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The Effects of Formula Instruction on Knowledge and Use of the Target Formulas

Nor Ashikin Ab Manan[1*], Ambigapathy Pandian[2]
[1]Universiti Teknologi MARA (UiTM) Perak, Seri Iskandar, Perak, Malaysia,
noras914@perak.uitm.edu.my
[2]Universiti Sains Malaysia, Pulau Pinang, Malaysia,
ambiga@usm.my

Abstract- *This study was conducted to explore the benefits of formula instruction in an academic writing class. Its main objective is to determine whether the students' knowledge of the target formulas can be enhanced through direct instruction of the target academic formulas (DIAF) chosen from the academic formula list (AFL).In this study, twenty five formulas were selected from the Academic Formula List (Simpson-Valch & Ellis, 2010) as target formulas and were directly taught to a group of students attending an academic writing class. After five weeks of instruction, their knowledge of the target formulas was tested using an objective test and an academic essay writing test. This paper discusses the result of the study by addressing four research questions: (1) What are the effects of formula instruction on the students' knowledge of the target formulas? (2) What are the effects of formula instruction on the students' academic writing performance? (3) What are the effects of formula instruction on the use of the formulas in the academic essay? (4) What is the effect of target academic formula use on the scores of the academic essay writing test?*

General Terms- *Academic formulas, Academic Writing*

Keywords-*Teaching Academic Formulas; Academic Language; Academic Writing Ability*

1. INTRODUCTION

This study was conducted to explore the benefits of formula instruction in an academic writing class. Its main objective is to determine whether the students' knowledge of the target formulas can be enhanced through direct instruction of the target academic formulas (DIAF) chosen from the academic formula list (AFL) compiled by Simpson-Valch and Ellis (2010). The study attempts to address the following research questions: (1) What are the effects of formula instruction on the students' knowledge of the target formulas? (2) What are the effects of formula instruction on the students' academic writing performance? (3) What are the effects of formula instruction on the use of the formulas in the academic essay? (4) What is the effect of target academic formula use on the scores of the academic essay writing test?

2. LITERATURE REVIEW

Recent research of academic corpora conducted in the field of corpus linguistics reveals that vocabulary used in academia is often made up of multiword combinations (Biber & Barbieri, 2007; Biber, Conrad, & Cortes, 2004; Biber, Johansson, Leech et al., 1999; Coxhead & Byrd, 2007; Granger, 1998; Schmitt, 2004). Academic discourse contains a high frequency of lexical bundles, collocations, formulaic sequences and idioms (Ellis, Simpson-Vlach & Maynard, 2008). This revelation has led many researchers in the field of language teaching to embark on corpus-driven research to identify the most commonly used word combinations or formulas in academic discourse. The main purpose of identifying these formulas is to inform ESP/EAP teachers of the expressions which could be the target for direct instruction in the academic writing classrooms. Corpus research has identified formulas in corpora of written and spoken language which occur significantly more frequently in academic than non academic registers. According to Hyland (2012), academic formulas are extended collocations that appear more frequently than expected by chance and they contribute to the sense of coherence in a text by helping to shape the meanings in specific contexts. Biber, Johansson, Leech et al. (1999) concluded that academic formulas are frequently made up of three types of fragments, which make up over 70% of four-word patterns in academic discourse. The three forms are as follows: (a) Preposition + noun phrase fragments,(b) Noun phrase + '*of*' phrase fragments and (c) Anticipatory '*it*' fragments.

Simpson-Valch and Ellis (2010) has identified and compiled a list of academic formulas for teaching purposes, known as the Academic formula list (AFL). The formulas are classified according to their primary discourse-pragmatic functions and are divided into three

main divisions namely 'Referential Expressions', 'Stance Expressions' and 'Discourse Organizing Functions'.

