Inference Strategies to Improve Reading Comprehension of Challenging Texts

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Abstract

This study aimed to explore inference strategies necessary to successfully read journal articles. Eighty-eight graduate students read a set of texts on education and economic growth and answered comprehension questions. Twenty-four of these participants also volunteered for an in-depth interview. The findings revealed that students usually relied on their bottom-up processing. They skipped difficult parts, especially technical information and graphic illustrations. They sought help from friends to enhance their understanding. Overall, they were successful at interpreting the thesis statement, the gist of the section, the meaning of the tested words and clause. However, they were less able to infer the underlying argument, the tone of the article, and the attitudes of others toward the research findings. A substantial number of students also failed to utilize information from section headings and the organization of research articles to guide their reading tasks.

Keywords: inference strategies, reading research articles in a foreign language, interpretation of research articles, challenging reading texts, L2 reading ability

1. Introduction

Most textbooks and journal articles for graduate students are challenging in many ways. Factors contributing to text difficulty may arise from various elements within the text, the knowledge base of the individual reader, or the context of interaction between the writer and the reader. Within the text lie the unknown vocabulary, the complicated sentence structure as well as the organizational pattern. The individual reader approaches the same piece of text with different background knowledge, reading proficiency, and purpose. The shared assumption between the reader and the writer may be proportional large and mutually conducive to the reading success, or otherwise (Nuttall, 2000).

As reading is a crucial means of gaining new knowledge, students need to acquire effective strategies to cope with reading demands (Hellekjaer, 2009). Students often struggle with texts: reading at a painfully slow speed, picking up tiny bits of information while being barely able to grasp even major ideas that are directly stated. This leaves a lot to be desired when they have to process the text inferentially. In order for them to read efficiently, they need much training in handling unfamiliar words, automatically processing the seemingly ambiguous syntax, relying on the existing knowledge base for the top-down operation to drive meaning, to infer, and to successfully reach the intended conclusions.

It is hypothesized that students should benefit from learning to modify their reading strategies. This involves weaning off dependency on bottom-up processing and, instead, relying more on top-down processing. The focus is on improving students' inference ability to increase their word power, to resolve potentially problematic syntax, and to use organizational patterns and existing schemata to guide overall comprehension.

This study aims to answer two research questions. Firstly, what inference skills must the reader employ in order to understand the journal article about the impact of education on the economic growth? Secondly, what strategies are crucial to read the journal article successfully?

The two main objectives in this study are, therefore, to identify inference skills necessary to comprehend a research article in terms of the main ideas, the writing style/tone and other text-based elements such as lexical items, syntax as well as discourse structures and to investigate inference strategies for coping with text difficulties.

This study will provide empirical evidence to confirm the above-mentioned hypothesis. The findings will also indicate the optimal approach in the teaching of reading skills that could be adopted and promoted as a model. The study should prove eventually to greatly benefit learners in their attempt to comprehend challenging texts.

2. Review of Literature

The teaching of reading has traditionally been text-based (Pearson & Stephens, 1992). Local strategies necessary to draw text-based inferences help the reader to determine the meaning of unfamiliar lexical items and to clarify syntactic ambiguity, usually within a sentence boundary. Helpful strategies of relying on contextual clues, doing word analyses or consulting dictionaries are fundamental for vocabulary meaning. Resolving syntactic ambiguity resulting from cohesive ties such as pronoun references and ellipses are limited within the boundary of a single sentence or paragraph. In order to deal with a challenging text like reading a research article under investigation, such local strategies of reading are somewhat limited in usefulness. The reader needs to rely more on pre-planning and monitoring strategies. Studies in cognitive psychology provide insights into the mind of the reader that interacts actively with the writer in the meaning reconstruction through text (Rumelhart, 1980; Anderson & Pearson, 1984). The schema theory explains how the reader uses the existing knowledge to comprehend texts, both bridging the missing gap and elaborating the text meaning (Anderson, 1984).

Paris, Lipson & Wixson (1983: 789) describe three ingredients for strategic behavior: "a capable agent, an attainable goal, and an allowable action that the agent can perform to reach the desired end state." To become a strategic reader, the person must possess conditional knowledge (knowing when and why to apply various actions) in addition to declarative (knowing that) and procedural (knowing how) knowledge.

