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Graph Writing Test Taking Strategies and Performance on the Task: The Role of Academic Background

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Abstract
The growing inclusion of integrated writing tasks in assessment batteries calls for more research studies to investigate these tests. Although previous studies have largely concentrated on reading-writing tasks, relatively little attention has been directed to graph writing tasks. Drawing upon Yang's (2012) model which explored the relationship between performance on the graph writing test and the graph writing test taking strategies of L2 writers, the present study aimed at investigating the relationship between Iranian EFL learners' graph writing test taking strategies and their performance on the graph writing task. The participants (N=300) of this study were from two academic backgrounds: Humanities (N=150) and Engineering (N=150). Firstly, the participants took a graph writing test followed by a graph writing strategy inventory including graph comprehension, graph interpretation, and graph translation. It was found that graph writing scores have the highest correlations with graph interpretation whereas graph comprehension and graph translation have low correlations with graph writing scores. The scores of the Engineering group had the most notable correlation indices with the selecting (SEL) and linking (LIN) strategies. For the Humanities group, the highest correlation indices were related to global processing (GP) and selecting (SEL). Local processing (LP) strategy did not have a significant correlation with writing scores in this group. The results could be valuable in making informed decisions about integrated writing task development, instruction, and evaluation.
Keywords: graph writing strategies, graph writing test, academic background

INTRODUCTION

Academic writing is assumed as the core competency in colleges and universities. An adroit student, who is capable of writing impeccably, can communicate his knowledge with the members of academia and will not lose his opportunities in conveying his thoughts and ideas because of his shortcomings in writing skills. Additionally, failure in academic studies can be another outcome of poor skills in writing. Interestingly, writing

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in academic contexts necessitates the identification, synthesis, and manipulation of the information presented in different sources. As a result, writing from sources is of great value (Campbell, 1990; Leki& Carson, 1997). Integrated writing tasks seem to pave the way for the elicitation of students' ability to incorporate several sources. These tasks are supposed to enhance validity, improve test fairness, and bring about positive washback effects on language teaching and learning (Cumming, Grant, Mulcahy-Ernt, & Powers, 2004; Weigle, 2004; Cumming et al., 2005). Compared to conventional writing tasks, assessing writing in the integrated form seems more authentic (Lewkowics, 1997; Wesche, 1987).

Graph writing task is a kind of integrated writing which requires the comprehension of the information presented in graphs and the reconstruction of visual information in to written form (Yang, 2012). According to Hyland (2006), many academic accomplishments demand the ability to analyze graphs. The increasing use of graphs for the presentation of data in a concise, comprehensive, and eye-catching manner calls for due attention to the importance of graphicacy in English. To fulfill a graph writing task, students are required to consolidate their capabilities in the analysis and interpretation of graphs. In order to decipher graphs, it is necessary to engage in strategies encompassing global and local processing, linking, organizing, planning and evaluating (Yang, 2012). Acquiring writing ability in academic contexts is the impetus for those who wishfully plan to continue their education abroad, and interestingly the ever-changing nature of learning challenges communicative competence (Hyland, 2006). For instance, the presentation of information in the form of graphs, tables, and charts in conferences, seminars, and lectures has been recently accounted for transferring data efficiently. These forms of visual chunks have made it convenient to convey a lot of information succinctly. Together with brevity, these illustrations seem to also facilitate comparison and contrast of different elements being discussed. It is worthy to mention that this area in academic writing is in need of more elucidation because literacy in graph comprehension and description is assumed to be instrumental in the accomplishment of some expert reports and projects.

Interestingly, the format of graph writing tasks can have an effect on test takers' performance whose level of proficiency is equal (Xi, 2005). For instance, regarding most of the humanities students, their uncontrolled mathematical anxiety may reveal itself in the performance on graph writing tasks. In other words, lack of graph familiarity may affect their comprehension and description of graphs (Xi, 2010). Therefore, dealing with the interpretation of the information presented in the form of graph seems to be a laborious task for those who have difficulty in understanding mathematics or at least are not at ease with digits and numbers. Consequently, it may be speculated that academic background can influence the performance of such tasks. On the other hand, given their acquaintance with numerical representations, test takers with engineering background seemingly accomplish these tasks with consummate ease. Admittedly, EFL learners, irrespective of their fields of study, should be accommodated with necessary skills and literacies in order to live up to new academic standards and expectations and be fully prepared for diverse demands of workplace that is in search of qualified

graduates with technical and communicational abilities (Hyland, 2006). Therefore, this study investigated the performance on a graph writing task and the strategies exploited by test takers regarding different academic backgrounds.