2.1 Direct Teaching of Academic Formulas

Meunier (2012) stresses that adopting a formulaic approach to L2 teaching seems relevant for three reasons. Firstly, formulaicity is ubiquitous in language. The ubiquity of formulas in language has been confirmed by numerous studies in the field of corpus linguistics and phraseology (i.e. Sinclair, 1991; Ellis, 1996; Howarth, 1998; Erman & Warren, 2000; Foster, 2001; Wray, 2002; Biber et al., 2004; Biber & Barberi, 2007; Conrad, 2008; Rayson, 2008). Hyland (2012) asserts that academic formulas are an important defining feature of academic discourse and are considered an important component of fluent linguistic production and the use of academic formulas can facilitate efficient communication as they often structure an academic discourse by guiding the readers through a text, for example; "*in the next section"*, "*as shown in figure",* or linking ideas such as "*due to the"*, "*in contrast to"* (ibid).

Secondly, formula use has been shown to be a marker of proficiency in L2 (Cortes, 2004; Hyland 2008). For example, Zang (1993) conducted a study among 30 native and 30 non-native speakers of English college freshmen's writings and found a significant correlation between knowledge and use of English collocation and writing proficiency. Al-Zahrani (1998) who conducted a study among 81 Arab-speaking learners found a significant correlation between the subjects' English collocational knowledge and their overall language proficiency. While Kennedy and Thrope (2007) conducted an analysis on IELTS writing component concluded that highly rated papers made use of higher number of formulas. Hawkey and Baker (2004) who analysed a set of compositions written by candidates of several different examinations spanning a wide range of proficiency, discovered that among other linguistics features, a higher frequency of collocation and idioms were utilised in highly rated essays compared to lower rated ones. Similar findings were reported by Ohlrogge (2008) who investigated a corpus of written compositions for the Examination for the Certificate of Proficiency in English (ECCE). On a similar note, Dai and Ding (2010) reported a correlation of r=.46 between the numbers of formulaic sequences used by L2 learners in the writing assignments and the marks given for these assignments by independent assessors.

Thirdly, teaching the formulas seems relevant because studies have demonstrated that L2 language learners find formulaicity challenging (i.e. Nesselhauf, 2005; De Cock, 2004; Fan, 2009; Ang, Abdul Rahim, Tan., & Salehuddin, 2011; Yunus & Awab, 2011; Okuwaki, 2012; Namvar, 2012; Naderishahab & Tahririan, 2013). Thus, teaching the formulas would help L2 learners improve their knowledge and use of formulas which in turn may improve their academic writing performance.

3. METHODOLOGY

The study is a quasi-experiment conducted among diploma in computer science students from a public university in Malaysia, enrolled in an academic writing course. Two intact groups of thirty students assigned as an experimental and a control group participated in the study (N=60). They were from similar age group, ranging from 19 to 21 years old. They were homogeneous with regard to their mother tongue (Malay), cultural and educational background as well as the length of exposure to formal English as a second language (ESL) instruction.The study involved one independent and three dependent variables for each of the experimental and the control groups. The independent variable for the experimental group was the Direct Instruction of Academic Formula (DIAF) which was the *treatment* plus academic writing instruction. The independent variable for the control group was the academic writing instruction without the treatment.

The dependent variables for the study were; (a) the scores of the pre and post Academic Essay Writing (AEW) test; (b) the scores for the Target Academic Formula (TAF) test; (c) the number of target academic formula used in the post AEW test.

3.1 Conducting the Study

The Academic Writing course's syllabus covers three skills which are 'academic reading', 'academic writing' and 'speaking'. It has six contact hours per week (3 x two-hour class) and the time is divided equally among the three skills. DIAF was carried out during the period allocated for 'academic writing' component and was conducted two hours per week for five weeks (week two to week six).

3.2 Target Formulas Selaection

Twenty five target academic formulas (TAF) were selected from the Academic Formula List (AFL) by Simpson-Vlach and Ellis (2010). Table 1 shows the selected formulas identified from the top 200 Written AFL list as target formulas to be used in the study. The target formulas were selected from "pedagogic corpus", texts used in the classroom as teaching materials (Willis, 2003: 163), to ensure better contextualization and relevance. The criteria for formula selection for this study were as follows: the formula should appear at least once 1) in the Academic Writing course's prescribed textbook and / or 2) in the supplementary material for the course.

