Promoting the Reading Comprehension of Freshmen Engineering Students Through an Interactive Approach to Content-Based Materials

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Abstract

One of the main concerns of reading education is to develop appropriate pedagogies that will suit the needs and promote abilities of second language learners today. Instead of promoting traditional approaches, reading should be taught in a more interactive and communicative manner. In this light, this study sought to test the effectiveness of a content-based interactive reading pedagogy to enable first year engineering students develop significant levels of reading comprehension of science texts and develop compensatory strategies to help in improving their attitude and motivation towards reading. The quasi-experimental approach was used in the study. The reading comprehension test results of the experimental group were tested against the scores of the 40 students in the control group who underwent treatment using the traditional approach to reading. In addition, a researcher-designed reading attitudinal survey was administered to both groups to describe the students' reading orientation and attitude towards the use of compensatory strategies in reading. The reading attitudinal survey revealed that the experimental group gave a more positive response in using compensatory strategies while reading. The results of the paired sample t-test or hypothesis testing revealed that there is no significant difference between the pre-test and post test scores of the control group. On the other hand, there is a significant difference between the pre-test and post test scores of the experimental group, which means that the interactive pedagogy was effective in developing the experimental group's reading comprehension of content-based materials.

Key words: Interactive Approach to Reading, compensatory strategies, attitude and motivation towards reading, content-based materials, reading orientation

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Introduction

One of the determinants to be able to survive in the society and the globalized world is for one to be able to know how to read. Almost all information in the globe today can be acquired from printed materials. According to Wallace (1992), reading is a tool for survival, a medium for social interaction, and a means to access general knowledge of the world. Hence, it is understandable that a primary concern of educators today is to train students to become better readers and language users to be able to survive in the industry and in the society as well.

To address concerns in reading education, it is important to review the existing practices of reading instruction in the country. The behaviorist psychologists believe that learning takes place through stimulus, response and reinforcement (May, 1996). When applied to reading, it is believed that graphic representations like letters and words in a text are considered as stimuli used by the students to create response. Hence, reading in the past decades was considered as a process of recognizing letters to form words and words to form sentences. In turn, this process is considered to guide students in comprehension (Donaldson & Reid, 1985). However, since the introduction of the Psycholinguistic Theory by Goodman (1975), the reading process has been taken into a different light.

The Psycholinguistic Theory purports that successful comprehension is not based on the number of words recognized in a text, but is based on the implementation of effective reading strategies. Reading is a selective process in which a reader only chooses to use the most important graphic cues to assist him/her in comprehending. Thus, the reader is considered as an active participant in meaning-getting process in contrary to the behaviorist view that readers are just passive identifiers of letters and words. The reading process is, therefore, universal and applies to all languages. But though this has been considered a general reading theory, reading in the second language still has to be viewed differently from reading in the first language.

In 1979, Coady introduced a revolutionary view of the reading process through his Basic Psycholinguistic Modes of ESL Reading where he recognizes the important role of the second language reader in the creation of meaning, and not just the meaning that resides in

the text. In his model, he emphasizes the importance of three components: processing strategies (include linguistic ability), conceptual abilities (general intellectual capacity), and background knowledge. The third component is better explained by the Schema Theory.

Schema Theory emphasizes the importance of background knowledge or previously acquired knowledge of the reader in the process of comprehension. According to Coady (1979), a text can only provide clues and directions, but the construction of meaning is done by the readers according to their own past experiences and knowledge. In second language reading, background knowledge is the factor that makes L1 readers different from L2 readers, since the prior experiences that affect readers' interpretation vary according to culture.

Since the recognition of schema as an integral contributor in the reading comprehension, researchers suggest that activating and using prior knowledge can help compensate for language difficulties of L2 readers (Devine, 1984; Hudson, 1982). However, it should also be noted that L2 readers are still susceptible to comprehension breakdown due to lack of appropriate background knowledge about the topic of the text. Carell (1988) suggests that while readers can freely use their schema in reading comprehension, their interpretation should not deviate from the intended meaning of the text. Moreover, researchers also believe that linguistic proficiency of L2 readers is still necessary (Cummins, 2003; Pulido, 2001; Lee, 1998; Cohen et al., 1988 & Eskey, 1988).

