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Effect of Mini-Research Project (MRP) Module on English Technical Writing Skills among Engineering Students

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Abstract

English technical writing is one branch of communication that engineering students attain during their study at higher learning level in technical institution. Thus, this study aimed on the influence of a Mini-Research Project Module (MRP) on engineering students' English technical writing skills. 134 engineering students were selected using a systematic sampling technique from four different intact mixed engineering classes of polytechnics located in two zones in Peninsular Malaysia. The four classes comprise two experimental groups and two control groups. A quasi-experimental quantitative research design with the Nonequivalent Groups Design (NEGD) method was employed. The study formulated two research questions and tested three hypotheses at a 0.05 significance level. Descriptive analysis and inferential statistics included a Paired-sample T-test and a One-way ANCOVA, were applied. Results revealed that usage of MRP module significantly increases English technical writing skills in experimental group students. The pre-test average score was observed to be 10.06, which raised to 19.39 in the post-test, representing a 92.79% increased. The results showed significant effects on the experimental group's students' skills in English technical writing after using the MRP module. Thus, this study recommended that using the MRP module could enhance students' improvement in their English technical writing skills. Therefore, it is proposed that more technical institutions attempt modular learning approaches.

Keywords: English Technical Writing Skills, Module, Technical Institution, Engineering Students, Quasi-Experiment

Introduction

The use of module in teaching and learning has been long discussed by numerous researchers. Modular learning as one of the instructional materials has been used widely even literature has indicated materials as modules should be developed for learners (Kitao & Kitao, 1997). It is identified that the use of modules could be a substitute instrument for learning and moreover for learners' satisfaction (Nardo & Hufana, 2014). For instance, a modular

approach that changes conventional teaching methods to an outcome-based learning paradigm is becoming increasingly common in higher education institutions due to the growing complexity of knowledge including in engineering (Dejene, 2019). A modular-based strategy can effectively enhance students' comprehension. It has been demonstrated that using this modular approach to teach and learn English grammar enhances students' comprehension and critical thinking skills (Ibyatova et al., 2019).

Yazon (2017), in his paper on module validation and efficacy in evaluating students' learning discovered that the module was successful in promoting learning. Ambayon (2020) conducted a different study on the modular approach to students' literary achievement. The findings demonstrated that college students who used a modular approach improved their performance in literature from poor to excellent, while those who did not use one improved from poor to fair achievement. In line, Ahmad et al.(2017) stated that teaching and learning sessions which used modular instructional materials have shown second highest score as preferred learning method.

A study of modular approach in teaching Science 10 by Valencia (2020), employing a modular teaching strategy drastically improved test scores and led to students being classified as competent. This suggests the method has demonstrated a crucial connection to enhancing students' academic achievement. Likewise, Khalil and Yousuf (2020) discovered students who were using a modular method to teach mathematics achieved higher results in their paper on the influence of modular approach teaching on secondary school mathematics achievement. The modular teaching approach was proven to be a more effective learning strategy for secondary school pupils than the standard teaching method.

With all the information and the benefits of using modular learning approach mentioned earlier, a study is needed to identify if the modular approach with specific content in technical writing can provide positive effect on engineering students’ skills in English technical writing. This is because, the Communicative English course offered in the curriculum for engineering programs at Malaysian polytechnics for diploma programs has not emphasized technical writing skills. Consequently, polytechnics students do not have the knowledge in English technical writing that they supposed to possess. For instance, a study from Sanmugam et al. (2012) at a polytechnic in Malaysia found that some contents of the material used in the module of Communicative English course at polytechnic are unrelated to the needs of students in the engineering field.

A study by Lam and Chong (2013) had investigated polytechnic students' perceptions of their language learning experiences during their Communicative English course and revealed that more than half of the students agreed that the English language curriculum did not help them to improve their English in a technical context. This indicated that polytechnic overlooked to provide relevant English course in the curriculum of the polytechnic engineering education system in Malaysia (Ahmad Yasruddin et al., 2010). This also showed that there is mismatch of students’ needs with the curriculum provided by the polytechnic. Furthermore, Ahmad Yasruddin et al. (2010) also mentioned the English technical writing skill deficiencies of polytechnic students on understanding technical documents, using correct grammar, vocabulary and sentence structure, writing test/investigation report and questioning for clarification are among the important skills that polytechnic students lacked.

