. In this case, Processes (as verbs) and Properties (as adjectives) are reworded metaphorically as nouns (Halliday, 1994), for example:

- *They produce this machine.*
- *<u>The production</u> of this machine.……..*

2.2 Nominalisation

Nominalisation derives from the word *nominalise* (verb), meaning 'to form a noun from a verb or adjective', for example 'truth' from 'true' (Hornby, 2010:1035). Nominalisation is defined as the process of turning words that are not normally nouns into nouns, like *employ* (verb) → *employment* (noun) (Knapp & Watkins, 2005).

Furthermore, it is said that nominalisation is a form of grammatical metaphor, read on two levels at once, a grammatical meaning and discourse semantic meaning. In addition, it is also argued that scientific writing becomes difficult in certain ways. The difficulties lie more with the grammar than with vocabulary. It is also stated that difficulties arise when Processes are nominalised so that activities are coded as if they were Things (Martin & Rose, 2007).

Forming of Nominalisation

Nominalisation is formed by using the present participle form of the verb, such as *singing, cutting*, or by adding suffixes: - *ion*; - *ment*; *-al* (Knapp et al., 2005). There are many ways used for forming nominalisations. Adjectives can be nominalised and turned into a noun form. For example: *expensive → <u>expense</u>*; *unstable → <u>instability</u>*; *tense → <u>tension</u>*
Many verbs can be changed into nouns.

a. by changing the verb form:
   discuss → <u>discussion;</u>
   identify → <u>indentity</u>
b. by using the verb+ing: *her <u>acting</u>, an old <u>saying</u>*

Some verbs can be used as nouns without any change eg. *the cause, a visit, a struggle*. In addition, Knapp et al. (2005) argue that the process of nominalising can also be taught to students as an editing strategy. This is in line with Derewianka's (1998) opinion that because nominalisation tends to make text dense and

abstract, students still need assistance how to 'unpack' it.

Effects of Nominalisation

The realisation of nominalisation in written text causes the effects of creating abstract and technical terms, condensing, compacting the meaning into a simple sentence, and removing actors. They are elaborated as follows.

- **Effect of Creating Abstract and Technical Terms**

Nominalisation tends to lead to more abstract texts, because concrete participants such as people tend to disappear from the text. Technical terms are introduced through nominalisation (Gerot et al., 1995).

Nominalisation is contributed both to technical terminology and to reasoned argument. It also sums up an explanation sequence or process and reports using a single technical term (Halliday & Martin, 2005). This is illustrated by Droga et al. (2011):

- *Heat from the sun causes liquid water to become water vapour.*
- *This process is called evaporation.*

- **Effect of Condensing**

Nominalisation condenses previous information into a single word that can be used to move the text along (Droga et al., 2011), like in following examples:

- ✓ *When the sun heats up the water, it evaporates into steam.*
- ✓ *Evaporation causes the steam to rise into the air.*

Consequently, the text becomes difficult to read and to say, because much of the explicit grammatical information is lost, the meaning becomes buried (Gerot et al.,1995).

- **Effect of Compacting Meaning**

With nominalisation, more and more information tends to become packed in nominal group within clauses rather than distributed over a number of clauses (Gerot et al., 1995). Derewianka (1998) argues that one way of making a text more compact and 'written' is to change verbs (and other words) into nouns. Instead of saying, for examples:

- ✓ '*When you heat a liquid it can change into a gas. When the gas cools it returns to a liquid.'*
- ✓ *'Vaporation is followed by condensation.'*

- **Effect of Removing Actors and Time**

Nominalisation removes 'actors' or those responsible for action, evidense or argument (Droga et al., 2011). On the other hand, Knapp et al. (2005:56) argue that "nominalisation clauses and verbs enable the removal of agency and time from processes," It is also called "a time less and agentless phenomenon", where the process of *failing* has become *failure*, a timeless, agentless phenomenon. They are indicated by the following examples:

- *Because the President failed to remove the troops, many deaths occured.*
- *The failure to remove the troops resulted in many deaths.*

Level of difficulty

The level of difficulty of the scientific reading text used in the test is regarded moderate. This is viewed from many sources, including Ravelli's (1999) texts' lexical density (that is 7.2) and Halliday's (Halliday & Martin, 2005) argument that written language tends to have around four to six (4 - 6) lexical words per clause. In other occasion, he mentions that text's lexical density is between three and six (3 – 6) (Halliday, 1985, as cited in Yuliana, 2011). On the other hand, the lexical density of the reading text used in the test is 5.5. Therefore, based on these data, the scientific reading text has an appropriate level to be used by Polytechnic students in the Test.

