



**Title of Project:**

Test-takers' Cognitive Processes While  
Synthesizing Multiple Texts and Graphs

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**Final Report**

**Motivation for the Research**

Increasingly, integrated writing tasks are becoming more common in the field of second language assessment. It is widely acknowledged that integrated writing tests can provide a better prediction of how students perform in real-life academic writing tasks (Cumming, Kantor, Baba, Erdosy, Eouanzoui, & James, 2005; Gebril, 2010, McCulloch, 2013; Plakans, 2008; Plakans & Gebril, 2013; Weigle, 2002). There is a rising number of publications on integrated writing concerning its construct validity, discourse types, the effects of borrowing from source texts, and test-taking strategies. However, few studies have been conducted to help understand how some of the different features of the source inputs affect test-takers in integrated writing. The problem is partially explained by the many types of source inputs used for integrated writing. For instance, the TOEFL iBT® requires test-takers to apply their reading and listening comprehension skills into writing. The IELTS®, meanwhile, requires test-takers to write a short descriptive essay based on visual information or data (i.e., tables, charts, and graphs). Yet another test called the TEAP (Test of English for Academic Purposes) uses both multiple texts and two types of graphs as prompts for an integrated writing task. Incorporating information from graphs into integrated writing demands an additional cognitive skill set.

While there are some existing studies on the washback effects of the TEAP writing test (e.g., Nakamura, 2014; Weir, 2014), as well as on the validity of the test through criterion-based approaches (e.g., Chan, Wu & Weir, 2013, Koizumi & Nakamura, 2016), this study was the first to explore the cognitive processes of test takers while completing TEAP reading-into-writing using an eye-tracking device. The outcomes of the study were intended to benefit test developers and teachers by offering a clearer understanding of students' cognitive processes when synthesizing texts and the information from graphs information in the process of producing essays.

**Research Questions**

This study addressed an overarching research aim of exploring the key variables that affect the cognitive process of reading-into-writing tasks such as "What are Japanese EFL test-takers' cognitive processes while completing the TEAP reading into-writing Task B?" Also, four sub-research questions were explored to understand the cognitive process of integrated writing tasks among the L2 writers. These questions are as follows:



- (1) To what extent do test-takers incorporate information from the multiple texts and the graphs?
- (2) To what extent do the features of the graphs (e.g., line graph vs. bar graph) affect the cognitive processes of integrated writing tasks?
- (3) What role does language proficiency play in integrated writing tasks?
- (4) What kinds of test-taking strategies are used for integrated writing tasks?

### **Research Methodology**

The existing literature on the TEAP has used mostly questionnaire surveys and stimulated-recall interviews as research methods. Indeed, much of the previous literature investigating cognitive processes has depended on a conventional think-aloud method. These days, however, eye-tracking technology is used in combination with a qualitative method for it provides additional insights into the cognitive processes of integrated writing. For example, Brunfaut & McCray (2015) used an eye-tracker with a stimulated-recall method to validate each component of the Aptis reading test that mirrored global processing, text processing and task processing at different CEFR levels. Most recently, Yu, He, & Isaacs (2017) also used the eye-tracking device to investigate the cognitive process of graph-sourced writing in combination with retrospective stimulated individual interviews as well as focus group discussions.

This study also adopted an eye-tracking method to investigate the eye movements of the test-takers (N=38) that reflected their behaviors and decision-making processes. The participants' ages ranged from 15 to 18 years old with at least three years of English language education in junior high school and two or three years in high school depending on their grade at that time. By using an eye-tracking device this study combined with qualitative results from questionnaires and focus groups discussions. This mixed-methods approach was taken to reduce the risk of misinterpreting the eye-movement results.

The study consisted of four phases: (1) analysis of the participants' reading and writing proficiency levels using the Aptis test scores, (2) analysis of two sets of integrated writing tasks collected by the *Tobii* eye-tracker (TX300), (3) analysis of the decision-making processes by means of cognitive processing questionnaires, and, finally, (4) analysis of the test-takers' experiences through focus group discussions.

### **Summary of Findings**

The Aptis reading (M=32.35, SD=8.66) and writing scores (M=37.67, SD=9.401) were used as predictors to find any association with eye-movement variables in order to figure out what affects integrated writing processes. To understand the role of reading in integrated writing, Mann-Whitney U test was conducted to compare between the students of upper and lower intermediate English levels.

The main findings of the quantitative analysis suggest that the first ten minutes of eye-movement recordings showed some crucial differences between upper intermediate and lower intermediate level participants. The language proficiency played a major role in fulfilling the task requirements ( $p=.032$ ), essay compositions ( $p=.013$ ) and the title of a line graph ( $p=.031$ ) as measured by Fixation Duration Rate.

In addition, Wilcoxon signed-ranks tests suggested that the participants with lower proficiency tended to rely upon the information from the first few paragraphs based on the Rate of Fixation Duration which calculated the relative amount of time viewing of the Area of Interests (AOIs). In reporting quantitative results, the researcher also acknowledges there was a chance that significant statistical results may not have been accurate due to the repeated testing.



The quantitative results gave further explanations to validate some of the quantitative findings. For example, the qualitative analyses using the gaze-plots in timed segments, students' written outputs, and the questionnaires helped understand test-takers' behaviors, while making the decisions during each stage of the integrated writing task. Gaze-plots, which were made during the first five minutes of recordings, showed that the participants with a lower proficiency did not review the Task Instructions very carefully to identify the purpose of the essay, which was also validated through the questionnaire. The AOI switches of the participants also showed in which order they read the paragraphs from the source texts. Some of these selected cases illustrated how some participants with higher marks read the source texts in order of the paragraphs, whereas some participants with lower marks skipped a paragraph or two.

### **Implications**

This study used eye-tracking to explore any differences in cognitive operations between the test-takers at the upper-intermediate and lower-intermediate levels during integrated writing. First and foremost, the study revealed the importance of familiarizing students with the task requirement. Students who have lower reading proficiency would probably benefit the most from understanding the task requirement and the purpose of the essay in advance. Secondly, this study unveiled that the less successful participants did not read the source texts in order and jump straight to writing the essay. Thirdly, the less able students often showed longer strings of words or sentences copied directly from the source texts. If the information had to be synthesized and reported, it would usually mean that students needed to know how to paraphrase the sentences in their words. Understanding the basic academic knowledge of how to paraphrase sentences and cite sources would be a key area of improvement for the less successful writers.

These findings will be relevant for both students and educators regarding how they should approach integrated writing activities in class. Instead of teaching grammatical sentences and structures by translating between the two languages, teachers should focus on introducing students to more reading materials on a broad range of social topics and on making certain they have opportunities to gain skills in paraphrasing so that they can synthesize information from given source texts and graph information.



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