However, these are the skills that students should acquire and demand by the industries (Ismail et al., 2017; Ahmad Yasruddin et al., 2010; Jobstreet.com, n.d.). On the other hand, knowledge and skills in English technical writing are included as parts of the important competency related to effective communication that engineering students should acquire (BEM, 2019).

In different angle, apart from mismatching between what students' needs with what polytechnic has provided, this issue also showed that there is a lack of effective instructional materials used in the polytechnic education system. For instance, an empirical study at other polytechnic settings in Malaysia had identified that the existing module provides a very limited information on how to conduct a mini project (Siti Fazlina et al., 2018; Siti Fazlina et al., 2019). As a result, the students did not get sufficient practice in writing which led to the lack of English technical writing skills. Thus, the purpose of this study is to examine the effect of using a Mini Research Project Module (MRP) on engineering students' English technical writing skills at polytechnics in Malaysia. In particular, this study formulated two research questions and tested the following three hypotheses:

a) Research question

(1) Is there any significant difference between pre-test mean scores on students' skills in English technical writing in the experimental group and in the control group?

(2) Is there any significant difference between post-test mean scores on students' skills in English technical writing in the experimental group and in the control group?

b) Hypothesis

The following hypothetical statements were tested at a 0.05 level of significance.

Ho1: There is no significant difference between pre-test and post-test mean scores on students' skills in technical writing in the experimental group,

Ho2: There is no significant difference between pre-test and post-test mean scores on students' skills in technical writing in the control group and

Ho3: There is no significant difference in post-test mean scores on students' skills in technical writing between experimental group and control group after controlling the effect of pre-test.

Literature Review

Definition of a Module, Using Modular Approach in Teaching and Learning and Effects of Using Module in Teaching and Learning

Previous studies have shown that using modular approach as instructional materials in teaching and learning sessions has revealed high scores as a preferred learning method. A module is an instructional material which could be an alternative method of knowledge acquisition in the teaching and learning process. According to Rusell (1974), a module is a learning package of a unit which relates to a single concept of certain subjects. In addition, Miller (1979) stated that a module is supposed to be objective, systematic, independent, and well-defined. More specifically, Greager and Murray (1985) defined a module as an independent and a complete teaching unit which aims to achieve a few targeted objectives. Not much differently, Husen and Postlethwaite (1994) also stated that a module represents a

complete set of teaching packages which covers a unit of certain subjects. While Alwiah (1981) describes module as a complete set of small parts which are related to each other. Other than that, Kamdi (1990) mentioned his description of a module as a complete set of self-teaching and learning material which contains several components such as objectives, teaching materials, teaching activities, assessment and instructions, and a systematic guideline which enables students to follow individually and independently. In a similar line, a few pieces of literature have pointed out that a module is a full set of self-learning items. All skills related to the tasks given are combined to form a network (Ab. Rahim, 1991; Sidek & Jamaludin, 2005).

Using modules enables learners to apply self-control over their learning. Learners can always turn back to the parts of the module that they have not mastered yet. A module is a set of learning opportunities that are prepared around well-defined topics that cover the components of instructions, specific objectives, teaching and learning activities and assessment using standards measurement (Nardo & Hufana, 2014). More specifically, Moradi et al. (2018) referred to a module as an intervention which structured with several key educational principles such as prior knowledge, integrating testing and individual self-paced learning.