Hence, reading is now better viewed as a combination of bottom-up and top-down processing, which starts from the reader to the text. The Interactive Approach to Reading provides that a reader has a variety of knowledge sources he can use in the process (Rumelhart, 1977). In effect, if a reader has difficulty processing a text because of lack of linguistic skills, it can be compensated by background knowledge about the content and vice versa (Stanovich, 1980).

Eskey and Grabe (1988) argue that both bottom-up processing and top-down processing have important implications to the interactive approach to reading. Since second language (L2) readers are susceptible to both language and content problems of a text, there is a need for classroom instruction to include both bottom-up and

top-down processes of reading to assist students in the comprehension process.

This study therefore examines how the Interactive Approach to Reading can help improve reading instruction in higher education. The proficiency of students in reading does not only give them a tool to survive in the industry in the future, but it also serves as a means for them to acquire knowledge in the content areas. According to Hernandez (2003), "The ability of English language learners to succeed in the content learning has to do with how well they can infer meaning, draw conclusion, learn terminology, analyze problems, and synthesize information from various sources" (p. 126). Therefore, it is an important question whether these skills can be addressed by an Interactive Approach to Reading.

Furthermore, it is also a present need to test the effectiveness of the Interactive Approach in reading content-based materials. This is especially important since the expository nature of content texts and their complex vocabulary and structure pose more comprehension problems among second language readers. In the tertiary level especially in specialized courses in Science and Technology, it is not only important for students to learn how to read, but it is also of utmost importance that they read to learn. Content-based materials are keys to their mastery of the content of their fields. Proper understanding of these materials can therefore assist them in attaining this mastery.

The present study investigated the effectiveness of Interactive Reading Pedagogy to the reading comprehension of selected freshmen engineering students to content-based texts. In addition, it also sought to determine the effectiveness of the approach to the development of reading motivation among the students. With these objectives, this study further contributes to the development of reading comprehension performance of the students specializing in the field of engineering, since their reading prowess will not only contribute to their language proficiency, but also to their achievement in the content areas.

Specifically, the study sought to answer the following:

1. Is there a significant difference in the reading comprehension test scores of the subjects

    1.1 who did not undergo training on the interactive approach to content-based materials?

1.2 who received training on the interactive approach to reading content-based materials?

2. Does the interactive reading pedagogy enable the students to develop compensatory reading strategies in coping with content-based materials?

3. Is the motivation to reading content-based materials of the subjects promoted by an interactive reading instruction?

Method

Participants

This quasi-experimental study involved 80 first year engineering students who were placed in two groups in the experiment. The total number of 80 subjects comfortably met the required statistics for the quasi-experimental nature of the study. There were 40 subjects in the experimental group and 40 subjects in the control group. The participants obtained above average, average and below average scores in the University Entrance Examination in English. Their high school grade ranged from 80 to 90. Also, all the subjects considered English as their second language.

Instruments

A 55-point researcher-designed reading comprehension test with content area texts in science was constructed. The test included a multiple-choice test and a short-answer test. Part I includes the three types of multiple-choice comprehension questions by Johnson (cited in Alderson, 2000): textually explicit questions which question and answer are both found in the same sentence of the text, textually implicit questions which require readers to combine information across sentences, and script-based questions which answers cannot be directly found in the text and which requires readers to combine textual information with background knowledge. To ensure the reliability of the reading comprehension test, it was pilot-tested using two other regular first-year engineering classes from the same University which did not officially participate in the study.

In addition to the reading comprehension test, a researcher-designed attitudinal survey form was also administered after the treatment period. It aimed to provide insights into the subjects' reading orientation, use of compensatory reading strategies, and

motivation towards reading content-based materials. Simple ranking method or scale method was used to analyze the results. The survey was given to both experimental and control groups as data source of retrospection necessary in validating the t-test reading comprehension results.