Table 1: Target Formulas

in relation to (1)	a variety of (9)	appears to be/ does not appear to be (17)
in response to (2)	with regard to (10)	on the basis of (18)
(from)(the) point of view (of) (3)	can be/ is/ are affected by (11)	in terms of (the) (19)
to distinguish between (4)	give rise to (12)	in accordance with (20)
the relationship between (5)	as well as (13)	due to the fact that (21)
in conjunction with (6)	more/less likely to (14)	as a consequence (22)
according to the (7)	(there) are a number (of) (15)	as a result of (23)
can be considered (8)	there are several (16)	due to the (24)
		can be achieved (25)

All students who registered for the course had to buy the prescribed textbook and both the experimental and control groups were provided with the supplementary materials. Therefore, subjects from the experimental groups were exposed to the formulas through direct instruction while the subjects from the control groups were exposed to the formulas indirectly when using the course's prescribed textbook and the supplementary materials. Another consideration in TAF selection is that the formulas have to be recognizable to the subjects and are commonly found in teaching materials not only for the academic writing course but other courses in their academic discipline (i.e. lab report, term paper and written assignments).

3.3 Procedure for Conducting the Study

The subjects from both the experimental and control groups were informed of the objectives of the study. Since the study was conducted during normal academic writing class, the treatment (DIAF) was embedded into the academic writing lessons which employed a process writing approach. Several types of exercises using the target academic formulas (TAF) were prepared. The types of exercises include (1) fill-in-the-blanks, (2) matching, (3) sentence construction using the target academic formulas, and, (4)developing the thesis statement and topic sentences. Table 2 shows the schedule for DIAF exercises, TAF and AEW tests. Since the study was conducted among students who were attending an academic writing course, the experimental variable, DIAF, was designed to fit into the course's syllabus with minor adjustment to the course's schedule and scheme of work.

In addition, exercises for TAF was designed as a study tool and embedded into the classroom activities. This was to ensure minimum disruption to the normal classes and to avoid resistance from both students and lecturers towards the experimental method being studied.

Table 2: Exercise and Test Schedule

WEEK	TIME	TYPE OF EXERCISE
1st	2 hours	Pre AEW Test
2nd	2 hours	Fill-in-the-blank (sentence level) Matching (sentence level)
3rd	2 hours	Fill-in-the-blank (paragraph level) Matching (paragraph level)
4th	2 hours	Sentence construction using the formulas
5th	1 hour 1hour	Sentence construction using the formulas Writing thesis statement using the formulas
6th	1 hour 1hour	Sentence construction using the formulas Writing topic sentences using the formulas
7th	1 hour 2 hours	TAF test Post AEW test

DIAF involves three types of activities which were conducted during the experimental period. The first activity involved learning the target formulas in context. Prior to the activity, a list of the target academic formulas was distributed to the subjects. The subjects were given two reading comprehension passages of the same theme to work on. The target academic formulas found in the passages were highlighted and their meaning and functions were discussed.

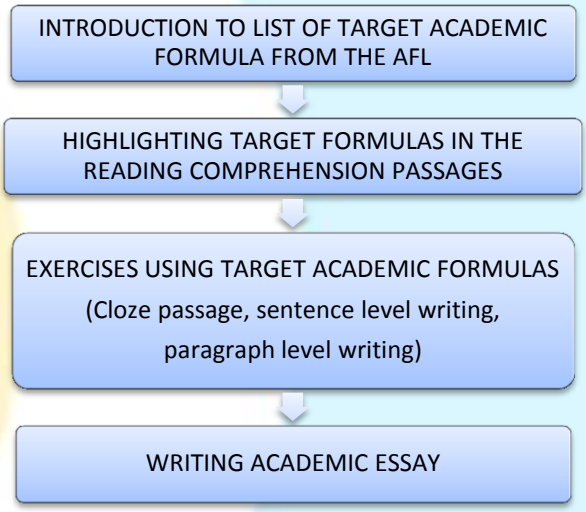

Figure 1: Instructional Procedure

The subjects' awareness of the formulas was raised as they read the passages and answer the reading comprehension questions. In addition to awareness raising exercises, the subjects practised constructing sentences using the target formulas. Figure 1 shows the instructional procedure for DIAF. Both the experimental and control group's lecturers were furnished with lesson plans prepared for the experimental period. The control group utilised the course's existing lesson plans while the experimental group's lesson plans for week 2 to week six were designed to accommodate DIAF. Minor adjustments were made to the scheme of work, thus the lesson plans were also adjusted accordingly.