Vast literature in using module as an alternative tool in teaching and learning had been conducted extensively. The significant impacts of using modules have been the reason why researchers are still in think and interested in developing module and studying the effects of using module. For instance, Olivio (2021) studied using a printed modular distance learning found that the module used had created a positive learning environment yet need an action plan for improvement the implementation of the modular learning. In another study by Chee and Mazlini (2021) on the effect of using project-based inquiry learning STEM Module. The outcome of their study had showed positive impact on the understanding, interest, and attitude of students as respondents. Apart from that, a study by Banegas and Consoli (2021) on the effects of a module on teacher research. Their findings revealed that the module had positive impact on English language proficiency, students-teachers' identity, and role of reflection. In line, studies on effect of using module by Safitri et al.(2020) in improving students' critical thinking skills had presented progressive results in students' scores which also showed positive effect of using the module. Aligned, Ambayon (2020) in his study on modular based approach and students' achievement in literature which addressed effective instructional material. His findings showed an improvement in students' achievement which also indicated positive effect on using the module.

Parallel to the above mentioned studies that contributed to positive impacts from utilizing modules, a study from Mazrekaj and De Witte (2019) entitled the effect of modular education on school dropout had also revealed positive achievement whereby the use of module had successfully reduced the number of dropout students. Nevertheless, a study in 2018 by Tg Nur Liyana et al. in evaluating English Module that guidance to help develop ideas for writing. The findings revealed that students' performance showed significant increase which reflected positive impact of using the module. Another study that presented positive impacts on using modules was in 2018 by Moradi et al. on enhancing teaching-learning effectiveness by creating online interactive instructional modules for fundamental concepts of Physics and Mathematics. Their results showed that students' performance increased after

using the module. In general, previous studies had reported that the use of modules in teaching and learning session had significant impacts.

In a research conducted by Zhang (2022), on the efficiency of a multimedia module on intermediate Chinese as a Foreign Language (CFL) learners understood and used the "shì…de" construction, as well as how well students perceived the program's efficacy. The results demonstrate that, with the exception of their comprehension of the second usage, students' understanding, and application of the construction considerably increased after utilizing the module. The program was well-received by the students, who found it enjoyable to use and valued its availability, design, and presentation.

A study on the impact of modular learning of English for Specific Purposes on students' satisfaction of education process was carried out at the South Ural State University. The study's findings indicate that the use of modular learning improved students' performance and raised their degree of satisfaction with the educational process (Kolegova & Levina, 2022). Another study by Nurdin et al.(2023) was about the effect of learning outcomes on the use of module revealed a significant increment on student learning outcomes. Thus, modular approaches in teaching and learning session are crucial and the benefits of using it are undeniable since many researchers have applied it many times in different fields.

Technical Communication Skills as one of the Crucial Employability Skills

The engineering industry has recognized that future graduate engineering students should equip themselves with appropriate employability skills before embarking on workplace destinations. Among the employability skills that are listed are communication skills (ABET, 2019). One of the communication skills in the workplace is writing, which includes technical writing skills. Proficiency in technical writing empowers students to interact successfully with various audiences. Technical writing is an essential talent for engineers since it helps them convey concepts, guidelines, and project specifics. Writing research papers, project proposals, or design documentation requires clear, concise technical writing to communicate complicated ideas understandably (Padma, 2023a)

In addition, maintaining technical writing ethics is crucial for preserving the integrity of engineering and technical professions. Engineers have to expand on existing knowledge while doing innovative work, continuously applying ethical norms, and appropriately citing sources. By doing this, they support a culture of trustworthiness, integrity, and professionalism in their industry (Padma, 2023b).

Higher education instructors have developed several strategies to help engineering students become more proficient in technical writing, including integrating writing into the existing engineering curriculum, working with writing centers, and using evidence-based pedagogy. (Keyser & De Loatch, 1984; Weissbach & Pflueger, 2018, Wu et al., 2022). This is for the reason that proficiency in technical writing empowers students to interact professionally with various audiences (Wu et al., 2022). The improvement of students' critical thinking and active learning is linked to the development of technical writing abilities, which also cater to the needs of students with diverse learning styles and are an effective means of assessing students' comprehension of technical content (Wheeler & McDonald, 2013; ABET, 2021; Ramamuruthy, Dewitt & Alias, 2021; Cantera et al., 2021). Therefore, from the research

findings of various studies including using module in teaching and learning and as well as from studies on technical writing above, this study had tried to identify the effect of using a module in teaching and learning English technical writing.