LITERATURE REVIEW

Assessing Academic Writing

A number of high-stake writing tests have replaced discrete-point assessments with those which are based on performance and more authentic performance-based assessment (Grabe & Kaplan, 1996). These new forms of assessment make it possible to estimate how students use language in real-life situations since they are obliged to fulfill a real-life task (Jones, 1985). Unlike conventional writing tasks, academic writing ones consist of some assignments which are a combination of reading and writing (Whalen & Menard, 1995). As a result, the urge for authenticity has been the impetus for inclusion of integrated writing tasks in assessment batteries (yang, 2009). The incorporation of integrated writing tasks can be beneficial in several ways. The resemblance of these tasks to the real-life ones in academic contexts brings about the opportunity to predict examinees' performance on academic writing in future (Yang, 2009). Additionally, the authenticity of these tasks offers positive washback effects (Weigle, 2004; Wesche, 1987). Moreover, the provision of stimulus material enhances test fairness since examinees are not affected by lack of information on the topic (Read, 1990; Weir, 1993).

Integrated Writing Strategies

According to Grabe (2001), the completion of integrated writing tasks including reading-writing and reading-listening- writing tasks encompasses the capability of task goals recognition, source material manipulation and the integration of information. From a constructivist perspective, the interaction between writing and sources can be delineated. According to Spivey (1990), organization, selection, and connection take place for meaning construction.

In an effort to investigate evaluating strategies, Esmaeili (2002) examined ESL adults' strategy use when the test includes thematically- related reading and writing. His findings demonstrated that many students reconsidered their previous goals and thoughts; moreover, they made local and global changes to written texts.

A number of studies have examined the interaction of reading and writing strategies in reading-writing tasks. Plakans (2008) identifies three categories of reading strategies including goal-setting, comprehending the source texts, and mining information for use in writing. Each category constitutes a number of strategies. Plakans (2008) proposed a model involving two phases of writing: preparing to write and writing. In another study, Plakans (2009) explored the relationship between writing performance and reading strategies. As the results revealed, the high-performance group of participants made use of a wider range of strategies; additionally, they employed more global reading strategies like mining strategies in order to extract information from source texts. The lowest performance group utilized more word-level reading strategies and rarely made

use of mining strategies. The findings of Plakans' both studies divulge elaborate connections among writers, strategy use, task characteristics, and source texts.

Yang (2009) examined integrated writing tasks. She sought to investigate the relationship between test takers' strategy use and their performance on a reading-listening-writing task offered in TOEFL iBT. She found that self-regulatory strategy use, rhetorical strategy use and test-wiseness strategy use are the three important strategies used by the test takers.

Graph Writing Studies

Despite the contribution of several studies to the understanding of instrumental operations of reading–writing tasks, graph writing tasks especially in L2 writing and language assessment literature have rarely been investigated. Carswell, Emery, and Lonon (1993) examined thought processes during interpretation of line graphs. They reported that viewers were engaged in both local and global integrations. Most of the studies on graph writing have focused on description and interpretation of graphs. Studies exploring the main processes involved in graph comprehension suggest three key processes as follow: encoding of key features of a graph, associating the features with graph schemata, and connecting the features with specific graph referents (Bertin, 1983; Carpenter & Shah, 1998; Kosslyn, 1989; Lohse, 1993; Pinker, 1990). Curcio (1987) investigated the comprehension of mathematical relationships in graphs. This study dealt with first language graph writing. In his view, three components are involved in graph comprehension: literal reading of the presented input, "reading between the data" which is in need of comparisons, and "reading beyond the data" including making predictions and inferences. Later, Friel, Bright, and Curcio (2001) expanded the notion of graph comprehension by defining three essential areas in graph perception. Additionally, they introduced a new construct under the name of "graph sense". Kosslyn (1989) maintained that there are four constituents in a graph or display including background, framework, specifier, and labels. Moreover, semantic, syntactic and pragmatic analyses are required for understanding graphs.

In an attempt to address construct irrelevant factors in graphs, Xi (2005) carried out a construct validation study. He investigated testees' characteristics including graph familiarity and the characteristics of the task encompassing the number of visual chunks, and familiarity with graph. He concluded that the mentioned characteristics affect cognitive processes in the comprehension and description of graphs, and the gained scores. He found out that graph familiarity is a potential source of construct-irrelevant variance. Additionally, the reduction of visual chunks and allocating time for planning could lessen the effect of familiarity with graphs.

