

***Constructing and Validating Behavioral Components Scale of Motivational Goals in Mathematics***

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**Abstract**

This study aimed to construct and to validate the behavioral components of students' motivational goals as contextualized in Mathematics. The factors of motivational goals were based on Dowson and McInerney's framework composed of mastery, performance, work avoidance, social affiliation, social approval, social responsibility, social status, and social concern. The reliability of the scale was analyzed using Cronbach's Alpha. The Cronbach's Alpha reliability coefficients of the eight motivational factors are 0.82, 0.73, 0.75, 0.83, 0.84, 0.88, 0.79, and 0.89 respectively. To assess the validity of the scale, its items were subjected to exploratory factor analysis. EFA result shows that the eight factors of behavioral motivation was reduced to six factors.

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## Introduction

The Philippine education performance in Mathematics is far below the international average as revealed in the 2011 Global Competitiveness Report of the World Economic Forum under the area of Education, where it ranked 112th in Science and Mathematics among 138 economies, while, in the 2003 Trends in International Mathematics and Science Study, it ranked 43rd out of 47 participating countries. Recent studies emphasized the relationship between motivation and learning Mathematics. Walter and Hart (2009) said that “student motivation has long been a concern of Mathematics educators.” In the research of Pantziara and Philippou (2014) they pointed out that “enhancing students’ motivation in the Mathematics classroom is an important issue for teachers and researchers, due to its relation to students’ behavior and achievement.”

Dowson and McInerney defined the behavioral components of students’ goals as “a range of concrete actions associated with each goal” (2003, p. 100).

They identified eight behavioral factors in the motivational goals of students namely: (a) mastery - a variety of behaviours implicating initiative, challenge-seeking, self-regulation, and effective effort management, (b) performance - a variety of behaviours particularly relating to the measurement of academic performance relative to others or attempts to maximise academic grades and marks relative to others, (c) work avoidance - a variety of behaviours designed to minimise engagement, or effort, in, particularly, demanding academic work, (d) social affiliation - a variety of affiliative academic behaviours; particularly working together with other students in productive or cooperative ways, (e) social approval - a variety of academic behaviours designed to please, or at least attract the attention of, significant others (particularly parents or teachers), (f) social responsibility - a variety of behaviours involved with participation in supportive classroom/school roles, or increased academic effort due to perceived role expectations, (g) social status – a variety of academic behaviours (particularly effort management), which are designed to promote students present, or future status, (h) social concern – a variety of behaviours designed so that students may be, at least potentially, involved in helping situations or appointed to helping roles. (Dowson & McInerney, 2003, p. 101)

The study of Dowson and McInerney attempted to construct an inductive, systematic, and contextual approach to the study of students’ motivational goals. However, they stopped at identifying the eight factors in the motivational goals of students. In order to expound further for the eight factors in motivational goals, quantitative data are needed to support it. The theory is domain, general and qualitative; it needs a more empirical quantitative study. Their theory on motivational goals is general, not subject specific.

With the gap found out by the researchers, this study aimed to (a) construct a test that will measure the behavioral components of students’ motivational goals in Mathematics, (b) validate the constructed test that will measure the behavioral components of students’ motivational goals in Mathematics, and (c) measure the reliability of the validated test on Behavioral Components Scale of Motivational Goals in Mathematics.

## **Participants**

The study consists of first year college students from a private university in Manila, Philippines, in which 270 of them are Pharmacy students and 300 are Medical Technology majors. The Pharmacy students voluntarily took part in answering the Behavioural Components of Students Motivational Goals in Mathematics (Dawson & McInerney 2003), and the Medical Technology majors, also voluntarily participated by answering the constructed scale that was based from the survey result.

Since the participation was voluntary, the researchers used the convenience sampling technique. The consent from the respective professors of the participants was sought before administering the instruments. The available and willing participants were the only ones who answered the survey and the scale test. The researchers facilitated the instruments to the participants to ensure accuracy on administering the instruments and on achieving their desired objectives.

## **Instruments**

This study used two instruments: the first instrument was the Behavioural Components of Students' Motivational Goals (Mathematics) Survey anchored on the theory of Dowson and McInerney (2003). The survey forms were used to collect data on students' behavioral components of motivational goals. It includes two sections namely the academic goals and social goals. The academic goals section asks students to write on what motivated them most to study mathematics in terms of their mastery, performance, and work avoidance; while, the social goals sections asks the same in terms of their social affiliation, social approval, social status, social responsibility, and social concern.