Chamot and O'Malley (1994) classify three types of strategies: cognitive, metacognitive and social/affective. Cognitive strategies are necessary for making inferences while reading.

Weiner and Bazerman (1991) encourage the learner to become a strategic reader when approaching academic prose in two ways. The first is by adopting a reading technique known as SQ3R (survey, question, read, recite and review). This strategy stresses the importance of text engagement on the reader's part as an integral component in the reading process. The objectives are twofold: to activate relevant prior knowledge and to promote text interpretation and retention. They also recommend a three-phase strategy (before reading, while reading and after reading) that the reader needs to actively carry out to get the most out of a text.

Advocating an information processing model of reading, Munro (1999) suggests the cognitive analytic approach for identifying problematic junctures through observing what skilled reader do when trying to understand text.

Bhatia (1993) maintains that a research article in any field of study, science or social science, displays its characteristic, recognizable nature of linguistic presentation that signifies its particular function, purpose and desired goal of communication. The reader can therefore apply strategies to exploit the conventional rules of the research article genre. He cited Swales' analysis of a typical article introduction as consisting of a four-move structure, namely, establishing the research field, summarizing previous research, preparing for present research, and introducing the present research. Applying the work of Swales (2004, 1990), Kanoksilapatham (2009), studying prevalent organizational patterns as manifested in scientific research article abstracts, observed that the use of such moves could be recognized with some variations.

Nuttall (2000) differentiates four types of meaning when a text is processed. Each word carries its own conceptual meaning, i.e., representing a certain concept or idea. When words are put together to form a sentence, the sentence manifests its propositional meaning. It conveys the plain sense or signification of a statement, which can be verified. The other two meanings, termed contextual and pragmatic, are added onto the propositional meaning. When a proposition is considered in a context, it carries its contextual meaning that provides the force or functional value of a statement. When a statement is meant to convey the writer's attitudes, the intended effect on the reader is known as the pragmatic meaning, suggesting the writer-reader interaction.

Nuttall stresses the importance of making a clear distinction between the propositional meaning (signification) and the contextual meaning (value). To fully understand a text, the reader must be able to interpret the value of the proposition and the logical flow of this value, not simply understanding its signification. Widdowson (1978) makes this distinction, using "cohesion" and "coherence" to refer to text unity in terms of signification and value, respectively.

Fielding and Pearson (1994) review research in reading instruction and conclude that it is possible to teach comprehension. Many successful strategies include using background knowledge to make inferences or set purposes, getting the main idea, identifying the sources of information needed to answer a question and using the typical structure of stories or expository texts to help students understand what they are reading.

An independent organization providing services in education and career planning, (ACT, 2006: i) issued a report calling for orchestrated effort to ensure that all students leaving high school "armed with the reading skills needed both for college and in the workplace." The report states that nearly half of 2005 ACT-tested high school graduates were not ready for college and workplace reading. To upgrade their reading ability, students need to be able to handle complex texts characterized in the following ways:

1. Relationships: Interactions among ideas or characters in the text are subtle, involved, or deeply embedded.

2. Richness: The text possesses a sizable amount of highly sophisticated information conveyed through data or literary devices.

3. Structure: The text is organized in ways that are elaborate and sometimes unconventional.

4. Style: The author's tone and use of language are often intricate.

5. Vocabulary: The author's choice of words is demanding and highly context dependent.

6. Purpose: The author's intent in writing the text is implicit and sometimes ambiguous. (p. 17)

Leedy (1981) gives guidelines for reading any research report by first reading the title, abstract, skimming through the report, noting the main headings and subheadings to get the organization of the report as a whole. The reader then has to read the report carefully and in detail, noting the problem which was researched and the manner in which the data were collected and interpreted. Finally, read the conclusions and relate them back to the research problem.

Similar suggestions could be found elsewhere, e.g., "How to read articles in academic or scholarly journals: Dissecting the parts of a research article" by Shannon Lausch (www.associatedcontent.com), or "Wanderings of an online librarian: How to read a journal article" (joy.mollprojects.com).