Later, he extended his investigations in this regard. He claimed that less familiar participants with graphs tended to be weaker and less organized in their descriptions. Moreover, he found that allocating time for planning and reduction of the complexity of graphs could mitigate the effect of the familiarity with graphs (Xi, 2010).

Despite scarce literature on how writers approach graphs in language testing contexts, a few IELTS validation studies have been conducted (Bridges, 2010; Mickan, Slater, & Gibson, 2000). There are two studies for the validation of the first writing task of academic IELTS. Mickan et al. (2000) investigated the response validity of the writing subset of the IELTS. They studied the readability of test prompt together with discourse and pragmatic features influencing the comprehension of the prompts. Verbal protocols and interviews after the test provided the necessary data for this study. They found out that lexico-grammar and purpose of the test prompts affected the readability; besides, socio-cultural features were influential in the comprehension of the prompts.

Bridge (2010) investigated the cognitive validity of the first task of academic IELTS. To this end, he explored the cognitive processes involved in completing this task, and six steps in writing were identified: macro-planning, organizing, micro-planning, translating, monitoring, and revising. His findings indicated that test takers utilized all the strategies, but organizing was used less than the rest. The study indicated that the first task on academic IELTS is more of a knowledge telling one.

Yang (2012) attempted to probe into the nature of strategies used in a graph writing task; because there were not studies on the strategies employed by test takers in completing such writing tasks. To examine the construct validity of graph writing tasks, she studied the relationship between the strategy use and performance on a graph writing task. She considered the validity issues of graph writing tasks, and proposed a model revealing the strategies used in such a task. The participants were 315 freshmen with intermediate to high-intermediate level of proficiency. Her instruments encompassed a graph writing strategy inventory, a graph writing task, and open-ended questions. She maintained that graph writing ability is associated with graph-comprehension, graph-interpretation, and graph-translation. As far as the relationship between graph writing strategy and performance on the task was concerned, she admitted that graph-comprehension and graph-interpretation had no direct effect on the performance whereas graph- translation influenced graph writing ability significantly.

Assessment Criteria for Graph Writing

Analytic scoring has been regarded as a useful manner of measuring strengths and weaknesses of L2 language test takers having uneven developmental proficiencies across different aspects of writing (Raimes, 1990). Despite of scarce research investigating various features of L2 graph writing, a number of L1 graph processing theories have brought about useful information about necessary skills for graph comprehension and interpretation: ‘‘read the data,’’ ‘‘read between the data,’’ and ‘‘read beyond the data’’ (Curcio, 1987; Friel et al., 2001). The skill to ‘‘read the data’’ is in need of extracting key ideas from the graphs; the skill to ‘‘read between the data’’ centers at finding links between different pieces of graphical information; and the most advanced skill is to ‘‘read beyond the data’’ which needs extrapolation from the data. The IELTS rating criteria reflect these requirements as well. In a rubric validation study, it was found out that effective test-takers should take five steps: the identification of major

features of the graphs, the provision of sufficient details to describe those features, reporting trends and supporting details accurately, comparing and contrasting the graph information, and presenting an organized response (Shaw and Falvey, 2008). Likewise, the advanced level of the GEPT requires examinees to summarize the visual inputs, explain possible causes, and make recommendations for the events (Yang, 2012). Language use and organization along with content are the judging criteria of these tests. These studies have established a basis for understanding test-taking strategies and rating criteria used in assessing graph writing. Following Bachman's (2002) recommendations for test validation, yang (2012) delved in to graph writing by collecting data both on strategy use and test performance.

The Role of Academic Background

A few studies have been conducted in order to investigate the effect of academic background on test performance. In one of the earliest attempts, Alderson and Urquhart (1985) carried out a study to investigate the effect of students' academic discipline on their performance on ESP reading tests. The results of their study indicated the important role of academic background on test performance; however, they maintained that the effects were not consistent; therefore, the researchers admitted that there is a need for more studies to be implemented.

In the same vein, Hale (1988) investigated the effect of text content and major fields on reading comprehension. The results of that study demonstrated an interaction effect between major field and the text content on the scores of reading test.

