



## Validity and Reliability of the Science Motivation Questionnaire II (SMQ II) in the Context of a Japanese University

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### Abstract

*Publication is an obligatory step in scientific research. Scientific writing courses for learners of English as second language are uniquely burdened with the two-pronged objectives of developing the students' language proficiency and skill for critical analysis. Evidence has shown that the likelihood of achieving these objectives is seen in highly motivated students. In the present study, we adapted the Science Motivation Questionnaire II (SMQ II) to understand the motivating factors for first-year students enrolled in a scientific writing course in a research university in Japan. This course focuses on the acquisition of writing skills necessary to publish academic papers based on original research. The SMQ II was adapted and translated from English to Japanese. We assessed its reliability and validity based on the responses of 203 participants using the following statistical indicators: Cronbach's alpha, CFI, GFI and RMSEA. The results revealed high reliability ( $\alpha > 0.8$ ) for the adapted questionnaire. However, we have identified a low congruence to the original model, which warrants further investigation. This presentation will describe how the questionnaire was adapted to the context of this university and how the applied changes influenced the validity and reliability of the questionnaire.*

Keywords: motivation, academic writing, English language learning

### 1. Introduction

Scientific Writing courses are usually challenging for students, especially when the writing is in a foreign language. Learning the many rules that the scientific method imposes to writing while struggling with an unfamiliar language is not an easy task and requires a lot of work from both students and teachers. The likelihood that the desired goals are achieved at the end of the course is, then, susceptible to several intrinsic and extrinsic factors, reflecting on the students' motivation towards completing the required tasks. Assessing the motivation level of students enrolled in writing courses in a foreign language is, then, taken as an important curriculum development step.

Motivation, however, is a complex construct that cannot be completely covered by any single theoretical model [1]. Studies on motivation tend to explore some of the underlying motives regulating motivation constructs, and approaches can vary from investigations on cognitive aspects to behavior processes. One common approach is to assess latent variables of motivational constructs, such as ideas, concepts and behaviors. Glynn et al. [2] have suggested five latent factors (i.e. *intrinsic motivation; career motivation; self-determination; self-efficacy; and grade motivation*) to describe the motivation of students enrolled in science-related courses at college. Glynn's questionnaire [2] was revised and improved in 2011, and renamed the Science Motivation Questionnaire II (SMQ II) [3]. The SMQ II was shown to be valid as an assessment tool for the five motivation latent factors to the specific population (i.e. US public university students) investigated by Glynn. However, one can infer that different results can be expected from different target populations.

The present study focused on a specific English as a Foreign Language (EFL) scientific writing course in Japan. In total, 203 students enrolled in this course were inquired about the five factors described by Glynn et al. [3]. The main research goal was to adapt and validate a questionnaire based on the original SMQ II, but translated to Japanese, to assess students' motivation towards academic English writing. It is estimated that differences in context and language would affect some of the outcomes of the questionnaire.

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## 2. Material and Methods

### 2.1 Questionnaire adaptation

The SMQ II was translated to Japanese and adapted to the context of the investigation, and data was collected using a 5-point Likert scale (ranging from 1: never; to 5: always). For the questionnaire adaptation, we 1) kept as much as possible similar expressions and wording present on the original questionnaire; and 2) included in our model the same factors described in the original research. To ensure the translation did not result in any change of nature of the questionnaire, questions were back-translated by a bilingual Japanese native speaker not directly related to our research. Questions were randomly ordered to avoid any response bias. Due to incompatibility with the investigated students' profile, one question – "I am confident I will do well on science labs and projects" – was removed from the present questionnaire. This question was originally included as one loading factor for *self-efficacy*.

### 2.2 Participants

The students investigated here (N = 203) are enrolled in the first and second years of a science program, and are taking a compulsory academic English writing course. Students take an average of 15-course credits per week, and 11.96 hours/ week of extracurricular activities, as school clubs.