3. Methods

A total of 88 graduate students at a university in Bangkok participated in this study. A set of materials used in this study included a full-length research article, a short newspaper article and a magazine article. The main article was a nine-page long article, entitled "Education and Economic Growth," published in the Education Next Journal, Spring 2008, Volume 8, Number 2, downloadable at www.educationnext.org. The text of the research article consisted of 38 paragraphs, divided into seven sections with six section headings, all written in a noun phrase. Only the first section, which served as an introduction, was without a heading. The article also contained four figures in the forms of a world map, a table and two graphs. The abstract was not included. In its place was a one-line caption, "It's not just going to school but learning that matters." The reference section was also missing. (For a complete article, go to www.hanushek.net and read the chapter "Education and Economic Growth" prepared for the International Encyclopedia of Education, 3rd Ed. (February 16, 2008). For background information on the topic, go to EH.Net*Encyclopedia* mitch.education and read "Education and Economic Growth in Historical Perspective" by David Mitch, University of Maryland Baltimore County.

The other two articles appeared in the 4 March 2008 (p. 29) issue of the Wall Street Journal newspaper and the issue of 25 February 2008 (p. 17) of the Business Week Magazine. The newspaper article was a story on the research article "Education and Economic Growth" with a headline: "Smart kids, higher GDP" and a sub-headline that read "Study links skills in math and science to economic growth." It reported the gist of the research study in a journalistic style of writing, which included comments by the principal author (Eric Hanushek) and another economics professor at New York University. The magazine story was published on its regular feature page called "Numbers" with a title "Education: The next generation of U.S. workers is falling behind." It included a short (four-sentence) paragraph and four graphic illustrations, depicting the educational profile of U.S. students in a rather unfavorable tone.

The scores on the readability tests (http://www.joeswebtools.com/text/readability-tests/), of the research article are as follows:

The Flesch-Kincaid reading ease score is 47.3 (0 to 100, higher is best)

The Flesch-Kincaid grade level is 11.3th grade

The participants got a hard copy of the Education and Economic Growth article a week in advance. They were told to read it and to be prepared to answer some questions in the following week. They also had access to the Internet website in case they wanted to search for extra information. They were encouraged to consult any reference sources, discuss the article with peers, and prepare all necessary notes for use during the exam period. They were briefed on the nature of the exam questions that would require them to infer, analyze, synthesize and

evaluate the information based on that set of articles.

Participants spent three hours answering the comprehension questions. The questions were intended to elicit information on syntax, vocabulary, writing style and tone, text structure, main idea, the writer's purpose, evaluating opinions, analytical ability, and critical ability.

The researcher scored the answer against the suggested answer key. Each of the 24 volunteered participants, or 27 percent of participants in the study, spent approximately half an hour, talking to the researcher in Thai. The interview was meant to verify the written answer and to probe the extent of strategy use, a triangulation attempt to ascertain the validity and reliability of collected data.

4. Results

Research Question 1: Inference Skills Necessary to Comprehend the Research Article

Subjects perceived the overall difficulty of this research article at 84 percent (extremely difficult). They mentioned lack of prior knowledge as the main cause of text difficulty. Only seven out of 88 subjects (7.95 percent) stated that they had background in economics, education, research method and/or statistics. Of those without relevant schemata to infer necessary information, 61 percent cited lack of knowledge to make sense of figures, especially Figures 3 and 4, and other statistics. About a third of the subjects confessed having difficulty associated with prior knowledge of economics. About a fifth mentioned a lack of knowledge about the U.S educational system. A number of subjects (14.77 percent), however, perceived the article as well-organized, thus relatively easy to understand.

Table 1 summarizes the results that answer the first research question:

Table 1. Percentage of Acceptable Answer on Each Inferential Comprehension Factor

Factor	Percentage
Explicit Main Idea	94.32
Lexicon	85.23
Syntax	73.86
Summary of the Section	63.64
Discourse	58.96
Style and Tone	33.34
Implicit Main Idea	3.41

Main Ideas

The researcher looked at three components of the main ideas: the central theme, the thrust of argument and a summary of a section in the journal article.

The central theme as manifested in the caption ("It's not just going to school but learning that matters.") was explicitly stated and repeated nearly ten times throughout the whole article. Subjects, therefore, did not have any difficulty getting the theme. Less obvious to most of them was the underlying argument, represented in a cause-effect fashion as: *governors' pledge → educational reform → failure → more attempts required → competitiveness → higher GDP*.