3.4 Data Collection

Pre AEW test was conducted during the first week while the post test and the TAF test was conducted during the seventh week of the study period. The answer scripts for both pre and post AEW test were scored by two independent scorers. Marks allocation for the AEW test are as follows: (a) eight marks for content, (b) six marks for language, and (c) six marks for oranization. The total scores were then devided by twenty and converted to 100%. The average marks awarded by the two scorers were considered as the final scores. The scorers were furnished with a general marking scheme and a separate analytic scales for rating academic essays based on 'content' and 'language' respectively. The general marking scheme provides information on mark allocation for the different components and detailed destribution of marks for 'organization' component. The analytic scales for

rating the 'content' and 'language' components were adapted from the Academic Writing course's final examination marking scheme for writing component and Brown and Baily's analytic scale for rating composition tasks (Brown, 2004: 244-245). The answer scripts for the post AEW test were scrutinized by an independent scorer and the number of target academic formulas correctly used by the subjects were recorded and counted.

TAF test was an objective test where the correct answer was either right or wrong and required little judgement on the part of the scorer. Thus, the answer scripts were scored by the researcher herself immediately after the test. Each question was allocated one mark (15 x 1 mark). The number of correct answers were divided by fifteen and converted to 100%.

4. DATA ANALYSIS AND FINDINGS

Data analysis was conducted using SPSS 20 *for Widows* on the results of TAF test as well as the pre and post AEW tests to address the research questions.

4.1 Addressing Research Question 1

In order to answer the first research question, (1) *What are the effects of formula instruction on the students' knowledge of the target formulas?,* an independent sample *t*-test was conducted on the results of TAF test for both the experimental and control groups. Table 3 shows the descriptive statistics for TAF test scores.

The mean and standard deviation for the experimental group are 11.27 and 2.15 respectively while the mean for the control group is 7.1 and its standard deviation is 2.38.

Table 3: Descriptive Statistics for TAF Test

	Group	N	Mean	Std. Deviation	Std. Error Mean
TAF	EXP	30	11.267	2.149	.392
	CON	30	7.100	2.383	.435

Next, Levene's test for equality of variances result (Table 4) shows that there is no significant difference (p = 0.377 > .05) in the variance of test scores between the experimental and the control groups. Thus, the result of ***equal variance assumed*** is reported, which means that the experimental and the control groups come from the same population.

Table 4: Levene's Test for Equality of Variances

		F	Sig
TAF	Equal variances assumed	.793	.377
	Equal variances not assumed		

Table 5 shows the results of *t*-test for equality of means. The probability value shown is 0.00 which is less than the predetermined alpha value ($a/2$ = .025). This implies that there exists adequate evidence to show that ***there is a significant difference*** in the mean scores of the experimental and the control groups. The experimental group performed better than the control group which suggests that DIAF has positive effect on the students' knowledge of the target academic formula.

Table 5: *t*-Test for Equality of Means

	t-test for Equality of Means						
	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence Interval of the Difference	
						Lower	Upper
TAF	7.113	58	.000	4.167	.585	2.994	5.339
	7.113	57.39	.000	4.167	.585	2.994	5.340

4.2 Addressing Research Question 2

To address the second research question; (2) *What are the effects of formula instruction on the students' academic writing performance?* , a paired-sample *t*-test was conducted on the results of pre and post tests of both the experimental and control groups. Both values are bigger than the predetermined alpha value ($a/2$ = .25), which indicate that that ***there is a significant difference*** in the mean scores of the pre test and the mean score of the post test for the experimental group as well as the control group. Table 6 and 7 show the descriptive statistics and the paired samples t-test results respectively.

Pair 1 is the experimental group and Pair 2 is the control group. Based on the table, it can be seen that the mean for the experimental group improves from 10.15 to 13.03 while the control group improves from 10.02 to 10.68. The improvement for the experimental group is bigger compared to the control group.