Methodology

A quasi-experimental quantitative research design method was employed for this study to determine the effect of using the MRP module by examining if there is any significant difference between pre-test and post-test mean scores on engineering students' technical writing skills in experimental and control groups. This kind of experiment research could show that the manipulated independent variable (IV) was the main factor that caused the effects to the dependent variable (DV) (Chua, 2011; Sekaran, 2003). In the context of this study, the IV was an intervention (treatment) which is the MRP Module and the DV was the technical writing skills (outcome in post-test). An experimental research design can determine whether an intervention used produced any effect (Maruyama & Ryan, 2014; Tuckman & Harper, 2012)

A research design is determined by research hypotheses (Chua, 2011). As mentioned before, this study tested three null hypotheses:

Ho1: There is no significant difference between pre-test and post-test mean scores on students' skills in technical writing in the experimental group,

Ho2: There is no significant difference between pre-test and post-test mean scores on students' skills in technical writing in the control group, and

Ho3: There is no significant difference in post-test mean scores on students' skills in technical writing between experimental group and control group after controlling the effect of pre-test.

Pre/post tests were employed as an instrument in this study. The test (pre/post-test) was built based on the content of the MRP activity module, and the purpose is to examine the effect of the MRP Module on students' skills after using the module. Therefore, the test was administered to both experimental (E1 & E2) and control groups (C1 & C2) before the treatment (MRP Module) was applied to experimental group students. This is called the pre-test. Once the use of the MRP Module by students in the experimental group has been completed, the post-test was administered to the experimental group using the same instrument (pre-test). The pre-test presents a measure of the characteristics or attributes of the group(s) that the researcher tests before the treatment is given to the group/(s) of experimental research. Then, after the treatment was given, the researcher took another reading of the test on the experimental group's students only. However, the control group students were also given the post-test but without being given the treatment. This is called a post-test. In other words, a post-test is a measure of the characteristics or attributes that the researcher tests after treatment is given to the respondents (Creswell, 2014).

Table 1.0 illustrates how the four-group quasi-experimental research design was administered. This study had used four non-equivalent groups pre-test-post-test design: (1) two experimental groups (E1 & E2), and (2) two control groups (C1 & C2). Two non-equivalent groups were given pre-test (E1 & C1), treatment (for the experimental groups only: E1)), and a post-test. Another two non-equivalent groups were not given pre-test (E2 & C2), but one of

the groups (E2) were given the treatment prior before both groups were given post-test (Campbell & Stanley, 1963; McGahee & Tingen, 2009; Shamsuri, 2012). Thus, the effect of the treatment (X) was replicated in four different patterns that could be determined: O2 > O1, O2 > O4, O5 > O6, and O5 > O3 (Campbell & Stanley, 1963).

Table 1.0
Four-Group Quasi-Experimental Research Design

Group	Pretest	Independent Variable (experimental treatment)	Post-test
E1	O1	X	O2
C1	O3	-	O4
E2	-	X	O5
C2	-	-	O6

Note. X – Treatment
O – Outcome measure/ score

Inferential statistics were used to analyse the data collected for this study. Analysis of Covariance (ANCOVA) statistics in SPSS were used to analyse the inferential statistics and test the hypotheses at the significance level of 0.05. The pretest results on English technical writing skills served as the covariate, accounting for any early differences between the groups because the groups were not assigned at random. To determine whether the data were appropriate for the statistical tool, it was subjected to the required parametric assumption tests. These tests include the Shapiro-Wilk test of normality, which evaluated the data distribution, and Levene's test of homogeneity, which examined the group variance. This study had fulfilled the requirements.

Table 1.1 displays the result for normality test of skills in technical writing for post-test means score for E1, E2, C1, and C2 groups. The significant values of the Shapiro-Wilk test for E1 group is p = .727, E2 group is p = .553, C1 group is p = .305 and C2 group is p = .082. Each of the values revealed p > .05. Therefore, an assumption in conducting parametric statistics had been achieved, where one-way ANOVA test was launched to test equality of post-test mean scores between experimental groups and control groups (Chua, 2014).