Procedure

The Interactive Approach to reading was introduced to the students in the experimental group to address both language and content problems to reading technical and content-based materials. According to Wallace (1992), effective reading involves access to content and culture which can be achieved through the use of the following reading stages: pre-reading tasks, while reading tasks, and post reading tasks. Therefore, the lessons conducted during the treatment period for the experimental group included the three stages.

The treatment for the control group was the Traditional Approach or Bottom-up Approach to Reading. Unlike the experimental group, the students in the control group did not use purely content-based reading materials. Instead, they used their English course book which partially included content-based texts.

The treatment period of three months was observed within one college semester. Thirteen interactive lessons, reading activities, and quizzes were given to the experimental group while traditional lessons and activities were given to the control group.

The administration of the tests and handling of classes were done by two female college instructors for the experimental and control groups. Both were oriented regarding the objectives of the research, and the two reading approaches vital to the study, the Interactive Approach to reading, and the traditional method. Both instructors had formal training on reading education and second language teaching in their graduate studies. The researcher ensured that they were comparable in abilities and professional training as well as experience. Interviews with the two instructors were also conducted during and after the experiment to gather their insights and feedback on the effectiveness of the treatment designed for the participants.

Results and Discussion

1. Is there a significant difference in the reading comprehension test scores of the subjects in the control group who did not undergo training on the interactive approach to content-based materials?

Table 1 shows the control group's pre-test and post test difference.

Table 1
Control Group Pre-Test and Post Test Difference

Student	Post test	Pre Test	Diff	Student	Post test	Pre Test	Diff
1	18	32	14	21	25	24	-1
2	18	28	10	22	21	20	-1
3	22	32	10	23	33	32	-1
4	21	29	8	24	30	29	-1
5	24	30	6	25	32	31	-1
6	19	24	5	26	25	24	-1
7	23	28	5	27	27	26	-1
8	29	31	2	28	30	28	-2
9	24	26	2	29	33	31	-2
10	33	35	2	30	29	26	-3
11	30	31	1	31	33	30	-3
12	32	33	1	32	25	22	-3
13	21	22	1	33	24	21	-3
14	30	30	0	34	30	26	-4
15	25	25	0	35	23	18	-5
16	26	26	0	36	29	24	-5
17	24	24	0	37	24	18	-6
18	29	29	0	38	32	25	-7
19	29	29	0	39	31	24	-7
20	33	33	0	40	33	25	-8

As can be seen in Table 1, only 13 out of 40 students or 32.5% in the control group increased their scores from pre-test to post test, the highest increase range being 14. Furthermore, there are a number of students who did not have any significant difference in their pre-test and post-test scores. For instance, there are seven students who

have 0 differences and more students with a difference of only 1, 2 or -1, -2. Further, 20 obtained lower scores in the post test with -8 being the highest difference.

The computed mean or difference in the control group was .05, while the computed standard deviation of the differences is 4.73909. The standard deviation of the mean (Sx) is .749316 and the control group obtained a t-value of .066728 which signifies that there is no significant improvement in their scores. It can be deduced from the statistical results that the traditional approach did not have significant effects on the reading comprehension of the control group when it comes to content-based science texts.

2. Is there a significant difference in the reading comprehension test scores of the subjects before and after receiving training on interactive approach to reading content-based materials?

The same statistical tool, paired sample t-test, was used to analyze the pre-test and post test results of the experimental group. The experimental group, unlike the control group, was not trained using the traditional approach to reading. Instead, their training was based on the principles of Interactive Approach to reading content-based materials. The following table shows the pre-test and post test difference of the experimental group.

As can be seen in Table 2, there were more students who improved their scores from pre-test to post test. Compared to the 39.059% of students in the control group who increased their scores, the increase in the experimental group was relatively higher. Twenty-five (62.5%) increased their test scores after the treatment in which three of them increased by the highest difference of 11. Only two students did not increase their scores at all, while more students in the control group obtained minimal difference or no difference at all. On the other end, 13 out of 40 students obtained lower scores in the post test.