Table 6: Descriptive Statistics for AEW Test

	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre AEW	10.15	30	3.299
	Post AEW	13.03	30	2.386
Pair 2	Pre AEW	10.02	30	2.531
	Post AEW	10.68	30	2.284

Table 7: Paired Samples *t*-test Results

Pre-Post	Paired Differences					t	df	Sig. (2-tailed)
	Mean	STD	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1	-2.883	2.029	.370	-3.641	-2.126	-7.79	29	**.000**
Pair 2	-.667	1.605	.293	-1.266	-.068	-2.28	29	**.030**

Next, the paired sample *t*-test results show that the *p* value for the experimental group is 0.000 which is smaller than the predetermined alpha value (*a*/2 = .025). This indicates that ***there is a significant difference*** in the mean scores of the pre test and the mean score of the post test for the experimental group. However, the *p* value for the control group is 0.030 which is larger than the predetermined alpha value (*a*/2 = .025). This means that ***there is no significant difference*** between the mean scores of the pre test and the mean score of the post test for the control group. Although both groups performed better in the post test, unlike the experimental group the improvement by the control group is not significant. Based on the inferential analysis results it can be concluded that incorporating DIAF into the academic writing class is beneficial in improving ELS learners' academic writing performance since the experimental group outperformed the control group in the post AEW test.

4.3 Addressing Research Question 3

Next, to address the third research question; (3) *What are the effects of formula instruction on the use of the formulas in the academic essay?*, the number of TAF used in the AEW test for the experimental and the control groups is compared. Figure 2 shows the frequency of TAF used in the AEW test for the experimental and the control group based on a scale. The use of 0 to 4 TAFs is considered low (L), the use of 5 to 8 TAFs is considered as moderate (M) while the use of more than 8 TAFs is considered as high (H).

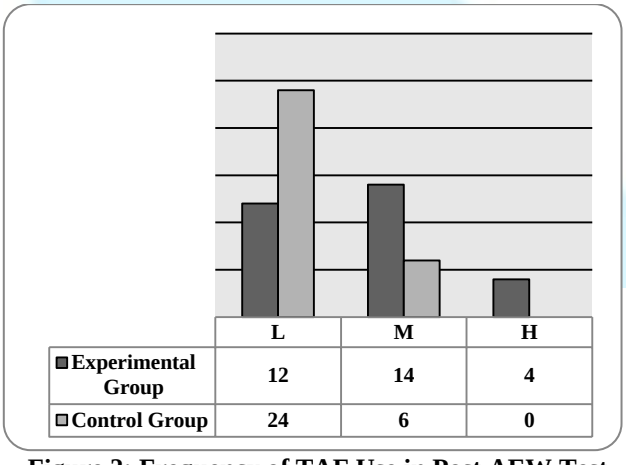

Figure 2: Frequency of TAF Use in Post AEW Test

The use of TAF in the post AEW test was further analysed. Figure 3 shows the comparison between the formulas used by the experimental and the control group of students during their post AEW test.