Table 1.1
Test of Normality for Post-Test Mean Score of Skills in Technical Writing

		Shapiro-Wilk		
	Group	Statistic	df	Sig.
Skills Post-test	E1	.978	33	.727
	E2	.973	33	.553
	C1	.963	34	.305
	C2	.944	34	.082

Table 1.2 shows the result of Levene's test for homogeneity of variances on post-test mean score of skills in technical writing. The result shows that F (3,130) = 1.741, p = .162. Both results indicated that the p values are not significant (p > .05) and show that the variances are

equal for all of the groups (E1, E2; C1, and C2). Therefore, the assumption of homogeneity of variance was met and comparison using ANOVA analysis for hypothesis testing is enabled to conduct.

Table 1.2
Levene's test for homogeneity of variances on post-test mean score of skills in English technical writing

Variable	F value	Df 1	Df 2	Sig
Post-test mean score of skills in technical writing	1.741	3	130	.162

Results and Discussion

Table 2.0 shows the analysis of t-test for pre-test of skills in technical writing between experimental and control groups. The analysis was conducted to seek if there was a significant different of pre-test mean scores for skills in technical writing between experimental group (E1) and control group (C1). This fulfilled the research question one: is there any significant difference between pre-test mean scores on students' skills in English technical writing in the experimental group and in the control group? The result shows that there is no significant different of pre-test mean score for skills in technical writing between group E1 group and C1 group (p = .089). Therefore, the results showed that at the beginning of this study, the skills in technical writing for E1 group and C1 group were found no significant different. However, to answer whether there is a statistically significant difference, further analysis using a t-test is needed.

Table 2.0
Independent Sample T-Test Analysis of Pre-Test Result for Skills in English Technical Writing between Experimental Groups and Control Groups

Sub-scale	Group	N	Mean	SD	t value	df	Sig
Pre-test score (skill)	E1	33	1.4135	.8198	1.724	65	.089
	C1	34	1.4135	.8192	1.725	64.974	.089

Table 2.1 shown that, there was a statistically significant difference in post-test mean scores of skills in English technical writing [F (1,130) = 6.194, p < .05] between groups which were given pre-test (E1 & C1) and groups without given pre-test (E2 & C2) which p = .014. This answered research question two: is there any significant difference between post-test mean scores on students' skills in English technical writing in the experimental group and in the control group? Table 2.1 Also shown that, there was a statistically significant difference in post-test mean scores of skills in technical writing [F (1,130) = 90.558, p < .05] between groups which were given treatment [experimental groups (E1 & E2)] and groups which were not given treatment [control groups (C1 & C2)] which p = .00. However, the partial eta squared is only .112 for the interaction effect which indicated a small effect size (Tabachnick & Fidell, 2019). Besides, adjusted r squared showed that 45.2% of the variance in post-test mean score was attributable to pre-test and treatment which indicated moderate relationships. Both

independent variables in this factorial design had shown statistically significant differences, therefore, Turkey's post hoc test was conducted by applying simple main effect test to determine which groups exactly are significantly different from each other and to compare the means from a significant interaction effect between the two factors (pre-test and treatment). By doing so would help verifying the results.

Table 2.1
Analysis of Pre-Test and Treatment Effects on Skills in English Technical Writing of Post-Test Mean Score Data

Source	Sum of squares	df	Mean square	F	Sig	Partial Eta squared
Pre-test	79.948	1	79.948	6.194	.014	.045
Treatment	1168.942	1	1168.942	90.558	.000	.411
Pre-test * Treatment	211.948	1	211.948	16.420	.000	.112
Error	1678.065	130	12.908			
Total	30789.000	134				

Note. a. R Squared = .465 (Adjusted R Squared = .452
b. Computed using alpha = .05