In another study which is more recent, Pae (2004) with the use of Item Response Theory carried out a DIF study for examinees whose academic backgrounds were different. The finding of this study suggested that the students of the Humanities group found seven items easier while nine items showed favor to the Sciences group. As far as the Listening section was concerned, the items which included job interviews and counting numbers were in favor of the Sciences group whereas items which dealt with human relationships favored the Humanities group (Pae, 2004). Regarding the reading part, Pae (2004) reported that the items the topic of which were a fishing village story, sports, science and technology, data analysis, the story of underwater explorers, and the effect of snow on animals favored the Sciences group. Concerning the Humanities group, however, the items pertaining to the life-story of a scientist, the importance of competition, and friendship were favored.

In a similar trend, Christian Krekeler (2006) undertook a study to investigate the impact of background knowledge in language for special academic purposes (LSAP) tests. His study the study applied the theory of linguistic thresholds to LSAP reading tests considering the fact that the findings of previous studies indicated that background knowledge had a varying effect according to language proficiency level. He reported that background knowledge had a strong effect on the performance of the reading test.

In a later study, Karami (2010) conducted a study to investigate academic background as a source of test bias among the test takers sitting the University of Tehran English Proficiency Test (UTEPT). The results demonstrated that in spite of the DIF items, the total test was not biased to any group; however, these DIF items could create some biased subtests. In conclusion, the study raised questions on the fairness of UTEPT. In a more recent attempt, Karami (2012) employed generalizability theory to explore the effect of academic background, items, persons, and subtests on the dependability of the UTEPT scores. He reported that background knowledge did not influence the examinees' performance, and it was not a source of bias in the UTEPT. As a result, the UTEPT might be considered unbiased against the groups with different academic backgrounds.

THIS STUDY

IELTS academic module is a language proficiency test in which a large number of people with different academic backgrounds participate. Hence, academic background can be regarded as a source of variance that may be not measured by the test. To date, a number of studies have been conducted on the effect of background knowledge on test performance (e.g. Alderson & Urquhart, 1985; Krekeler, 2006; Pae, 2002; Salmani-Nodoushan 2002). Interestingly, nearly all of the studies have shown that background knowledge can have a noticeable effect on test performance.

As a result, this study aims to investigate the underlying constructs of graph writing tasks, and explore the role of academic background on the utilization of graph writing strategies in the completion of a graph writing task. The present study focuses on the relationship of performance on the graph writing task and graph writing test taking strategies with regard to the role of academic background among Persian EFL learners. It is an attempt to answer the following questions:

1. Is there any statistically significant relationship between Persian EFL students' graph writing performance and their test taking strategy use?
2. Is there any statistically significant difference in the relationship between strategy use and performance on a graph writing task among the students of humanities and engineering?

METHOD

Participants

The sample for the present study consisted of 392 EFL learners enrolled in preparation courses for IELTS at Afarinesh institute in Tehran, Iran. As far as the level of proficiency was concerned, their course covered competencies from C1, and C2 levels described in the Common European Framework of Reference. The participants' proficiency level was established either through a placement test before the course, or through passing the prerequisite courses at the institute. The participants aged 19 to 47 (mean age = 27.45, SD = 3.92), and their levels of education varied from BA to MA. Regarding the participants' gender, 35 percent of them were male (N = 105), and 65 percent of them

were female (N = 195). The participants of the current study were divided into two groups: Humanities and Engineering. The Humanities group composed of 150 people equaling 50 percent of the total represented different disciplines including, law, political science, industrial management, journalism, foreign languages and literatures, and economics. The other half of the total had studied Engineering fields such as electronics, industry engineering, software engineering, mechanical engineering, and civil engineering.

Instruments

Three instruments were employed in this study: a graph writing task, the graph writing strategy inventory, and IELTS graph writing scoring rubrics. The graph writing task was used to assess the participants' performance on L2 graph writing, the inventory contributed to the elicitation of information on strategy use, and scoring rubrics helped to evaluate the writing. The aforementioned instruments are enumerated below.

The Graph Writing Task

One of the graph writing tasks pertaining to academic IELTS writing section was utilized in order to observe the participants' performance on the task (see Appendix A). Regarding the fact that IELTS academic module is designated to measure the test takers' language proficiency in academic contexts, the graph writing task was embedded in the writing section to engage the participants in a university-level writing activity which is in need of graph literacy.