Table 2
Experimental group Pre Test and Post Test Difference

Student	Post test	Pre Test	Difference	Student	Post test	Pre Test	Difference
1	30	19	11	21	26	24	2
2	27	16	11	22	25	23	2
3	25	14	11	23	19	17	2
4	37	27	10	24	31	30	1
5	26	17	9	25	21	20	1
6	31	23	8	26	24	24	0
7	35	28	7	27	23	23	0
8	33	26	7	28	32	33	-1
9	25	18	7	29	33	35	-2
10	35	29	6	30	31	33	-2
11	35	29	6	31	22	24	-2
12	34	28	6	32	20	22	-2
13	33	28	5	33	30	33	-3
14	31	26	5	34	22	25	-3
15	30	25	5	35	19	22	-3
16	31	27	4	36	22	26	-4
17	25	21	4	37	19	23	-4
18	20	16	4	38	24	29	-5
19	23	20	3	39	23	28	-5
20	28	26	2	40	25	31	-6

The mean (d) of difference or average of all the scores is 2.425 while the computed standard deviation of the difference is 4.908849. The computed s_x is .776157. Since the t-value for the experimental group is 3.124367, it shows that there is a significant difference between the pre-test and post test scores and that the post test scores are significantly higher than the pre-test scores. This means that the reading comprehension significantly improved after the treatment period as revealed by their mean gain score. Hence, it can be said that the interactive reading pedagogy was effective in improving the experimental group's performance in reading content materials in science.

3. Does the interactive reading pedagogy enable the students to develop compensatory reading strategies in coping with content-based materials?

Control Group Reading Orientation

Table 3 shows the summary of the reading orientation of the control group. Questions #2 and #4 in the table determine if the reader is word-oriented. A word-oriented reader gives much attention to vocabulary recognition and reading all words in the text. In question #2, students mostly answered 'agree' (35%) when asked if they believe that they need to read all words in a text to understand it. However, the percentage of those who answered 'disagree' closely follows at 33%. Furthermore, when asked if they give particular focus on vocabulary to understand the text (question #4), most of them still agreed (65%).

Table 3
Control Group Reading Orientation Survey

	QUESTIONS	RANKING SCALE 1	%	2	%	3	%	4	%
1.	When I read, I usually skip unimportant words and only focus on the more important details of the text.	2	5%	9	23%	18	45%	11	28%
2.	When I read an article, I make sure that I read all the words because I believe that to be able to understand a text one should understand all the words in it.	1	3%	13	33%	14	35%	12	30%
3.	I can understand a text more when I read aloud rather than when I read silently.	10	25%	20	50%	6	15%	4	10%
4.	I give particular focus on unfamiliar vocabulary in the text to be able to understand the topic more	0	0%	7	18%	26	65%	7	18%
5.	I can always understand a text even if I don't know the meaning to some unfamiliar words.	2	5%	20	50%	14	35%	2	5%

Question #3 aimed to determine if the reader is sound-oriented. Sound-oriented readers are those who give particular importance to sounds of letters and pronunciation of words in a text. Most of the students (50%) disagreed while 25% the strongly disagreed. This means that students in the control group were not very much open to sound-oriented reading.

Finally, questions #1 and #5 focused on meaning-oriented reading which gives more emphasis on the meaning of the text. In question #1, most students (45%) answered 'agree' when asked if they usually skip unimportant words. However, when asked if they can always understand a text even if they do not know the meaning of some words (question #5), most of them (50%) answered 'disagree'. This may mean that while the students do not give attention to less important words in the text, they exert more effort understanding the more important ones.

In sum, the answers of the control group to the reading orientation survey reveal that word-oriented reading is most acceptable to them. This was shown by the importance they give to vocabulary processing as a means to comprehension. This attitude may be attributed to the Traditional Approach in Reading in which students are trained to give importance only to vocabulary building and syntax.

Experimental Group Reading Orientation

Table 4 provides the results of the reading orientation survey conducted after the treatment period. In questions #2 and #4, the survey determined if the reader is word-oriented. Students mostly answered 'agree' (48%) when asked if they believe that they need to read all words in a text to understand it, and when asked if they give particular focus on vocabulary to understand the text, most of them (43%) answered 'agree'.