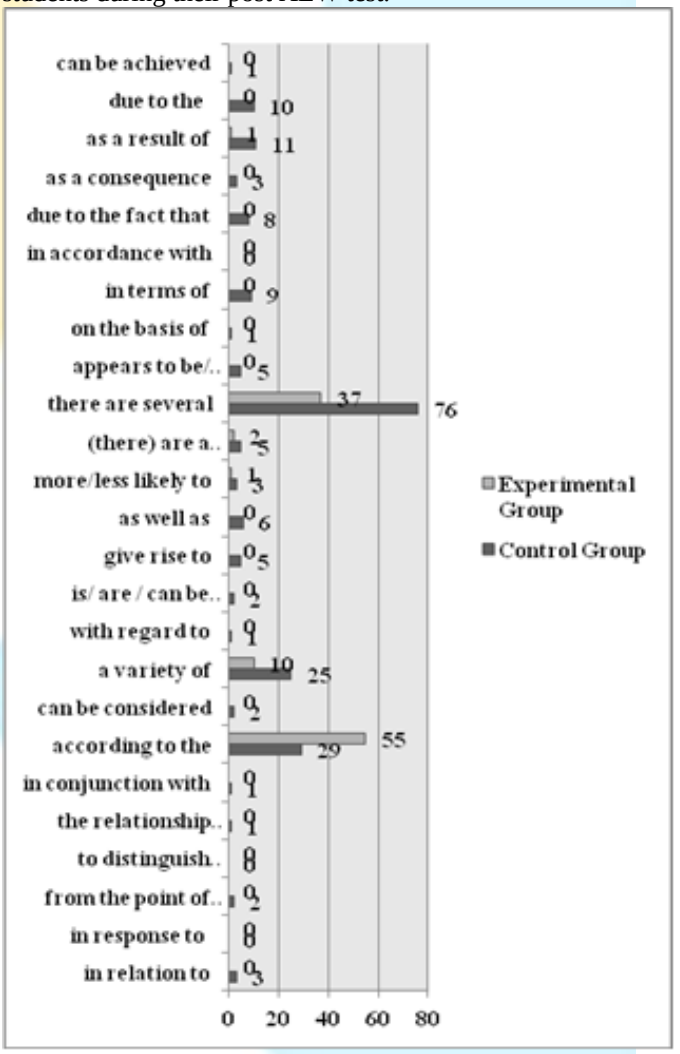

Figure 3: TAF use in the Post AEW Test

Out of the twenty five target formulas, there are three formulas which were not used by any of the students. The formulas are '*in response to'*, '*to distinguish between*' and '*in accordance with'*. The formulas '*there is no'*, *'there are several'were* are the most frequently used followed by the formula '*according to'*.

The experimental group used a wider range of target formulas compared to the control group. The formulas

'*there is no/there are several/many/a lot of/ various/some/ a few'* were used seventy six times, *'according to'* was used twenty nine times, *'a variety of'* was used twenty five times, ' *as a result'* was use eleven times, '*due to'* was used ten times. *' in terms of*' was used nine times, *'due to the fact that'* was used eight times and '*as well as'* was used six times. The formulas '*appears to be/ does not appear to be', '(there) are a number (of)*', '*give rise to'* were all used five times. Other target formulas such as '*as a consequence', 'in relation to'* and '*more/less likely to'* were used three times each. The formulas '*from th view*', '*can be considered'* and '*is/ are / can be/ affected by'* were used twice. Finally, the formulas '*the relationship between', 'in conjunction with', 'with regard to', 'on the basis of*' and *'can be achieved'* were used only once

Although the control group was indirectly exposed to all the formulas during their lessons, they only used a few of them during the post AEW test.

The formula 'according to' was used fifty five times, the formulas '*there is no', 'there are several'* were used thirty seven times, 'a variety of' was used ten times, '(there) are a number (of)' was used twice while 'as a result' and 'more/less likely' were used once respectively.

4.3 Addressing Research Question 4

To address the fourth research question, (4) *What is the effect of target academic formula use on the scores of the academic essay writing test?*, Pearson's correlation analysis was conducted between the number of TAF used in the post AEW test and the post AEW test scores.

Table 8: Descriptive Statistics

	Mean	Std. Deviation	N
Post AEW Test Scores	11.858	2.601	60
Number of TAF Used	4.067	2.596	60

Table 8 and 9 show the descriptive statistics and Pearson's correlations coefficient of the number of TAF used in the post AEW test and the post AEW test scores respectively. The value of Pearson's correlation coefficient ***r*** is +0.433 which is bigger than 0 but less than 0.5 ($0 < r < +0.5$). The probability value obtained is 0.000, which is less than the predetermined alpha value ($a = 0.05$).

Table 9: Pearson's Correlation

		POST AEW	FREC_USE
Post AEW Test Scores	Pearson Correlation	1	**.433****
	Sig. (1-tailed)		**.000**
	N	60	60
Number of TAF used	Pearson Correlation	**.433****	1
	Sig. (1-tailed)	**.000**	
	N	60	60

**. Correlation is significant at the 0.01 level (1-tailed).

These imply that there is ***a significant positive linear*** relationship between TAF test scores and the frequency of TAF used in the AEW test. The conclusion is made at the significance level of $a = 0.05$ (5%) or confidence level of (95%). Based on the statistical test results it can be concluded that the number of TAF used in the essays correlate positively with the scores.