To accomplish the graph task, the participants were asked to demonstrate their capabilities in the comprehension and evaluation of the information presented in the charts. Furthermore, they were asked to report the logical relationships. Since the present study is a confirmatory study of Yang's (2012) model, the graph writing task of her study was employed. The selected task is one of the IELTS writing subsets including two common forms of charts, namely a bar graph and pie charts. There was some theoretical evidence for the incorporation of pie charts: First, they were assumed to be the most effective means of stimulating the integration and interpretation of the information (Carswell, 1990; Hollands & Spence, 1992). Second, pie charts made it possible to compare different parts with the whole (Wilkinson, 1999).

In order to tackle the mentioned graph writing task, the participants were required to provide a response based on the illustrated charts; conveniently, they were supposed to summarize the main points and make appropriate connections to address the argumentative task. They were expected to plan and deliver their answers within 30 minutes in 200 to 225 words.

The Graph Writing Strategy Inventory

The inventory (see Appendix B), developed by Yang (2012), was a 6-point Likert-scale one ranging from 'never' (0) to 'always' (5). It had 31 items divided into the following subscales: global processing, local processing, evaluating, linking, selecting, and

planning in order to embrace the strategies associated with each of the mentioned subscales. According to Yang (2012) there were three theoretical frameworks for the taxonomy of the items in the inventory: graph writing (Bridge, 2010, Mikan et al., 2000), graph comprehension and interpretation (Carpenter and Shah, 1998; Carswell et al., 1993), and integrated writing (Plakan,2009; Spivy,1990). Graph comprehension, graph translation, and graph interpretation as the three stages involved in graph writing were the basis of this inventory. This inventory has been validated for validity and reliability in Yang's (2012) study in which explanatory factor analyses were done with 115 pilot participants. Then, it was administered to 315 participants of her study. To assess the reliability the Cronbach alpha was administered. It is revealed that all alpha coefficients are beyond .7; therefore, it is concluded that the graph writing strategy inventory has a good internal consistency.

The Graph Writing Scoring Rubrics

The graph writing scoring rubrics developed by Yang (2012) (see Appendix C) established the framework for rating the graph writing task in terms of content, organization, and language use. As far as content was concerned, highlighting the key features and presenting an overview of the information and their relationships paved the way for task requirements. Regarding language use, mechanics of writing, grammar and vocabulary range are important for evaluation. In terms of organization, logical sequence of ideas and cohesion within and between the paragraphs are criteria for assessment (Yang, 2012).

Procedure

Prior to the implementation of the main study, a pilot study was carried out on 10 participants to check:

1. The appropriateness, and resolution of the graphs presented in the graph writing task.
2. The comprehensibility of the statements in the graph writing inventory.

Based on the information gained through the pilot study, insights were provided as to how to conduct the study; in addition, due to the fact that the statements of the inventory were intelligible for the participants, it was ascertained that the graph writing strategy inventory could be used without translation, since the translation of the inventory would create some problems related to the validity of the study.

Considering the fact that the participants were the students of IELTS classes at Afarinesh language institute, over 20 classes contributed to data collection. Firstly, the participants were asked to fill out a form related to their personal information including gender, age, field of study, and university degree. Then they were engaged in the graph writing task, and they were given 30 minutes to fulfill the task. Immediately after completing the graph writing task, the graph writing strategy inventory was administered, and 10 minutes were allocated for the inventory completion.

In terms of scoring, two raters each with five years of experience in teaching and assessing writing rated the essays according to graph writing scoring rubrics to take care of inter-rater reliability of the scores. It is worthy to note that the raters majored in TEFL. Prior to the rating of the essays, the raters took part in a couple of training sessions so that they could be fully familiar with the scoring rubrics. Afterwards, each of them rated the graph reports independently. Then, the obtained scores were averaged. If any of the assigned scores varied from the average by more than one point, the third rater came in to sort out the incongruity (Weigle, 1999). Then, the relationships between the performance on the graph writing task and test taking strategies regarding different academic backgrounds were estimated. Moreover, the inter-rater reliability of the writing scores given by the two raters was also investigated.

Data Analysis

In order to analyze the data in this study, SPSS version 16 was used. The nature of research questions required correlational analysis. In order to answer the first research question, which deals with whether there is a statistically significant relationship between the participants' writing scores and their test taking strategies, the Pearson correlation coefficient analysis was performed. To investigate the second research question, which focused on the differences in the relationship between the participants' writing scores and their test taking strategies among the students of engineering and the humanities, the Pearson correlation analysis was utilized once more.

RESULTS AND DISCUSSION

Having analyzed the data, the researchers investigated the relationship between graph writing strategies and performance on the graph writing test, and they also explored the differences in employing graph writing strategies in each group. The following table illustrates descriptive statistics of the variables.