3. Research Method

This study employs qualitative method, but in analyzing the data, quantitative criteria are used (Crocker, 2009). This study was conducted in a state-owned Polytechnic in Bandung, having Diploma III and IV, majoring in manufacturing engineering. Its participants were 20 students of year three.

In this study, a qualitative case study is applied for some reasons. First, the aim of this investigation is not to generalise or to test hypothesis, but rather to improve support for other students of the same campus. Second, the

rich data, deep analysis, and the long term contact with the cases afforded by the case study is better suited to this research interest than quantitative methods. Third, this study provides a framework for analysis such material (Hood, as cited in Heigham et al., 2009).

In addition, Bogdam and Biklen (cited in Frankle & Wallen, 1996:442-443) propose the characteristics of qualitative research: (1) that the nature of setting is the direct resource of data, and the researcher is the key instrument in qualitative research, and (2) that data are collected in the forms of words rather than numbers; (3) that qualitative researchers are concerned with process as well as product; (4) that qualitative researchers tend to analyse their data inductively. Those statements above can be inferred that in this study, students in Polytechnic are the direct resource of data, while the researcher has been teaching English there for years.

Collecting data

There were two methods of data collection. The first one was by carrying out an English test, using a scientific reading text, following Droga & Humphrey's excercises (2011). The second one was by interviewing some participants, representing the high, the medium and the low achievers. The data in the forms of scores (as test results) were triangulated by the data collected through interview. It was supposed to support and to improve the validity and realibility of the study (Alwasilah, 2011).

The procedure of conducting the test (consist of underlining and unpacking tasks) is elaborated as follows. First, every participant was asked to read a scientific text entitled *Technological Innovation* (Dieter, 1991) given to them. The text for the test is attached on the Appendix. Later, they were ordered to underline the 22 nominalised words found in the text. After that, they were instructed to unpack the nominalisations they had underlined on the test paper. For instance, the nominalised word found in the text '*ability*' (as a noun), was unpacked into '*able*' (as an adjective)

A semi-structured interview was conducted individually among some of the participants representing all participants, a few days after the test. This is verbal questionnaires consisting of questions designed to elicit specific answers (Frankle & Wallen, 1996). The data resulted from the interview is inserted in the following section in the process of discussing the data resulted from the test.

Analysing data

The framework of data analysis is a taxonomy of metaphor developed by Halliday & Matthiessen (1999. In Ravelli & Ellis, 2004) posted below.

Table #1: Types of Nominalisation

Type	Semantic shift:	Grammatical shift:	Examples
I	from quality to entity	from adjective to noun	*The society is stable.* *The stability of society…….*
II	from process to entity	from verb to noun	*The driver drove the bus.* *The driving of the bus……*
III	from circumstance to entity	from adverb / prep. phrase to noun	*The driver drove the bus very fast.* *The speed at which the driver drove the bus*
IV	from relator to entity	from conjuction to noun	*The driver drove the bus very fast, and so the brake faailed.* *The result of fast driving is that the brake failed.*

The procedure of analysing the data is as follows. First, the students' works of underlining nominalised words they found in the test paper were identified, continued with the unpacking task. Later the scores were given to the correct answers with the maximum scores of 22 for every task. After classifying the scores, they were transferred into percentages, as posted in Table#3. Next, those scores were categorised into very low, low, medium, high, and very high, as shown in Table#2. Finally, the results of conducting the test were interpreted.

4. Findings and Discussion

In average, Polytechnic students seem moderately understand nominalisation, supported by some findings. First, their ability

in identifying the nominalised word was higher than unpacking them. Second, they were 55% categorized low, 15 % medium, and 30% high. They are posted in Table #2 below.

Table #2 : Ss' Levels of Understanding Nom.

