



Describing and interpreting graphs: The relationships between undergraduate writer characteristics and academic graph writing performance



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ABSTRACT

Although graph-based writing is common in tests of academic English due to its correspondence with the real-world academic writing, a concern, however, has been raised regarding the role of graphic prompts in writing and the proper interpretation of performances on such tests. This study investigates the relationships between writer characteristics (graph familiarity, English writing ability, and content knowledge) and performance on a graph-writing test with two tasks: GD task and GI task. The participants were 234 English as a foreign language (EFL) health science and medical major undergraduate students. Quantitative data from multiple sources were collected, including the graph familiarity questionnaire, the content knowledge test, the English writing test, and the graph-writing test. The findings from structural equation modeling analyses showed that these graph tasks elicit writers' content knowledge and academic writing ability. Overall, graph familiarity had no significant impact on writers' performance on either of the graph task, while content knowledge and writing ability had significant and positive effects on test performance. Content knowledge thus introduced a potential source of construct-irrelevant variance. The study has implications for the development and use of graph-based writing as a measure of academic writing.

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1. Introduction

The launch of digital age has ushered in a growing demand for our capacity to produce, manipulate, and interpret visual and graphical representations of information (Lowrie & Diezmann, 2007). As communication technologies and graphic application software have become more advanced and accessible, students encounter increasingly more complex forms of graphic displays in direct educational contexts as well as everyday life, which makes the ability to manage non-verbal information a necessity in the contemporary society (Shah & Hoeffner, 2002). According to Åberg-Bengtsson and Ottosson (2006), “being graphicate,” like being literate and numerate, is a crucial part of everyday knowledge (p. 43).

In light of the increased role of graphics in the process of obtaining information and constructing knowledge, many educational programs in various disciplines have started to adopt graph tasks as part of their academic writing assignments (Roth, 2003). Quite a few commercial and in-house language tests have also incorporated graph tasks in their assessment batteries (e.g., International English Language Testing System—IELTS, Diagnostic English Language Needs Assessment—DELNA,

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General English Proficiency Test—GEPT). However, a large-scale essay test, the Test of Written English (TWE), started and stopped using these tasks (Golub-Smith, Reese, & Steinhaus, 1993) due to construct-related validity concerns.

Research studies in language testing also seem to have diverged with respect to the use of graph tasks. While graph tasks have been proposed to address authenticity in testing academic writing (Stansfield, 1986), several researchers have cautioned about the multifaceted nature of graph tasks in terms of their potential effects of graph format on graph writing performance (Golub-Smith et al., 1993). As Bachman (1990) and Bachman and Palmer (1996) pointed out, test performance is highly intertwined with test-taker characteristics and task characteristics. Further, they argue that the relationship between test-taker characteristics and task characteristics, termed as “interactiveness,” is an essential element in test validity. Thus one of the most fundamental and pressing issues is the degree to which test-takers’ individual characteristics and task characteristics are involved in completing graph tasks.

Despite the wealth of literature on the influence of test task characteristics and test-taker characteristics on test performance, very few studies investigated such relationship in graph-based language assessments. Among the limited body of studies, most of them were conducted in the context of listening and speaking assessments (Ginther, 2001; Katz, Xi, Kim, & Cheng, 2004; Xi, 2005, 2010) except for Yu, Rea-Dickins, and Kiely (2011). For example, Xi (2005, 2010) found that test-takers’ graph familiarity affected their oral performance on graph description tasks and thus their graph familiarity represented a source of construct-irrelevant variance. In a follow-up study, Xi (2010) suggested that potential predictors of test-takers’ performance also included their familiarity with the topical content of the graphs. Test-takers’ graph familiarity and content knowledge thus raise questions on the validity and fairness of graph-based speaking tasks yet far less is known about how these factors might affect test-takers’ writing performance.

To gain insight into the nature of graph tasks, the present study explores the relationships among graph familiarity, English writing ability, content knowledge and performance on a graph description (GD) task and graph interpretation (GI) task developed for a writing section of an achievement test. The test was administered to health science and medical undergraduate students in a required Freshman English class at the end of the semester. Freshman English course aims to develop students’ academic communication skills including listening, speaking, reading, and writing. The achievement test is included as one of the four measures (students’ writing portfolio, oral presentations, quizzes) to determine whether a student has attained the level of English ability required by the course and whether they need to retake the Freshman English course or other English for Academic Purposes (EAP) courses (e.g., Medical-Nursing English, Medical Technology English) to fulfill degree requirements. The original achievement test did not include a writing section. Given that the ability to describe and interpret graphs is the sine qua non of students in medical and scientific fields (Kosslyn, 1994; Mayer, 1993; Miller, 1998), the inclusion of GD and GI tasks in the new achievement test has been seen as essential to examine whether students are ready for their incoming academic demands.

The GD and GI tasks require test-takers to describe statistical graphs and then make personal interpretations (i.e., suggestions or predictions) based on the data. Since successful performance on the tasks relies on adequate comprehension and interpretation of the graphs, test-takers’ individual characteristics such as familiarity with the graphs and topical content knowledge about the graphs are expected to play some roles in graph writing performance. Among the three factors under investigation, graph familiarity and content knowledge were not defined as part of the construct of the tasks. Because graph description and interpretation tasks were developed to measure whether test-takers have the language ability to describe and interpret graphical data, graph stimuli should be accessible enough so that they can truly demonstrate their writing skills regardless of their levels of graph familiarity or topical content knowledge.

Prior to the official administration of the tasks, more validity-related information should be gathered and the issue of concern be addressed to explore whether these tasks are valid measures of writers’ graph writing ability. As a result, the purpose of this exploratory study was to address the validity issue of graph writing tasks by examining the impact of graph familiarity, content knowledge, and English writing ability on academic graph writing performance.

2. Related literature

2.1. Models of graph comprehension and interpretation

Although a dearth of second language research exists on the role of graph viewers’ characteristics in graphic communication, a handful of studies in cognitive psychology have proposed models to elaborate the influence of viewer characteristics on their comprehension and interpretation of visual chunks in graphical displays (e.g., Freedman & Shah, 2002; Peebles, Cheng, & Shadbolt, 1999). Among a number of models, Freedman and Shah (2002) knowledge-based construction-integration (CI) model provided a comprehensive framework which has shaped the concepts of graph comprehension and interpretation by taking into account viewers’ prior knowledge and expectations. The CI model, drawing on Kintsch’s (Kintsch, 1988) Construction-Integration model and discourse comprehension theory, specifies three dimensions involved in graph comprehension and interpretation: domain knowledge, graphical literacy skills, and explanatory skills. Domain knowledge refers to the content or topical knowledge of graphical information necessary for viewers to make accurate quantitative judgments and meaningful interpretation of the graphical display characteristics. Graphical literacy skill, also called graph schemata (Pinker, 1990), is considered a graphical knowledge used to facilitate “the chunking of the elements” or “the translation of visual descriptions into a conceptual representation” (Freedman & Shah, 2002, p. 25). In other words, viewers with higher graphical literacy skills tend to be less influenced by graph formats and features and thus can make more reasonable

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