Table 1. Descriptive Statistics of the Variables

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Graph Comprehension	300	21.00	49.00	38.4833	6.61733	43.789
Graph Interpretation	300	13.00	36.00	26.8322	5.27545	27.830
Graph Translation	300	21.00	64.00	45.9100	11.47727	131.728
Total	300	58.00	150.00	1.1279E2	21.45196	460.187

With respect to the first research question in the study, the relationship between the participants' writing scores and their test taking strategies was analyzed. The descriptive statistics for the various strategies and the writing scores are displayed in Table 2. It appears that the correlations were low to moderate although all correlations are significant. It seems that the significance of even low correlations is due to the rather large sample size used in this study. It may be concluded that graph writing scores have the highest correlations with Graph Interpretation (as represented by SEL and LIN in table 2). Graph Comprehension and Graph Translation have low correlations with graph writing.

Table 2. Correlations among strategies and writing scores

		GP	LP	SEL	LIN	PL	EVA
Writing Score	Pearson Correlation	.285**	.252**	.442**	.465**	.258**	.296**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000
	N	300	300	300	298	300	300

** Correlation is significant at the 0.01 level (2-tailed).

Considering the second research question in the study, differences in the relationship between the participants' writing scores and their test taking strategies among the participants of the both groups were investigated.

The correlations among various strategies and writing scores are separately displayed for the students of the humanities and engineering in Table 4.5. (p.66). It appears that almost all indices are higher for engineering students. For this group, the differences in correlation indices are most notable in the selecting (SEL) and linking (LIN) strategies which together form the Graph Interpretation component.

For the Humanities group, the highest correlation indices are related to global processing (GP) and selecting (SEL). All correlations are also significant except for the local processing (LP) strategy which does not have a significant correlation with writing scores in the Humanities group.

Table 3. Correlations separately displayed for Humanities and Engineering

Field			GP	LP	SEL	LIN	PL	EVA
Engineering	Writing Score	Pearson Correlation	.245**	.328**	.517**	.634**	.382**	.342**
		Sig. (2-tailed)	.003	.000	.000	.000	.000	.000
		N	150	150	150	148	150	150
Humanities	Writing Score	Pearson Correlation	.389**	.149	.334**	.288**	.228**	.329**
		Sig. (2-tailed)	.000	.068	.000	.000	.005	.000
		N	150	150	150	150	150	150

** Correlation is significant at the 0.01 level (2-tailed).

In terms of correlations, the relationships among the various strategies and writing scores were also investigated using Pearson Correlation. In comparison to Humanities, almost all indices were higher for engineering students. The differences in correlation indices were most notable in the SEL and LIN strategies which together form the Graph Interpretation component. All correlations were also significant except for the LP strategy, which did not have a significant correlation with writing scores in the Humanities group.

With regard to the second research question, the correlation between the writing scores and the strategies employed by each group was analyzed separately. According to the results, almost all indices were higher for engineering students. The differences in correlation indices were notable in the selecting (SEL) and linking (LIN) strategies, which together form the Graph Interpretation component. All correlations were also significant, except for the local processing (LP) strategy which did not have a significant correlation with writing scores in the Humanities group.

CONCLUSION

Concerning the research questions, the relationships among the various strategies and writing scores were also investigated using Pearson Correlation. Question one sought to find the relationship between writing scores and graph writing strategies. The findings suggested that all the relationships were significant, and that writing scores had the highest correlation with selecting and linking which together form the Graph Interpretation component. Therefore, it was concluded that the graph writing task required the test takers to deploy an array of interpretation strategies along with comprehension and translation strategies in order to complete the task successfully.

With regard to the second research question, the correlation between the writing scores and the strategies employed by each group was analyzed separately. According to the results, almost all indices were higher for engineering students. The differences in correlation indices were notable in the selecting (SEL) and linking (LIN) strategies, which together form the Graph Interpretation component. All correlations were also significant, except for the local processing (LP) strategy which did not have a significant correlation with writing scores in the Humanities group.

LIMITATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

First, there are a number of different forms of graphs namely bar graphs, pie charts, etc. It is worthy to mention that the type of graph used in the graph writing task, in terms of its complexity and number of visual chunks can affect the test takers' performance (Xi, 2005, 2010). To propose a comprehensive model, the graph writing task employed in this study has both pie charts and bar graphs.