Table 2.2 and Table 2.3 showed analysis of simple main effects using the Turkey post hoc. The analysis of simple main effects was conducted between groups which were given pre-test and groups which were without given pre-test in Table 2.2, and between groups which were given treatment and groups which were not given treatment or control groups (C1 & C2) in - Table 2.3. From the results of simple main effect analysis showed in Table 5.9, there was a statistically significant differences between the groups which were given pre-test with the group without given pre-test, $p < .05$. From the table, the difference in post-test mean score between E1 group (given pre-test) and E2 group (not given pre-test) is 4.060, $p = .00$. Moreover, the difference in post-test mean score between E1 group (given pre-test) and C2 group (not given pre-test) is 7.4528, $p = .00$. Simple main effect analysis showed that E1 group which was given pre-test was significantly performed better in post-test score of skills in technical writing than E2 group and C2 group which were not given pre-test. However, there was no statistically significant difference in simple main effect of pre-test between C1 group which was given pre-test and C2 group which was not given pre-test on post-test score of skills in English technical writing.

Table 2.2
Analysis of Simple Main Effects using Turkey Post Hoc Test between Groups given Pre-Test (E1 & C1) with Groups without given Pre-Test (E2 & C2) on Skills in English Technical Writing

(I) Pretest	(J) Pretest	Mean Difference (I-J)	Std. Error	Sig.
YesE1	NoE2	4.0606*	.88449	.000
	NoC2	7.4528*	.87796	.000
YesC1	NoE2	-4.3627*	.87796	.000
	NoC2	-.9706	.87138	.682

Table 2.3 shows the results of simple main effect analysis on post-test mean score of skills in technical writing of groups which were given treatment and groups without given treatment. There was a statistically significant interaction effects to the groups which were given treatment with the group without given treatment, $p < .05$. As shown, the difference in post-test mean score between E1 group (given treatment) and C1 group (not given treatment) is 8.4234, $p = .000$ which demonstrated significant effect. Furthermore, the difference in post-test mean score between E1 group (given treatment) and C2 group (not given treatment) is 7.4528 1, $p = .000$. The result demonstrated a significant effect ($p < 0.05$) of treatment on post-test mean score of skills in technical writing for C1 group (not given treatment).

As stated in Table 2.3, the difference in post-test mean score of skills in technical writing between E2 group (given treatment) and C1 group (not given treatment) is 4.3627, $p = .000$. Moreover, the difference in post-test mean score of skills in technical writing between E2 group (given treatment) and C2 group (not given treatment) is 3.3922, $p = .001$. Again, the result demonstrated a significant effect ($p < 0.05$) of treatment on skills in technical writing for E2 group. Therefore, it can be concluded that; treatment significantly affect the post-test results of skills in technical writing on the experimental groups in this study.

Table 2.3
Analysis of Simple Main Effects using Turkey Post Hoc Test between Groups which were given Treatment (E1 & E2) with Groups without given Treatment (C1 & C2) on Skills in Technical Writing

(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.
YesE1	NoC1	8.4234	.87796	.000
	NoC2	7.4528	.87796	.000
YesE2	NoC1	4.3627	.87796	.000
	NoC2	3.3922	.87796	.001

Ho1: There is no statistically significant difference between pre-test and post-test mean scores on students' skills in technical writing in experimental group

The difference between pre-test mean scores and post-test mean scores in experimental group were analysed using descriptive analysis before Hypothesis 1 was tested. Three categorical of five scale mean score (Kerlinger, 1979) was used to interpret the findings:

(1) mean scores between 1.00 to 2.40 are referred as low, (2) mean scores between 2.41 to 3.60 are referred as medium; and (3) mean scores between 3.61 to 5.00 are referred high.

Table 2.4 revealed that the mean scores of skills in technical writing for group E1 had raised by 92.79 % from the mean scores of pre-test to the mean scores of post-test. Thus, the result shows that there was a high increment in students' technical writing skills of post-test scores for group E1.