Based on the data collected from the survey, the researchers came up with the initial draft of the Behavioural Components of Students' Motivational Goals (Mathematics) Scale. This is a scale that lists the ten most frequent behavioral motivations of students as reflected on the survey result. The scale has two sections: (a) academic goals- mastery, performance and work avoidance; and (b) social goals- social affiliation, social approval, social status, social responsibility, and social concern. This instrument prompts students to rate themselves on a 5-point Likert scale (5-always, 4-often, 3-sometimes, 2-rarely, 1-never) on their academic and social motivational goals behavioral components. This instrument was the basis for constructing the final Behavioural Components of Students' Motivational Goals (MATH) Scale.

## **Procedures**

### **Adaptation and Administration of the Survey**

Using Dowson and McInerney's theory on motivation (2003), the researchers made an adaptation of their concepts on individual goals and goal categories. A survey questionnaire was crafted consisting of the academic goals and social goals with the corresponding specific goals under each. The survey questionnaire elicits from the student respondents (pharmacy students) their best motivation in achieving each goal listed. After writing the survey questionnaire, the researchers subjected it for a peer review to insure its readability since the definitions used were quoted from the study

of Dawson and McInerney (p. 100). The comments of trained editors were acknowledged and the recommended revisions were done, after which, the final copy was produced.

Upon request from the mathematics professors of the student respondents, the survey was administered by the researchers. They explained in detail to the respondents how the survey be answered and to what purpose the survey serves. The responses were tabulated and analyzed by the researchers. Based on the result, only the 10 most frequent answers on each goal were taken and were included in the construction of the scale- the Behavioural Components of Students' Motivational Goals (MATH) Scale.

#### Construction and Administration of the Scale

Following the framework of Dowson and McInerney (2003), the students' individual motivational goals were consolidated based on careful analyses of their responses. Considering the context of these, similar answers were collated and the ten (10) most frequent answers were included in the scale. These were included in the construction of the scale. Before the scale was administered to the medical technology students, it was subjected to specialists' review to establish its readability and form. Taking the specialists' feedbacks, the researchers did the necessary revisions.

The researchers requested the Mathematics professors of the respondents for the administration of the scale. The researchers facilitated the administration to clearly explain the answering procedure as well as the objectives of the test. This was also to allow clarifications and questions from the respondents while they were taking it.

The data gathered were treated statistically using Cronbach's Alpha and Exploratory Factor Analysis to establish the reliability and validity of the scale.

### **Results and Discussion**

In order to establish the internal consistency reliability of the items in the scale, the researchers used the Chronbach's Alpha reliability coefficient test to analyze the data. This item analysis technique helped them determine how well the items in each behavioral motivational factor measure the intended behavior. They followed the proposed rule of thumb interpretation of George and Mallery (2003) where “ $\alpha > .9$  – Excellent,  $\alpha > .8$  – Good,  $\alpha > .7$  – Acceptable,  $\alpha > .6$  – Questionable,  $\alpha > .5$  – Poor, and  $\alpha < .5$  – Unacceptable” (Gliem & Gliem, 2003).

The initial analysis showed that the eight factors in motivational goals have the following Chronbach's Alpha coefficient: mastery (0.815), performance (0.728), work avoidance (0.752), social affiliation (0.831), social approval (0.837), social status (0.786), social responsibility (0.882), and social concern (0.885). This reflects that the over-all internal consistency of each factor considering the 10 items included in each of them is either acceptable (performance, work avoidance, social status) or good (mastery, social affiliation, social approval, social responsibility, social concern) based on George and Mallery (Gliem & Gliem, 2003). However, although, the statistical analysis showed a generally accepted statistical value, Gliem and Gliem also emphasized that the Chronbach's alpha can be improved depending on the number of items in the scale (2003). The researchers believed that the 10 items can be lowered further specially if the statistical analysis suggests a significant value that

calls for this action. Looking at the statistical results, they found out several items having average (0.2- > 0.4) inter-item correlations.