Second, it will be difficult to assess the level of proficiency of a large number of participants in this study. Therefore, the participants are selected from an institute, and their level of proficiency is determined through a placement test before the beginning of the course, or passing the previous required courses, and their level of proficiency is assumed to be C1-C2 according to the Common European Framework of Reference. It is possible that difference in the level of language proficiency leads to a more comprehensive model. In other words, the strategies which are used by advanced, intermediate, or elementary test takers to complete a graph writing task may be varied.

Given the potential impact of graph familiarity on graph comprehension, interpretations, it is offered to investigate the performance of expert and novice writers. Additionally, the level of proficiency can have a potential influence on graph comprehension, interpretations and translation; therefore, it is also useful to examine how writers with different levels of proficiency attempt graph writing tasks and employ graph writing strategies. Such analysis may pave the way for establishing a more comprehensive model for considering the relationships between graph writing strategy use and performance.

Furthermore, it is worth mentioning that there are many different forms of graph writing tasks with their own specific characteristics. According to previous studies,

interpretation processes vary in accordance with different visual dimensions of graphs (Cleveland, 1993), graph complexity (Trafton & Trickett, 2001), and numbers of visual chunks (Xi, 2005, 2010). Since these task characteristics may influence the product of graph writing, it is recommended that the mentioned issues deserve to be explored in future studies and undergo further investigation. Given the fact that this study was a questionnaire study, only a limited number of strategies were incorporated in the graph writing strategy inventory (Yang, 2012). Definitely, qualitative studies like verbal protocols may shed more light on the writers' mental operations in response to graph writing tasks. Due to the complex nature of graph writing tasks, further studies are required to examine the construct-related issues.

Although this study investigated the relationship between graph writing strategies and the overall performance on tasks, it may seem interesting to explore how different strategies can influence different features of writing ability including language use, connecting and organization.

In terms of social and affective strategies, it may seem useful to investigate the role of motivation, anxiety, and emotion in the completion of integrated writing tasks. Examining such factors can illuminate the nature of such tasks.

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APPENDICES

Appendix A: Graph Writing Task

We would be thankful if you could provide us with the following pieces of information below, before attempting the writing task.