Table 2.4
Analysis of comparison between pre-test and post-test mean scores in experimental group (E1) using descriptive analysis

Variables	Mean score		Difference of pre-test and post-test mean score (%)	Remark
	Pre-test	Post-test		
Skills in technical writing of group E1	10.061	19.394	9.333 (92.79%)	increase (high)
SD	3.269	3.409		
N	33	33		

Table 2.5 shows a significant increase in the mean score of skills in technical writing from pre-test mean score (M = 10.061, SD = 3.269) to post-test mean score (M = 19.394, SD = 3.409) with t value, t (32) = -15.028, $p < 0.05$. Therefore, because $p = 0.00 < 0.05$, null hypothesis is rejected (Ho1: There is no statistically significant difference between pre-test and post-test mean scores on students' skills in technical writing in experimental group). In conclusion, there was a statistically significant difference of mean total scores of experimental group on technical writing competency in terms of skills before (M = 10.061) and after (M = 19.394) using the MRP Module as a treatment. This result further underscores the influence of the MRP (Mini-Research Project) Module had a positive effect on students' English technical writing skills.

Table 2.5
Analysis of paired-sample t-test for pre-test and post-test mean scores of skills in technical writing of experimental group (E1)

Dependant Variable	Pre-test & Post-test	N	Mean	SD	t-value	Df	Sig
Pre-test and post-test of skills in technical writing	Pre-test	33	10.061	3.269			
	Post-test	33	19.394	3.409			
	Pre-test – Post-test	33	-9.333	3.568	-15.028	32	.00

Ho2: There is no statistically significant difference between pre-test and post-test mean scores on students' skills in technical writing in control group

The difference between pretest and post-test mean scores for control group was first analysed using descriptive analysis before Hypothesis 2 was tested. Hypothesis 2 was conducted to address the research question: Is there any significant difference between pre-test and post-test mean scores on students' skills in technical writing in experimental groups and in control group. Three categorical five scale mean score (Kerlinger, 1979) were used to interpret the findings: (1) mean scores between 1.00 to 2.40 are referred as low, (2) mean scores between 2.41 to 3.60 are referred as medium; and (3) mean scores between 3.61 to 5.00 are referred high. As mentioned in Chapter three, pre-test was only given to group E1 and group C1 while group E2 and group C2 were not given pre-test. As referred to Table 2.6, analysis of the difference between the mean scores of pre-test to the mean scores of post-test of group C1 on skills in technical writing has risen by 47.44%. Thus, the result shows that there was a medium increment in students' technical writing competence of post-test achievement for group C1.

Table 2.6
Analysis of the difference between pre-test and post-test mean scores of control group (C1) using descriptive analysis

Variable	Mean score		Difference of pre-test and post-test mean score (%)	Remark
	Pre-test	Post-test		
Skills in technical writing of C1 group	7.441	10.971	3.53 (47.44%)	increase (medium)
SD	3.963	3.148		
N	34	34		

Analysis of paired-sample t-test for pre-test and post-test mean scores on skills in English technical writing of control group (C1)is illustrated in Table 2.7. The table shows a significant increase in the mean score of skills in technical writing from pre-test mean score (M = 7.741, SD = 3.963) to post-test mean score (M = 10.971, SD = 3.148) with t value, t (33) = -3.529, $p < 0.05$. Therefore, because $p = 0.00 < 0.05$, null hypothesis is rejected (Ho2: There is no significant difference between pre-test and post-test mean scores on students' skills in technical writing in control group). Thus, the result has shown that there was a significant difference of mean total score on technical writing competence in terms of skills for the control group which was given pre-test but not using the MRP Module as a treatment.

Table 2.7
Analysis of paired-sample t-test for pre-test and post-test mean scores on skills in English technical writing of control group (C1)

Dependant Variable	Pre-test & Post-test		N	Mean	SD	t-value	Df	Sig
Pre-test and post-test of skills in technical writing	Pre-test		34	7.441	3.963			
	Post-test		34	10.971	3.148			
	Pre-test Post-test	–	34	-3.529	3.067	-6.709	33	.00

Ho3: There is no statistically significant difference in post-test mean scores on students' skills in technical writing between experimental groups and control groups after controlling the effect of pre-test.