Question #3 focused on determining sound-oriented students. When asked if they understand more when they read aloud, 38% of the respondents answered 'disagree', while 18% strongly disagreed. Further, 30% agreed while 18% strongly agreed. The results show an equal number of students who responded positively and negatively. This difference in opinion may be attributed to students' use of compensatory reading strategies. When faced with difficult reading

situations, an active reader resorts to different strategies and chooses which one is effective for a particular reading situation.

Table 4
Experimental Group Reading Orientation Survey

QUESTIONS	RANKING SCALE							
	1	%	2	%	3	%	4	%
1. When I read, I usually skip unimportant words and only focus on the more important details of the text.	1	3%	10	25%	21	53%	8	20%
2. When I read an article, I make sure that I read all the words because I believe that to be able to understand a text one should understand all the words in it.	0	0%	15	38%	19	48%	6	15%
3. I can understand a text more when I read aloud rather than when I read silently.	6	15%	15	30%	12	30%	7	18%
4. I give particular focus on unfamiliar vocabulary in the text to be able to understand the topic more	0	0%	11	28%	17	43%	12	30%
5. I can always understand a text even if I don't know the meaning to some unfamiliar words.	3	8%	12	30%	25	65%	0	0%

Finally, questions #1 and #5 determined meaning-oriented readers. According to Devine (1998), unlike the first two reading orientations in which readers focus more on the text, meaning-oriented readers focus more on background knowledge. In question #1, most students (53%) answered 'agree' signifying that they do not have to read all words and that they can skip words in a text and still understand them. A positive answer to the first question negates word-centered orientations and accepts meaning-oriented one. When

asked if they can still understand the text even if they are unfamiliar with some words, most students (65%) answered 'agree'.

The responses of the experimental group to the post survey suggest that most students, after undergoing an interactive approach to reading, accept meaning-oriented reading and have positive response to sound-oriented reading. In addition, the survey shows that they also have positive attitude towards word-oriented reading. This attitude may be attributed to their openness in using varied reading strategies after the interactive reading lessons where compensatory reading strategies were taught.

Reading orientations provide readers ideas on how they execute the reading process. It guides them as to what reading strategies to use as dictated by the principle of the reading model (Devine, 1998). The students' preference of a reading model or orientation may be attributed to the reading approach they were exposed to. The control group was more open to word-oriented reading since the Bottom-Up Approach instruction given them emphasized the importance of vocabulary recognition and grammatical knowledge, while the experimental group found meaning-oriented reading more acceptable because of the emphasis of the Interactive Approach on the role of both the reader and the text as important meaning contributors in the process of reading (Carell, 1988).

Control Group Use of Compensatory Strategies

Table 5 summarizes the responses of the control group with regard to their use of compensatory strategies while reading. In question #1, they were asked if they apply pre-reading strategies like looking at the title and illustrations. Most of the students (53%) answered 'agree', while 10 (23%) answered 'strongly agree'. Like question 1, question #3 aimed to describe students' use of pre-reading techniques. When asked if they make predictions as to what the text is about after previewing, 73% answered that they 'agree', while only 9% 'strongly agreed'. Responses to questions #1 and #2 reveal that the students have been using pre-reading strategies.

Table 5
Control Group Use of Compensatory Strategies

QUESTIONS	RANKING SCALE							
	1	%	2	%	3	%	4	%
1. Before reading a text, I usually preview it first by looking at the title, illustration and other parts that would give me an idea on what the text is about.	0	0%	9	23%	21	53%	10	25%
2. While reading, I constantly ask myself questions on the things I read about.	0	0%	5	13%	24	60%	11	28%
3. After reading the title or the first few parts of a text, I usually make predictions of what the text is really about.	0	0%	5	13%	29	73%	4	10%
4. I always find connection between the information I find in a text to the knowledge I have already learned in the past, or situations I have observed in my surroundings.	0	0%	3	8%	26	65%	9	23%
5. While reading, I usually find myself sometimes agreeing and sometimes disagreeing with the author/writer.	0	0%	1	3%	24	60%	13	33%

Questions #2 and #5 focused on determining students' use of while reading strategies. When asked if they constantly ask themselves questions, 60% answered 'agree', while 28% 'strongly agreed'. Meanwhile, when asked if they find themselves agreeing or disagreeing with the author (question #5), 60% answered 'agree', while 33% also responded 'strongly agree'. Only one respondent (3%) claimed that he/she does not use the said strategy while reading. Lastly, question #4 sought to find out if the subjects related currently retrieved information to those they have acquired before. The data reveal that 65% agree in using this strategy. The students' positive

response to the use of compensatory strategies in reading reveals that these strategies are not foreign to them, and that they have been using them in their reading activities.