Score Interval	F	%	Categories
39 – 50	2	10	very low
51 – 62	9	45	Low
63 – 74	3	15	Medium
75 – 86	5	25	High
87 – 98	1	5	very high
Total	**n = 20**	**100**	

Table #3: The Results of the Test

# Partc	Percentages of Scores of		Average %
	Underlining	Unpacking	
P#1	45	41	43
P#2	64	59	62
P#3	73	55	64
P#4	82	73	78
P#5	95	95	95
P#6	64	55	60
P#7	86	86	86
P#8	59	59	59
P#9	55	23	39
P#10	73	68	71
P#11	59	45	52
P#12	77	73	75
P#13	59	59	59
P#14	77	68	73
P#15	86	82	84
P#16	77	41	59
P#17	73	45	59
P#18	64	59	62
P#19	64	50	57
P#20	77	73	75
N=20	**70**	**60**	**65**

Table #3 shows the students' ability in identifying and unpacking nominalisation resulted from the test. In average, the score of underlining task is 70. It is higher than the scores of unpacking task, it is 60. So, the total average score is 65. With this condition, it is interpreted that Polytechnic students' understanding of nominalisation is moderate, means not very high.

Students with low scores

The discussion of the findings is first focused on eleven participants, posted in Table #2, whose scores were below average. In the test, they could only find a small number of nominalisations, and even, they could not completely unpack the ones they had underlined. They were interpreted to experience some difficulties in understanding the application of nominalisation in the text.

This case was revealed by some interview data as follows. The students recognised a certain word was nominalisation (e.g. *calibration*) but they did not know its root (e.g. *calibrate*). They often took it for granted when finding a nominalised word in a text (Baratta, 2010), particularly when learning engineering texts in Polytechnic. It happened because of the lacked of opportunity to learn or discuss about nominalised words. They also often made mistakes when turning the nominalised word into its base form. For examples: **An operator <u>maintenance</u> the tools.* It should be written: *An operator <u>maintains</u> the tools.*

This experience was openly acknowledged by some low achievers when interviewed, saying that they could not understand engineering textbook, like 'trigonometry', if not explained. Consequently, they were demotivated to read the textbook written in scientific language. Furthermore, their background of learning experience did support their achievement as argued that they did not take an English course because of no motivation to do it, and even they did not like it.

This is in line with Droga & Humphrey's (2011:100) statement that "texts that use a lot of nominalisations often appear very dense and can be difficult to read. This is because nominalisation changes the way to 'package' information in a clause". Furthermore, Halliday (cited in Halliday & Martin, 2005:76) argues some grammatical problems in scientific English that scientific texts are found to be difficult to read, because they are written in 'scientific language,' and that scientific forms are difficult to understand.

Students with high scores

The next discussion is centered on nine participants having above average scores, indicated in Table #2. In the test, they were able to identify nearly all the nominalised words relatively well. Some students only failed to identify nominalised words like *television* and *leadership* which come from their roots *televise* and *leader*. They argued in the interview session that they only knew the word *television* as it was but did not learn its base form. Moreover, nominalisation suffix *–ship* is rarely used.

The high achievement of these participants is supported by their experience in learning English in many ways, in high school and Polytechnic, as frankly stated when interviewed. This is in line with Baratta's (2010) finding. He stated that an increase in nominalisation use may be based on the reading that the students have done throughout the three years of the degree.

5. Conclusions and recommendations

In average, Polytechnic students moderately understand nominalisations used in scientific text. Most students could identify (by underlining) nominalisations found in the text. Nevertheless, their ability of unpacking nominalisations was lower than underlining. They often failed to unpack the nominalised words they had identified.

Finally, it is concluded that the students' achievement in the test is not high enough for them to understand scientific text optimally. In other words, scientific text is difficult for them to understand. It occurs because of some reasons: that nominalisation dominates scientific language, that the topic of nominalisation is not given to them in English class, and that there is no opportunity for the students and teachers to discuss it in the classroom.

Based on the above elaboration, it is recommended (1) that grammatical competence, especially with the topic of nominalisation, be given to Polytechnic students by having *explicit teaching* in English class; and (2) that teachers should manage time to discuss the application of nominalisation in scientific text to help the students have better understanding of the text. Hopefully, the improvement of the students' understanding on nominalisations may lead to better understanding of scientific text.

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