The inter-item correlation value describes the correlation of a single item in reference to the other items within a factor (Gliem & Gliem, 2003). In here, it refers to the correlation of one item to the other 9 items in one component factor. Taking into consideration only the items that would help improve the Chrobach's alpha reliability coefficient if deleted, the following coefficients and inter-item reliability correlation values, respectively, had been recorded: mastery (item5: 0.821; 0.365), performance (item4: 0.731; 0.258), work avoidance (item9: 0.762; 0.221), social affiliation (item7: 0.837; 0.295), social approval (item8: 0.840; 0.354), social status (item9: 0.787; 0.313), social responsibility (none), and social concern (item1: 0.887; 0.392).

When Cronbach's Alpha coefficient is closer to 1.0, the greater is the internal consistency of the items in the scale, and taking into account that a Cronbach's alpha coefficient value of 0.80 is a reasonable goal (p. 87), however, deleting any of the items mentioned does not contribute significantly to the reliability of the factor. Also, when the inter-item correlation values are to be considered, these items have met the least value of 0.2-0.3 for inter-item correlation (Tang & Cui, 2003).

To support this claim of retaining the items, it can be attributed to the fact that mastery (item 5), social approval (item 8), and social concern (item 1) have a higher inter-item correlations versus the minimum range (0.2 – 0.3) prescribed by Tang and Cui (2003). Also, their Cronbach's Alpha coefficient is of good value ( $\alpha > 0.8$ ) as to George and Mallery (2003). Social affiliation on the other hand, also met a Cronbach's Alpha (0.837) value higher than what is acceptable and deleting item 8 does not contribute much on the factor reliability, having it increased only to 0.840, while its inter-item correlation falls on the suggested minimum range.

In the case of social status, the only item that can be deleted is item 9 which in fact has a relatively high inter-item correlation (0.313) higher than the suggested minimum value, and its Cronbach's Alpha coefficient (0.786) lies on the acceptable level. Performance and work avoidance having an acceptable Cronbach's Alpha coefficient (0.728 and 0.752) do not also contribute significantly even if item 4 (performance) and item 9 (work avoidance) be deleted, for doing so only results to a minimal difference of 0.731 and 0.762 respectively. Moreover, their inter-item correlation values (0.258 and 0.221) lie on the minimum, thus the researchers opted to retain these items.

On the other hand, the construct validity of the scale was determined through exploratory factor analysis (EFA) using SPSS. The initial scale included eight factors which are mastery, performance, work avoidance, social affiliation, social approval, social responsibility, social status, and social concern. Each factor had ten items.

Prior to the extraction of the factors, the suitability of the respondent data for factor analysis was assessed using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, and Bartlett's Test of Sphericity. The result shows that the KMO of the sample is 0.70 which is higher than the minimum requirement of Kaiser (as cited in Field, 2013) which is 0.5, while Bartlett's Test of Sphericity is significant ( $p < 0.001$ ), suggesting that the data from the participants' responses are suitable for factor

analysis. The correlation matrix of the data was then analysed using principal component analysis. Using the Guttman-Kaiser criterion (eigen values  $> 1.0$ ), eight factors were identified from the EFA, but the scree plot suggested six factors only. It is concluded that the six-factor solution which accounted for 45% of the variance in the data provided the optimal solution because: (a) it was consistent with the scree plot, (b) it had the least number of items with weak factor loading or cross-loading (factor 1 loading 13 items, factor 2 loading 11 items, factor 3 loading 5 items, factor 4 loading 8 items, factor 5 loading 9 items, and factor 6 loading 9 items with the total of 55 items). In terms of the factor loadings, only items with loading of at least 0.40 in one factor and not more than 0.35 in another factor were considered.

### **Conclusion and Recommendations**

The results of the study reveal that Dowson and McNerney's eight behavioral components of students' motivational goals was adjusted into six factors because of the following reasons: (a) the scree plot suggested six factors, and (b) some factors merged based on the outcome of factor loading and cross-loading.

Thus, this study is considered only as the preliminary phase in constructing and validating behavioural component scale of motivational goals in Mathematics. To further this study, the six-factor components will be used where another set of test administration must be conducted with a larger number of participants in order meet the sufficient data needed for Confirmatory Factor Analysis (EFA) which will measure the goodness of fit of the items. Such undertaking will lead to the standardisation of the scale.

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