The results showed that most subjects had no problem with the explicitly stated theme. However, inferring the underlying argument proved problematic. Only a few subjects were able to link the ideas and to formulate the complete chain of argument. The data collected did not probe into whether the subjects understood the section headings.

Instead of asking the subjects to summarize the whole article, the researcher minimized their task load by targeting on only one section under the heading "More Rocket Scientists or Basic Skills for All?" The subjects were asked to summarize this section in one sentence using a maximum of 30 words. The purpose of the task was to probe the subjects' ability to read for the main idea and to interpret and express it in their own words of understanding. The results showed that nearly two-thirds (63.64%) could perform at a satisfactory level. Three examples of acceptable response were quoted:

"It is recommended that countries focus on human capital in both students with high performance level and those with the basic one because both are important to economic growth."

"Any country aiming at economic health should produce an army of intellectuals and make basic education

attainable to everyone at the same time."

"The country needs both elite scientists and basic-skilled people to make the GDP grow."

Writing Style and Tone

A third of the subjects correctly described the writing style and tone. They identified the writing style as formal and informative with well-supported evidence presented in the forms of sophisticated statistics and graphs. A good number of the subjects used the word "concern" to describe the authors' attitudes toward the quality and competitiveness of the U.S. education, pointing out the emphasis the authors placed on the acquisition of cognitive skills (rather than school attainment) as a more accurate index of economic growth. A much smaller number was able to justify their answer.

In general, this particular group of subjects failed to analyze other aspects of the writers' attitudes. Most noticeably was an optimism and determination to find ways to make American students perform better in comparison to high achievers whose average scores in math and science exceeded the American peers by 50 points. The subjects also missed identifying the cautious tone the authors consistently employed when linking educational achievement to economic growth. The results obviously showed the subjects had a limited view of analyzing the tone of the article.

Another interesting finding was that most subjects seemed to be confused about tone and the writers' purpose. Many used "to inform" or "to convince," which indicated the intended purpose rather than the attitudes underlying the authors' message.

Discourse

Most subjects (58.96 percent) displayed an ability to identify each major sections of the research article. Nearly a quarter of subjects (23.86 percent) wildly guessed at the answer without any definite idea of how to dissect the whole article into separate and distinct sections. Most subjects found the methodology section part the easiest to identify. Similarly, the results part presented no difficulty. On the other hand, the statement of the problem and the research hypothesis proved harder to ascertain. Virtually all subjects failed to realize that the introduction section generally includes the justification of the problem being investigated, the literature review, as well as the hypothesis. The most difficult section of the article was the discussion. The subjects showed high uncertainty where the discussion section began or ended.

The interview data confirmed that the subjects were doubtful when dissecting the various sections in the research article. Some successful ones pointed out that they sequentially divided the article relying on the section headings, exhibiting an awareness of strategy use to increase comprehension of a challenging text.

One particular subject (Subject #29) correctly stated the hypothesis: "The accurate measure of human capital is not the school attainment but the level of cognitive skills."

Lexicons

The two lexical items "skirted" and "heart" that were tested appeared in a phrase "have skirted the heart of the question." Both words being commonly known, the reader had to infer their figurative meaning as dictated by the context. As a verb, "to skirt" means to go around the edge, and the "heart" of the question is the most central point. The definition is to avoid talking about an important subject, especially because it is difficult or embarrassing: *a disappointing speech that skirted around all the main issues* (Longman Dictionary of Contemporary English, Third Edition, 2000, Essex: Pearson Education Limited, p. 1347).

None of the respondents in this study had any problem with the word "heart." A small number of them (approximately 15 percent, that is 13 out of 88) failed to provide a satisfactory synonym for the word "skirted."

The written answer to the test item showed that many students consulted dictionaries for the meaning of both words. Some specifically stated in the answer that they did look up the meaning in the dictionary.

The interview data revealed other vocabulary words that were perceived as hard words for a number of subjects. The list included "empirical," "cadre," "tentatively," "substantially," "cognitive," "K-12," and "rocket scientists." Some subjects labeled abbreviations, such as "OECD," "PISA," "K-12," and "GDP," as jargons or technical terms. They felt that these words were obstacles to comprehension.