### 2.3 Questionnaire administration and analysis

Questionnaires were administered at two distinct times, once at the beginning and once at the end of a 13-weeks semester. The administration was done during class after students were informed about the contents and goals of the questionnaire. Participation was completely voluntary and students were informed that none of the outcomes of this investigation would influence their grades at the end of the semester. The questionnaires were collected and kept safe, impeding any leakage of students' private information. Students' personal identification information was separated from the questionnaires' responses to avoid any analysis bias. This study was approved by the university's ethics committee. Collected responses were digitalized and counted using the recognition software FormScanner [3]. For the analysis and validation of the questionnaires, both absolute and comparative fit indexes were used. Following Glynn et al. [4], all analysis here was based on Classical Test Theory, meaning that observable information was used to make inferences about latent variables [5]. We assessed the internal consistency of the responses by Cronbach's alpha [6], and the observed variance and covariance of the model, the degree of discrepancy of the model and the comparative reduction in fit between the proposed and the original models were respectively assessed by the Goodness of Fit Index [7], the Root Mean Square Error of Approximation [8] and Comparative Fit Index [9]. Statistical analysis was done using SPSS AMOS v. 25.0.0.

## 3. Results

Following Glynn et al. [4] our analysis compared the five latent factors according to different indexes. Internal consistency of the responses was evaluated by Cronbach's alpha (Table 1). The alpha value varies from zero to 1.00, and for groups comparison values between 0.70 and 0.80 are reported as satisfactory [10]. Too low values for this index can be a result of a low number of question, lack of inter-relation between questions in each category or lack of homogeneity in the constructs investigated, while, on the other hand, values above 0.90 can indicate redundancy [11]. As observed in table 1, the obtained alpha values suggest a satisfactory internal consistency for all the factors included in our questionnaire, both at the beginning and end of the semester. However, values above 0.90 were obtained for some of the factors, particularly at the post-semester investigation, suggesting redundancy in our questions.

Additionally, the model validity was assessed by three indexes (table 2). The GFI ranges from zero to 1.00 measuring the variance within the model. Values over 0.90 are taken as a good fit [12]. RMSEA accounts for the degree of similarity between our model and the observed data. Values close to .05 indicate a close fit, while values close to 0.10 indicate a poor fit [12]. Finally, a CFI, varying from zero to 1.00, was taken to compare the proposed model to the original one. Indexes equal or higher than 0.90 are taken as a threshold here [12]. Contrary to the Cronbach's alpha results, the three indexes analyzed here show low validity for the model.



Table 1: Cronbach's alpha results for the pre-semester and post-semester application of the questionnaires. Cronbach's alpha values reported by Glynn et al. [4] are also provided for comparison.

	<i>Alpha (pre)</i>	<i>Alpha (post)</i>	<b><i>Glynn et al. [4]</i></b>
<i>Intrinsic motivation</i>	0.88	0.89	<b>0.89</b>
<i>Career motivation</i>	0.93	0.93	<b>0.92</b>
<i>Self determination</i>	0.89	0.91	<b>0.88</b>
<i>Self-efficacy</i>	0.77	0.83	<b>0.83</b>
<i>Grade motivation</i>	0.90	0.93	<b>0.81</b>

Table 2: Model fit indexes.

	<i>GFI</i>	<i>RMSEA</i>	<i>CFI</i>
This study (pre)	0.75	0.10	0.86
This study (post)	0.72	0.11	0.86
<b>Glynn et al. [4]</b>	<b>0.93</b>	<b>0.07</b>	<b>0.91</b>

#### 4. Discussion and Conclusions

Compared to Glynn et al. [2] analysis, although high Cronbach's alpha results are similarly reported for all the five factors, the confirmatory factor analysis results here is considerably low (tables 1 and 2). This may suggest that the translation and adaptation of the questionnaire were successful in keeping the original questionnaire's consistency, but other differences of context may influence the validity of the set of questions on the motivation factors' assessment.

In fact, structural differences in higher education in Japan are well reported in literature. Ushioda [13] brings an extensive review of how motivation has been studied in Japan and points out some of these differences. According to the author, there is a well-documented abrupt change in teaching focus between high school and university education. Students leave a high school model, where the English teaching approach aims for university entrance exams, and enter university, where the development of communication skills in English is taken as a major expectation. Adding to this, the author reports a lack of motivation of students towards learning at university, in a context where the name of the institution is more important than the skills acquired during education. Connected to this, our students scored an average of  $2.69 \pm 1.06$  when inquired about their interests toward learning about English writing, and a higher average of  $3.89 \pm 0$  when inquired about their interests on learning about Science. Students in this university could be more interested in contents directly related to their career, than acquiring other subsidiary skills (like English writing skills).

The results of our analysis suggest that the questionnaire model is not applicable in our context. Changes in context may result in different underlying motivation factors, and a possible lack of correspondence between the factors approached here and the actual factors influencing the students may have hindered the obtained indexes. Future investigations should consider more alterations to the original question sets, aiming to cover underlying factors to this Japanese university context.

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