In the null hypothesis three, the researcher intended to compare between the post-test score of experimental group and control group in terms of skills in technical writing after controlling for the effect of pre-test. The researcher also intended to examine whether by using MRP module could improve skills in English technical writing among experimental groups of polytechnics engineering students. Therefore, in analysing the data; the researcher had run a one-way ANCOVA test with: (a) post-test mean scores as the dependant variable; (b) the experimental group and control group as the independent variable, and (c) the pretest as the covariate.

Table 2.8 shows the result of one-way ANCOVA between subjects' effect. From the table, it can be seen that there is a statistically significant effect of treatment on post-test score after controlling the effect of pretest, $F (2, 96) = 91.383$, $p < .05$. Therefore, from the results, null hypothesis was rejected which indicated that there was no statistically significant difference in post-test mean scores on students' skills in English technical writing between experimental and control groups after controlling the effect of pretest. In addition, the effect size as stated in the following table showed .656 which is considered as large effect size. This is referred to Cohen's f as a measure for effect size for ANCOVA analyses (Cohen, 1988).

Table 2.8
Analysis of one-way ANCOVA test between subjects' effects on post-test after controlling the effect of pretest

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1628.044[a]	3	542.681	83.577	.000	.723
Intercept	507.805	1	507.805	78.206	.000	.449
Pretest score	438.837	1	438.837	67.584	.000	.413
Group	1186.733	2	593.366	91.383	.000	.656
Error	623.346	96	6.493			
Total	25325.000	100				
Corrected Total	2251.390	99				

Note. a R Squared = .723 (Adjusted R Squared = .714)

Overall, the significant effect of using the MRP module in improving English technical writing skills among engineering students is consistent with the findings of various previous researchers, such as Chee and Mazlini (2021) on the positive effect of using project-based inquiry learning STEM modules. Other than that, a study by Banegas and Consoli (2021) on the effects of a module on teacher research also revealed that the module had a positive impact on English language proficiency. In line, Ambayon (2020), in his study on modular-based learning, also showed an improvement in students' achievement, which also indicated a positive effect on using the module. In addition, this study's results are consistent with those of Kolegova and Levina (2022), who studied how students at South Ural State University felt about their educational experience after completing English for Specific Purposes modules. According to their research, students' academic performance was improved by using modular learning, and their general happiness with the educational process was also greatly increased.

Likewise, another study by Nurdin et al. (2023) at one technical institution in Indonesia also obtained positive learning outcomes after implementing a module.

Conclusion and Recommendations

The findings of this study concluded that the application of the Mini-Research Project (MRP) module significantly increased the students' skills in English technical writing. The use of the MRP module improved the post-test average score from 10.061 to 19.394, reflecting about a 92.79% improvement among the students in skills of English technical writing. Additionally, ANCOVA demonstrated that the MRP module's beneficial effects on students' performance were statistically significant, with a large effect size (0.656 > 0.400) interpreted. Therefore, given the findings of this study, it is recommended that using the MRP module could enhance students' improvement in their English technical writing skills.

This research makes theoretical and contextual contributions to the field of technical communication in higher education. Theoretically, it extends existing knowledge on the pedagogical impact of project-based learning on students' language acquisition, particularly in the context of English technical writing. By demonstrating the positive effect of the Mini-Research Project (MRP) module on the writing skills of engineering students, this study adds to the body of work that links active, hands-on learning methods with improvements in technical communication proficiency. Contextually, this study provides valuable insights for educators and policymakers in technical institutions, particularly in Malaysia, by showing the practical application of the MRP module within a real-world polytechnic setting. The significant improvement in students' technical writing abilities, as evidenced by the study's findings, suggests that modular, research-based learning approaches can be an effective strategy for enhancing technical communication skills in engineering curricula. Therefore, this research not only contributes to the theoretical understanding of teaching English for specific purposes but also offers a relevant, actionable recommendation for the integration of modular learning in technical education.

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