Syntax

Three quarters of the subjects (73.86 percent) paraphrased the statement "The Bracey critique is not entirely misplaced" accurately. About 15 percent misinterpreted the statement.

The researcher also investigated the use of pronoun reference in the news report (see Appendix WSJ Smart Kids,

Higher GDP). A few subjects demonstrated clear understanding of what specific idea the pronouns stood for.

Most answers indicated the general main idea that is referred to, but they lacked specific key words or phrases (e.g., *ways and means, approach, instructional methods/techniques*) to express it.

The figure below shows the summary of the results. Extrapolation of results earlier reported was carried out and transformed as a nine-point scale from 1 (easiest) to 9 (hardest). This is meant to show the relative degree of challenge the research participants experienced in comprehending this set of reading materials.

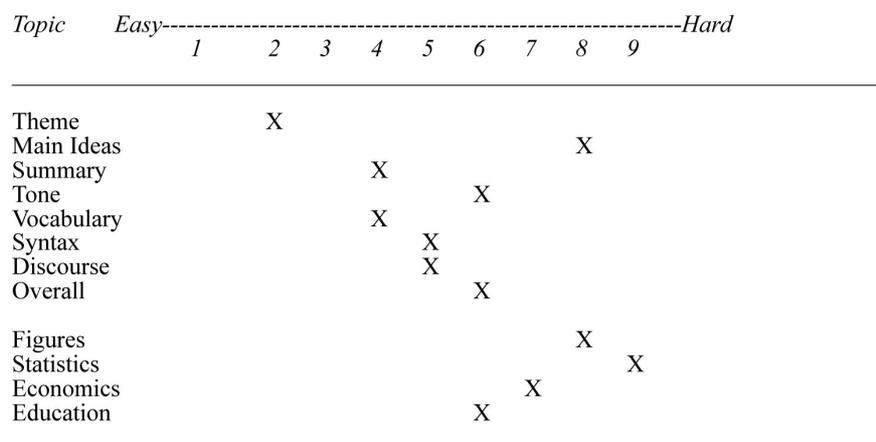| Topic	*Easy*---*Hard*								
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Theme		X							
Main Ideas								X	
Summary				X					
Tone						X			
Vocabulary				X					
Syntax					X				
Discourse					X				
Overall						X			
Figures							X		
Statistics								X	
Economics							X		
Education					X				

Figure 1. Degree of Comprehension Ease for Each Topic

In a nutshell, the subjects found this research article to be relatively difficult to read. The main contributing factors resulted from lack of prior knowledge. The subjects acknowledged the fact that unfamiliarity with technical terms in the field of education and economics considerably hindered their comprehension. The quantitative demands on deciphering Figures 3 and 4 were overwhelming, albeit ameliorated with helpful elucidation from some more knowledgeable peers. The statistical method employed to link the level of cognitive skills to economic growth was the hardest part to comprehend. The text, although quite comprehensible, was lengthy. The vocabulary was not a major problem, nor was the syntax. The complexity of ideas and the technical presentation style demanded close reading and concentration, making reading laborious to virtually all subjects.

Research Question 2: Inference Strategies for Coping with Text Difficulty

In the following section, I report the findings that answered the second research question: the problem-solving strategies subjects employed to comprehend the article.

As dictated by the research procedure, the subjects read the article individually and formed their own discussion groups to exchange ideas. A majority of subjects held at least one discussion session in a small group of friends. Many joined a peer tutorial session in which they shared, confirmed or modified their understanding. They also had someone who possessed the domain knowledge explain the more technical aspects of the article content, for example, the standard deviation (s.d.), the gross domestic products (GDP), K-12 education, rocket scientists, and Figures 3 and 4. Most subjects interviewed stated that the tutorial and group discussion sessions were helpful and contributed to better overall understanding.

The interview data showed that the subjects spent hours, or even days, to read and reread the article in preparation for the exam. All participants frequently used dictionaries to look up the meaning of unfamiliar words to make sure they understood each part well.

One particular subject revealed that he did not read the whole article. He remarked it was too long. He only read some parts and felt confident that he had enough information to answer the exam questions. He failed to elaborate how he decided what was important to read and what was not.