4.4 Effect Size of DIAF

Finally, in addition to determining the statistical significance of data (through *p* value) and the possible range of acceptable scores (confidence interval), it is also important to quantify the strength of the difference between two means or two variables (Creswell, 2008) by calculating the effect size. For *t*-test statistics, the effect-size (ES) can be calculated with the equation:

$$ES = \frac{[\text{Mean of experimental group}] - [\text{Mean of control group}]}{\text{Standard Deviation (pooled)}}$$

Figure 4: Formula for Calculating Effect Size

Pooled standard deviation can be obtained by averaging the standard deviations of both groups, taking into account the size of the groups (Coe, 2002), where N_E and N_C are the numbers in the experimental and control groups, respectively and SD_E and SD_C are their standard deviations.

$$SD_{pooled} = \sqrt{\frac{(N_E - 1)SD_E^2 + (N_C - 1)SD_C^2}{N_E + N_C - 2}}$$

Figure 5: The Formula for Calculating Pooled Standard Deviation

The criteria recommended by Cohen (1992) for interpreting the effect size are as follows: 0.20 is considered a small effect size, 0.50 is a medium effect size, and 0.8 is a large effect size. Table 10 shows the effect size of DIAF.

Table 10: Effect Size

Instrument	Effect Size	Interpretation
TAF	1.83	Large
AEW	1.004	Large

Based on the table it can be concluded that the effect size of DIAF on knowledge of TAF and academic writing performance is large.

5. DISCUSSION AND CONCLUSION

Drawing from the findings of the study it can be concluded that direct instruction of formulas can enhance the learners' knowledge of the target formulas and their academic writing performance. Although the time allocated for teaching the formulas in this study was short,

the effect size of direct instruction of the academic formula (DIAF) on the students' knowledge of the formula and their academic writing performave is large. It can also be concluded that the use of formulas correlates positively with the academic writing scores. Pearson's correlation coefficient (r=0.433) is close to the finding of earlier research by Dai and Ding (2010) who reported a correlation of r=.46 between the number of formula used and the marks awarded by assessors.

One of the biggest challenges faced by EAP and ESP writing teachers is time constraint. Although it is widely accepted that direct teaching is effective in improving language proficiency, the questions of ' W*hat to teach*?' and '*How to teach?'* within the limited time allocated for teaching have always been the concern of ESL writing teachers. This study has shown that teaching the formulas that the students are familiar with, and teaching them by providing exposure which promotes noticing can facilitate formula acquisition and consequently improve the students' writing performance.

5.1 Suggestion for Future Research

This study has provided evidence of the importance of formula instruction in an academic writing class. However, it should be noted that the study was conducted over a short experimental period involving a small sample. Since the experimental period was short, the question of whether the knowledge of formula is retained over time was not addressed. Therefore, a study conducted over a longer experimental period (i.e. over a full 14-week semester) and involving bigger samples should be considered for future research. Another limitation of this study is although Pearson's correlation coefficient can provide evidence of the relationship between two variables, it does not show cause-effect relationship. In this study although it can be concluded that the scores correlates positively with the number of TAF used, the researcher cannot claim that the scores are directly influenced by the number of TAF used since there are other extraneous variables that might influence the scores. A more sophisticated statistical analysis such as regression analysis should be utilised to determine cause-effect relationship in future research.

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Author's Biography

Nor Ashikin Ab Manan* is an English language lecturer from the Academy of Language Studies, UiTM Perak, Malaysia. She is currently pursuing a doctoral degree from Universiti Sains Malaysia. She has a Masters degree from the University of Stirling, Scotland, U.K. and a Bachelor of Science from the Ohio States University, U.S.A. Her research interest includes learning strategies, teaching methodologies and language testing.

Dr Ambigapathy Pandian is a Professor at the School of Languages, Literacies and Translation , Universiti Sains Malaysia. He has published numerous research articles in international journals and books. His latest international publication is***: New Literacies: Reconstructing Language and Education*** (2013) by Cambridge Scholars Publishing,UK.

* Corresponding author