Please do not write your name

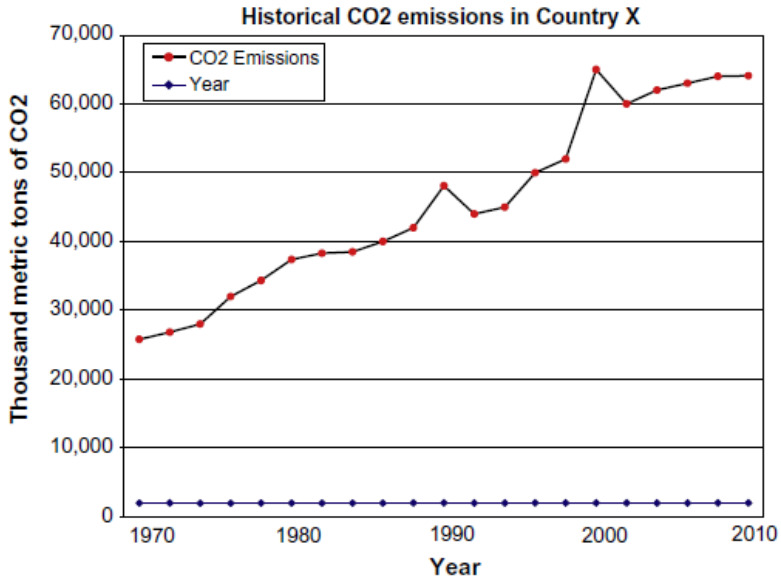
Gender: Female ☐ Male ☐ Age: ……

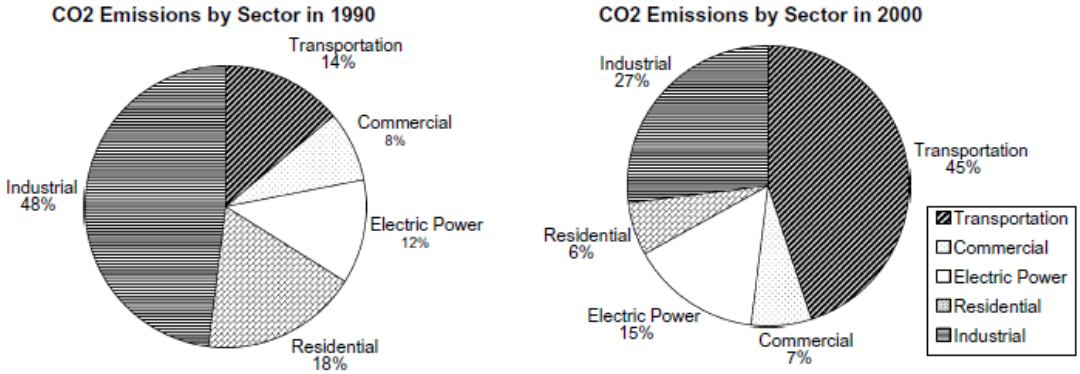
University Major: ……..……

University Degree: BA☐ MA☐ PhD☐

The charts below show carbon dioxide (CO2) emissions in country X between 1970 and 2010 and the percentage of CO2 emissions by sector in 1990 and 2000. Please read the following graphs and:

- Summarize the main ideas from the graphs and make connections where appropriate.
- Discuss possible causes of the events and make suggestions about what could be done to reduce emissions of CO2 in country X.
- An effective essay should be about 200-225 words in length.





Appendix B: Graph Writing Strategy Inventory

What strategies do you use to complete a graph writing task? There are 31 statements that can possibly refer to the strategies you employ in your writing. For each statement, please choose one of the scales: **5=always**, **4=often**, **3=usually**, **2=sometimes**, **1=rarely**, **0= never**. The acceptable answer is what you really do, not what others do or you think you should do. There is no right or wrong answer. Thanks for your cooperation.

	Graph Writing Strategies	0 never	1 rarely	2 Sometimes	3 Usually	4 often	5 Always
1	I thought of what I was required to understand to complete the task.						
2	I thought of how to connect one graph with the others.						
3	I thought of how to write my essay so it would fulfill the task requirements.						

4	I read the title of the graphs.						
5	I tried to identify the relationship between X and Y axes.						
6	I noticed the main differences among the graphs.						
7	I thought of words and phrases I could use to write my essay.						
8	I tried to identify the common trends presented in the graphs.						
9	I first skimmed the graphs for overall meanings.						
10	I summarized the main points in my mind.						
11	I predicted the content of one graph before reading the others.						
12	I thought of what to write in response to the graphs.						
13	I recalled my knowledge about the content of the graphs.						
14	I searched for the relationship among the graphs.						
15	I recalled my knowledge about the structure of the graphs.						
16	I tried to understand what X and Y axes represented.						
17	I analyzed overall trend changes indicated by the graphs.						
18	I described key patterns and trends in my essay.						
19	I reread the graphs to make sure I wrote down their key ideas.						
20	I checked my spelling to make sure my words were correct.						
21	I described the main differences among the graphs.						
22	I checked if I expressed my ideas by using appropriate words and phrases.						
23	I reread my essay to make sure it fulfilled the task requirements.						
24	I made inferences about possible causes of trend patterns.						
25	I checked if I had connected the ideas from the graphs.						
26	I checked my grammar to make sure my sentences were correct.						
27	I checked if I wrote what I meant correctly.						
28	I checked if my ideas were connected smoothly.						
29	I checked if I put my ideas in logical order.						
30	I checked if I expressed my ideas clearly.						
31	I described the maximum and minimum values in my essay.						

Appendix C: Graph Writing Scoring Rubrics

Level	Content	Organization	Language Use
5	• Highlights all key features • Clearly presents the connections between personal opinions and the task	• Presents a smooth logical flow throughout • Uses paragraphing skillfully	• Flexibly uses a wide range of vocabulary and sentence structures • Errors are rare
4	• Presents a clear overview of key features but some of them could be more fully extended • Presents reasonable connections between personal opinions and the task while they may be further illustrated	• Organizes ideas logically throughout • Manages cohesion between or within paragraphs effectively	• Uses a wide range of vocabulary and sentence structure effectively • Makes only occasional grammatical errors, which do not obscure overall meanings
3	• Covers only some, but not all, key features; there may be a tendency to focus on minor details • Presents some connections between personal opinions and the task while they may be unclear or ineffective for the task	• Presents ideas with some organization which may be inconsistent or incoherent • Uses a range of cohesive devices but they may be overused or used inadequately	• Uses vocabulary and sentence structures minimally adequate for the task • Presents grammatical errors which may partially obscure meanings of ideas
2	• Addresses limited ideas which may be significantly misrepresented, irrelevant, or repetitive	• Response lacks logical structures	• Uses only simple vocabulary and sentence structures which may be used repetitively or inappropriately