Data from the semi-structured interview indicated that most subjects concentrated on local strategies to comprehend the articles, processing text primarily in a bottom-up manner. They spent hours looking up the meaning of unfamiliar words when they started reading on their own. If they did not get a satisfactory answer from the dictionary, they consulted with friends. Virtually all subjects acknowledged peer assistance for the explanation of words like *K-12 education* or *rocket scientists* as they were not listed in dictionaries.

The interview data also confirmed that subjects had a discussion with peers on the meaning of *have skirted the heart of the question* and the interpretation of the statement *the Bracey critique is not entirely misplaced*. It is obvious that subjects relied on bottom-up processing as they began reading the research article with anticipation of the exam questions.

On the other hand, subjects neglected the use of global strategies when it came to answering the fifth exam question: identifying where each major part of a research article began. None of the interviewed subjects anticipated this type of question, nor did anyone raise the question for discussion during the peer tutorial session. More surprisingly, few subjects realized that the answer to the question had some connection to the format of a research article and the major headings.

I will briefly summarize the results of this study and discuss some interesting points concerning the findings, The last part of this chapter is the recommendation for further studies.

5. Discussion

5.1 Summary of Results

In conclusion, the researcher used a set of articles on education and economic growth to investigate graduate students' inference ability with an aim to determine necessary strategies needed to better comprehend challenging texts. The approach adopted in this study simulated the task graduate students had to go through in order to learn new information as well as to display their learning in written and oral communication. The subjects had enough time to read, resources (dictionaries/Internet websites) needed to maximize their understanding and the opportunity to discuss the matter at hand with peers. The focal point of investigation was the inferential and critical levels of understanding. The findings revealed that subjects usually relied on their bottom-up mode to build up meaning through lexical and syntactic processing. They read carefully and looked up word meaning from dictionaries. They skipped difficult parts that they failed to make sense of, especially technical information and graphic illustrations. Next, they sought help from friends to mitigate these problems. They were successful at interpreting the thesis statement, the gist of the *rocket scientists* section, the meaning of the target vocabulary items (*skirted the heart of the question*) and clause (*the Bracey critique is not entirely misplaced*). However, they were less successful at inferring the underlying argument, tone of the article and attitudes of others toward the research findings, pronoun references, discourse structure, and linkage of major ideas signaled through headings and implicitly suggested by research article format of presentation.

5.2 Discussion of Results

In this section I attempt to describe an ideal approach to reading a research article based on the information gained from this current study. I stress the importance of automatic processing of text (instantaneous recognition of words, sentence structures and text organization), on one hand, and the active role of the reader to interpret and evaluate what is read, on the other. I also recommend training in strategy use to promote efficient reading.

Linguistic Ability: Automatic Processing of Text

Research articles, by nature, are inherently difficult to read. They contain technical information, written by specialists and are intended for a specific group of audience possessing similar specialized knowledge. The language is concise, and the presentation format follows a well-established convention. Reading a research article in a foreign language is undoubtedly a daunting task. A non-native reader has to overcome linguistic limitations while trying to digest pertinent new information. Thai students, like Norwegians college students as reported in Hellekjaer's study (2009) faced many unfamiliar words. As a result, they consulted a dictionary or asked other students, a disruptive, yet persistent, practice to wean from. The findings confirmed the fact that vocabulary knowledge is tremendously crucial in comprehension and any second language reader needs to develop both reading fluency and accuracy (Nation 2008; Grabe 2009; Koda 2004).

Compared to vocabulary problems, subjects perceived that syntax presented less difficulty. Pronoun reference, nonetheless, remained a problem to many subjects that read locally and failed to process text across the sentence boundary. Perhaps the severity of syntactic uncertainty was not as acute as an absence of the concept due to an unknown word.

It is quite apparent from the data that subjects lacked the experience or skill needed to handle a journal article. They tackled the long text from beginning to end as a complete whole. Many subjects admitted that it was their first time reading something academic, this long and absolutely not of their own choosing. The task of mapping out portions of the article to headings (such as the statement of the problem, hypothesis, method, results and discussion) was too confusing to carry out. They sensed that the first two parts (research problem and hypothesis) preceded the method that was relatively easy to identify. They had confusion differentiating between the research

problem (i.e., what is a better measure of education that has great impact on the country's economic growth rate?) and the problem economists had (i.e., using school attainment or years of schooling). Consequently, many subjects offered as their answer any problem mentioned in the article the research problem. The research hypothesis (i.e., the cognitive skill level, which the test scores on math and science represent, is a better index for economic growth rate than years of schooling) was never explicitly stated, and it was difficult to infer. Indeed, the data showed that one subject was able to do so. Therefore, it is assumed that learners could be trained to infer and fill in the missing gap of understanding.