Experimental Group Use of Compensatory Strategies

The following table summarizes the experimental group's use of compensatory strategies after the treatment period. As can be seen, a majority (65%) agreed that they use 'previewing the text' as a strategy. When asked if they constantly question themselves while reading, 60% agreed while 18% strongly agreed. Based on the responses for both groups, the experimental group finds previewing the text more acceptable probably because of direct training they received on this type of strategy. However, when asked if the students constantly ask themselves questions, the control group gave a slightly higher positive response having more 'strongly agree' answers. This may be caused by the variety of questions that students may ask during the reading process. Since the reading orientation survey revealed that the control group pays much attention to vocabulary processing, the range of questions they may ask when reading a particular text may not only be questions regarding content, but also questions on vocabulary meaning.

When asked if they make predictions while reading (question #3), a more positive response was given by the subjects. Most of them (68%) responded 'agreed', while 23% 'strongly agreed'. Although the control group had more 'agree' responses, the 'strongly agree' responses in the experimental group is more noteworthy. The high percentage of those who answered 'strongly agree' suggests a more positive attitude.

Table 6
Experimental Group Use of Compensatory Strategies

QUESTIONS	RANKING SCALE							
	1	%	2	%	3	%	4	%
1. Before reading a text, I usually preview it first by looking at the title, illustration and other parts that would give me an idea on what the text is about.	0	0%	4	10%	26	65%	10	25%
2. While reading, I constantly ask myself questions on the things I read about.	0	0%	9	23%	24	60%	7	18%
3. After reading the title or the first few parts of a text, I usually make predictions of what the text is really about.	0	0%	4	10%	27	68%	9	23%
4. I always find connection between the information I find in a text to the knowledge I have already learned in the past, or situations I have observed in my surroundings.	0	0%	4	10%	21	53%	15	38%
5. While reading, I usually find myself sometimes agreeing and sometimes disagreeing with the author/writer.	1	3%	4	10%	24	60%	11	28%

When the subjects were asked if they connect previously acquired information to recently acquired information (question #4), most of the students gave a positive response. In addition, the percentage of those who answered 'strongly agree' in the experimental group (38%) is relatively higher than of the control group (20%). Among the five questions, question #4 displays the most positive response which means that the Interactive Approach successfully trained students in using top-down processing skills and critical reading skills.

Lastly, when asked if they usually find themselves agreeing or disagreeing with the author, most of them still gave positive responses, but there are more 'strongly agree' answers for the control group. This may be attributed to the fact that the experimental group has been exposed more to science texts which are more factual and logical than opinionated.

The experimental group's positive response to the use of compensatory strategies in reading reveals that they use varied reading strategies in the different stages of the reading process. Though the control group was also able to display a positive attitude, overall the experimental group showed a more positive use of the strategies. Again, this may be attributed to the emphasis of the Interactive Approach on exposing students to varied reading compensatory strategies that can help them overcome reading difficulties in all levels. However, aside from the strategies asked in the survey, more compensatory strategies were included in the reading lessons.

Effective readers select from a variety of strategies according to the nature of the text, the purpose for reading, and the context of the situation to arrive at comprehension (Wallace, 1992). In addition, wide knowledge on varied reading strategies help students know what to use in order to compensate for a reading difficulty whether in structure or content. This students' awareness of reading difficulties and their ability to overcome them pertains to their metacognitive awareness which is also developed by the Interactive Approach. According to Alderson (2000), metacognitive skills also contribute to effective reading. Hence, the experimental group's reading comprehension improvement may be attributed to the compensatory reading strategies and metacognitive skills acquired through the Interactive Approach to reading as treatment.

4. Is the motivation to reading content-based materials of the subjects promoted by an interactive approach to reading instruction?

The final part of the results discusses if the experimental group's motivation towards content-based texts increased after the treatment period. The data were gathered through a reflection/assessment journal activity. In this journal writing activity,

the subjects in the experimental group were given a chance to express their opinions regarding the interactive approach to content-based materials. They were asked questions that required them to answer freely and to further support the responses they gave in the survey and their performance in the reading tests.

When they were asked how they found the reading lessons and classroom and individual activities given to them, their answers can be summarized into three main points: first, that the reading lessons and activities were informative and helped them gain knowledge; second, that the lessons and activities were manageable, fun and interesting; and third, that the lessons and activities helped them improve their skills in reading.

Here are some of the specific answers the respondents gave: (Other responses which share similar thoughts and ideas are not repeated.)

Informative/Helped gain knowledge

(1) …texts and reading lessons are quite long but they bring new knowledge
(2) …informing (informative) to the subject and (improves) general knowledge.
(3) … enhanced my knowledge.
(4) I learned new ideas from it (text)
(5) … It is also information giving texts which gives new ideas and knowledge about different things.
(6) … texts are science-based so we are assured that those are factual information.
(7) I think the lessons given us not only provide us better understanding of the subject matter but also enhance our skills in reading.
(8) I found it (activities) useful because it tested my knowledge about the topic…
(9) The teacher would give us activities which can help us encounter problems regarding texts and reading lessons that can help us correct simple mistakes.

Manageable, Fun and Interesting

(10) …having different texts and reading lessons is easier and more fun
(11) … good and interesting science texts
(12) … fun because most of the texts are very interesting and new to us.
(13) I find it very interesting because I learned many words that are not familiar to me.
(14) It was somehow fun and enjoyable like the robot and people comparison
(15) They are fun… but at the same time we are learning.
(16) Participation of class were fully enjoyable and the activities done were very much educational.

Helped Improve Skills

(17) …texts helped greatly in making us understand reading skills taught
(18) …you can learn more reading skills and strategies
(19) I think the lessons given us not only provide us better understanding of the subject matter but also enhance our skills in reading.
(20) … cooperation and teamwork will be (was) developed.
(21) …. Helped improve our thinking and analytic skills as well as comprehension in reading a text.

The reactions of the subjects in the experimental group explained for their motivation to learn and gain knowledge in their areas of study. The interactive approach to content materials was able to expose them to these content-based texts and actually discuss science content in class. Top down processing and its emphasis on schema encouraged students to bring into the discussion the information that they acquired in the past. At the same time, the emphasis on bottom-up processing helped students overcome difficulties regarding the structure and vocabulary of science texts.

In addition, the subjects in the experimental group were trained to integrate strategies in the stages of the reading process to overcome reading difficulties whether due to lack of background knowledge of the content or lack of linguistic knowledge of the text.

Since a student's difficulty may not be another student's own, exposing them to varied reading strategies using the Interactive Approach opened up many opportunities for them to repair comprehension breakdown. In their journal activity, the students in the experimental group were able to share the strategies they learned that helped them most. The following strategies were highlighted: scanning and skimming skills, better vocabulary, faster reading rate/speed, making predictions and hypothesis, understanding sentence structure, using context clues, better interpretation skills, and setting purpose for reading.

The lesson on scanning and skimming was the most notable for the subjects in the experimental group. The list given shows that the subjects learned both bottom-up skills, like improving vocabulary, using context clues and understanding sentence structures, and at the same time learned top-down skills, like making predictions and hypothesis and setting purpose for reading.

With regard to the attitude and motivation towards content materials, the journal writing activity showed that the subjects in the experimental group were motivated to read to gain knowledge in their area of specialization though they found science texts difficult to understand. Most of the subjects' opinions were positive, that is they thought that their ability to understand science texts significantly improved after the treatment period. Also, most students wrote that they were more motivated reading science texts after the treatment period. Here are some of their insights gathered verbatim from the journal writing activities.