The method part, although easy to identify, was a hard piece to digest. Subjects were not asked to explain the research method; those being interviewed were unable to delineate satisfactorily how the researchers obtained the data for their analyses. The results, on the contrary, part presented no problem.

The discussion part proved the hardest to identify. After having read thus far, most subjects were unable to maintain their interest or energy to fit this puzzle neatly into the whole picture. The headings should have helped to alert some subjects, particularly if they had employed a more top-down approach to drive text meaning. The discussion in this research article is not quite typical in the sense that it does not follow the convention, i.e., summarizing the main findings first before extending the idea further. It just goes on and on without any introduction or transitional message.

The Reader's Prior Knowledge

My findings are in line with Koda's concludion (Koda, 2004) that technical or specialized knowledge is more essential to comprehension than linguistic knowledge. Participants with schemata of the U.S education, economics and statistics could infer needed information to enrich their understanding of the text much better than those without such knowledge. The acquisition of prior technical knowledge is a pre-requisite for interpretation, especially as the text gets more challenging.

From the interview data, a few subjects with prior knowledge acted as resource persons explaining technical concepts to those unable to interpret such phrases as K-12 education (kindergarten to grade 12), No Child Left Behind (legislation to help every child to learn), or rocket scientists (high achievers of academic learning). The subjects that had studied statistics were able to tutor friends on the concept of standard deviation and normal curve distribution. Many subjects benefited from peer coaching on how to interpret the figures. They learned that each dot in Figures 3 stands for an individual country included in the study, the steepness of the slope line reflects the rate of economic growth rate, and the cluster of dots along the line indicates the strength of relationship. They also learned that the intersection of education spending and reform curves in Figures 4 indicates the cost-effectiveness of investment.

Training in Use of Strategies

The findings confirmed needs for training in use of strategies when reading a challenging text for graduate students. Because skill development is a pre-requisite of effective strategy use (Hellekjaer, 2009; Paris, Lipson & Wixson, 1983), extensive reading is a must. Extensive reading should be encouraged or even required to build up reading accuracy and fluency (Grabe, 2010). Extensive reading in various disciplines is necessary to build broad-based schemata that will eventually help speed up reading.

In order to cope successfully with challenging texts, graduate students will have to apply strategies as outlined in the book by Wiener & Bazerman (1991). Specifically, they could benefit from adopting the SQ3R (survey, question, read, recite and review) technique when reading for academic purposes. By following the before-, while- and after-reading procedural steps, they could approach their reading selection with a firm reading purpose, make a sustained effort and boost their learning with a concrete product of own understanding.

6. Recommendation for Further Research

Shorter research articles complete with an abstract and references should be selected for further studies. The research article under investigation seemed too long and complicated to monitor which strategies the subjects used at each stage of reading. It was also not complete, i.e., without the conventionally accompanying abstract and references. Shorter reports will lessen the reading demand and allow the researcher to explore how the reader processes information at different stages of reading. The complete format of the short research article permits the researcher to observe more intensively what the reader does at the pre-reading, while-reading, and post-reading phases. They will also be more practical to conduct studies using a read-aloud technique of data collection.

A case study might prove more fruitful in extracting meaningful results. Limiting the number of participants to a manageable size should be more feasible to monitor each participant's reading behavior and use of strategies. An

ideal selection of participants would be those needing to read research articles to fulfill their research requirement for a graduate degree. A small number of participants, preferably from the same field of study, would be sufficient to generate rich research data.

It is also recommended that a longitudinal study should be conducted to follow up on accumulated skills needed to read research articles efficiently. A cross sectional study could hardly yield reliable data to reflect changes in strategy use. Working with a few participants with well-defined needs to conduct a research study for an extended period of time would produce a clearer picture of strategies required of a successful reader of research articles.

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