(1) Before teaching the class, I am very much interested by Science texts. But now, I think I can understand science texts better.
(2) …we are learning reading and reading comprehension, and at the same time, we are learning facts about Science.
(3) … we learned new words and proper use of terms/phrases.
(4) I improved a lot because I now know the approach I would make in reading these kinds of texts.
(5) I do improved some skills or lessons that are explained to us helped us a lot in Science courses. It made us do

our note-taking easier and helped us to understand the texts in our book very well.

(6) Somehow I became more interested in Science texts.

(7) …the lessons presented different types of structures of text and now, I have already got some ideas in what reading strategies should be used.

(8) …because of the different activities and exercise. It developed my reading skills or well my vocabulary.

(9) I think even for a little bit it helped me improve my reading skills and comprehension towards science texts.

(10) I think my reading skills and comprehension towards science texts have improved because of the new skills and strategies I've learned.

The Interactive Approach to reading content-based materials enabled the students in the experimental group to develop appropriate motivation in reading science texts. Although it was found out that both groups had positive attitude towards reading content-based materials, the experimental group showed a higher motivation since they engaged in more interactive discussions and used more content-based texts than the control group.

It can be deduced from the findings that the experimental group's motivation to read was caused by the opportunity to learn how to read and learn content at the same time. Hernandez (2003) explains that content-based instruction not only give students the opportunity to communicate in the target language, but also gives them the chance to communicate about the subject as well. Also, the experimental group's motivation may be attributed to the emphasis of the Interactive Approach on providing opportunities for participation in dynamic classroom interaction, and overcoming reading difficulties through the use of varied reading strategies.

Conclusions and Pedagogical Implications

The Interactive Approach to reading content-based materials is effective in improving the freshmen engineering students' reading comprehension skills because of the appropriate emphasis on bottom-up and top-down processing skills. This interaction gave the students

in the experimental group the opportunity to address difficulties in content processing and language processing due to lack of knowledge in skill and subject matter of the text. In second language reading, both processes are important in assisting students in language and content processing (Eskey & Grabbe, 1998; Carell, 1988).

Also, the Interactive Approach helped the experimental group acquire compensatory skills which assisted them in overcoming reading difficulties arising from lack of knowledge about the content or the subject matter of the text. Hence, the interactive process provided the students skills and strategies in compensating their own weaknesses with their own background knowledge (Stanovich, 1980). Furthermore, the Interactive Approach as treatment was successful because the experimental group found the lessons informative and relevant to their area of specialization, and dynamic as it encouraged exchange of ideas and feedback in the classroom.

It is therefore recommended that reading be taught in a more interactive and communicative manner. This interaction does not only refer to the interaction of bottom-up and top-down processing skills, but also the active participation of students in critical thinking, interactive activities, and discussions. Aside from individual, silent, and independent reading activities in which more time is usually spent, more collaborative reading and discussions should be offered to provide students opportunities to assess and evaluate meaning from a text, confirm with others predictions and assumptions, and share background knowledge with each other.

The purpose and strategy relationship in reading should be further emphasized. The purpose for reading dictates the kind of strategies to be used, hence, students should be exposed to different reading purposes as well as tasks, and to identify the appropriate strategies for a specific task and purpose. Moreover, second language reading education should recognize that second language students of reading may find a variety of difficulties when reading foreign texts. These difficulties may arise because the context is unknown or the language of the text is unfamiliar to them. For instance, the complex sentence structure and vocabulary may be a dilemma for them especially when most of the texts they use in research are international publications. Language teachers should recognize these reading difficulties. Thus, reading lessons should take into

consideration teaching students the language of texts from different areas of knowledge.

Furthermore, second language reading education should not only emphasize general reading abilities but also prepare students for real-life tasks in the future. For instance, exposing the students to texts that they encounter in their area of specialization would not only help them acquire more knowledge that they need but also help them be familiar with the language of their profession. In addition, exposing students to content-based materials would enable them to apply appropriate strategies in approaching these materials to enhance research skills. For future undertakings, it is suggested that the role of motivation to students' reading performance should be further considered. The relation of motivation and their use of compensatory strategies can be tested if they correlate with student's reading performance. Also, it is suggested that the reading attitudinal survey be further refined to include more questions on specific compensatory strategies.

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