Students Motivation Towards Science Learning: A Confirmatory Factor Analysis

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Abstract: ***This study explored the factors suitable to the Filipino students' motivation towards Science Learning Scale in Panabo National High School from Students Motivation Towards Science Learning (SMTSL) Scale by Tuan et al. (2005). Outcome of this study may be used as an instrument to assess motivational levels of their learners and strengthen the components of motivation that will hep students to become efficient in learning Science and academically successful and address problems in students' motivation in line with Filipino setting. This study also employed Confirmatory Factor Analysis (CFA) approach. the result shows the re-specified model of Students' Motivation towards Science Learning model.***

Keywords: CFA, SMTSL Scale, Model Fit, Filipino students, Science Motivation, PNHS

1. The Problem and Its Setting

1.1 Background of the study

Well-motivated students are enthusiastic in engaging with the learning materials, class activities and discussions, and are eager in achieving goals academically. Students' academic motivation call upon teachers to put focus on developing students' self-efficacies and on urging students to believe in their abilities to do well, and for teachers to also believe in their students (Gbollie and Keamu, 2017).

The most recent results of Programme for International Student Assessment (PISA), from 2015, placed the U. S. in an unimpressive result. Out of 71 countries in science, it ranked 24th. Among the 35 members of the Organization for Economic Cooperation and Development, which sponsors the PISA initiative, the U. S. ranked 19th in Science. Organization for Economic Co-operation and development (OECD) in the journal of PISA in Focus emphasized that the results mirror steady decline of students' motivation.

Parallel to this, Philippines' participation to the Trends in International Mathematics and Science Study (TIMSS) revealed that in 2003 shows that the Philippines at the 43rd out of 46 countries in HS II Sciencewhich is one among the three lowest country. Moreover, the NAT passing rate for high school students for School Year 2011-2012 was lower at 48.9% compared to the elementary students' 66.79% based on National Center for Education Survey (NCES) (Jalmasco, 2019).

Based on the Bureau of Education Assessment on the National Achievement Test for grade 10 school year 2016-2017 the Panabo city ranked 74^{th} out of 216 division in the Philippines with low mean score result of 36.32.

With the problem discussion above, the low rating of students' achievement in science is important to address. Furthermore, the fitness of the factors of students' motivation towards learning may vary depending in the data and cultural settings (Mavrikaki et. al., 2015). There are researches also that have been conducted in other countries which determine the level of students' motivation towards science (Albalate et. al, 2018). However, the factors fit for students' motivation towards science learning of the students in the Philippines have not studied at extent. And it is the aim of this study to identify the factors of students' motivation towards science learning suitable to the Filipino students and help them to become productive members of the society.

The researcher's intent is to contribute to the literature regarding students' motivation towards science learning in the norms of Filipino students. Result of this study will be usedas an instrument to assess motivational levels of their learners and strengthen the components of motivation that will help students to become more efficient in learning Science and be academically successful and address problems about student's motivation in line with the setting of Filipino student.

1.2 Statement of the Problem

This study aimed to identify the factors suitable to the Filipino students' motivation towards Science learning scale among the students of Panabo National High School.

Specifically, this sought to answer the following questions:

1) What are the items comprising Students' Motivation towards Science Learning Survey tool after face validation?
2) Do the underlying dimensions of students' motivation towards Science learning exhibit a parsimonious fit?
3) What is the reliability of Students' motivation towards Science learning scale for students in terms of:
   - Convergent Validity
   - Divergent Validity
4) Based on the results of analysis what measurement tool is suitable in the evaluation of students' motivation towards science learning scale?

2. Review of Related Literature

This study provides a synopsis of related researches which introduces the structure and framework for student's motivation towards science learning.

Factors Linked to Students' Motivation towards Science Learning

Various motivation factors in exploring students' motivation towards Science learning include students' self-efficacy, active learning strategies, science learning value, performance goal, achievement goal, and learning environment stimulation do contribute to students' Science learning motivation. In addition, the Science attitude related achievement (Tuan, Chin, and Shieh, 2005).

In the same study, it said that the SMTLS questionnaire was developed through analysis of existing research to identify motivation factors in science learning and adjusted the items from some relevant motivation questionnaires, such as the MSLQ, the Patterns of Adaptive Learning Survey and the Multidimensional Motivational Instrument in addition of the factors self-efficacy, performance goal, and achievement goal scales. Incorporated qualitative findings previous study of studies and the feature of science learning into designing scales and items.

In the same year an experimental study conducted by Tuan et. al., which investigated 8th graders with different learning styles their motivation outcomes through inquiry-based teaching. Students' motivation toward Science learning questionnaire (SMTSL) was used wherein after using inquiry instruction on student's motivation than students taught in traditional teaching there is an increase on the level of student's motivation. Similarly, the self-efficacy, active learning strategies, Science learning value, performance goal and achievement goal were the different learning styles of students that increased significantly in SMTSL scales.

In the study of Adaptation of the Students' Motivation Towards Science Learning (SMTSL) questionnaire in the Greek language in 2013 by Demitzkie et., Al. determined that the Students' Motivation Toward Science Learning (SMTSL) questionnaire was a valid and reliable tool for Greek students, with 6 sub-scales: self-efficacy, biology learning value, active learning strategies, performance goal, achievement goal and learning environment stimulation.

Consequently, according to Köksal (2012) the result advanced Science students on motivation toward Science learning questionnaire conducted in Turkey was out found to be as reliable and valid to use for further aims in studying with advanced Science students.

The adapted and translated questionnaire on students' motivation towards Science learning in Serbian language, particularly in Chemistry subject study, is consisted of 29 items contained five subscales that measured a sense of self-efficacy for learning chemistry, active learning strategies, chemistry learning value, performance goal and achievement goal. The outcomes showed that the tested model has good fit indicators which determined that the adapted and translated Serbian version of the SMTSL questionnaire is reliable and can be used in research and practical purposes (Olić et. al., 2013).

A study conducted in Malaysia by Chan and Norlizah (2017) which found that students' motivation towards Science learning has a significant relation to students' Science achievement. This rationalized the importance of students' motivation towards Science learning to students' Science achievement. In addition, among the scales, "active learning strategies" has the highest correlation with students' Science achievement.

Likewise, in the work of Albalate et. al (2018) with the senior high school STEM strands students; it is suggested that factors of motivation should be considered in implementing Science curriculum. Such factors that are linked to the motivation include self-efficacy, active learning strategies, science learning value, performance goal, achievement goal and learning environment stimulation.

Motivation and Science Learning: The most recent results of Programme for International Student Assessment (PISA), from 2015, placed the U. S. an unimpressive result; ranked 24th out of 71 countries in Science. Among the 35 members of the Organization for Economic Cooperation and Development, which sponsored the PISA initiative, the U. S. ranked 19th in science. According to Organization for Economic Co-operation and development (OECD) in the journal of PISA in Focus, the result of the assessment was associated to the students' motivation

In the year of 2017, Bullock study entitled "Factors Affecting Student Motivation and Achievement in Science in Selected Middle School Eighth Grade Classes" displayed a relationship between student motivation and student achievement. Student motivation was statistically significant to both student perceptions of teacher expectations and actual teacher expectations. It also suggested that student motivation increased with higher perceptual and actual teacher expectations which implied that students who are more highly motivated will have greater academic achievement.

Alfaddai (2015) suggested that children who are motivated are more likely to have higher academic performance, compared to those children who are not motivated. He also recommended that as educators, we should find the best model that will maintain a stable learning environment, which keeps students motivated to achieve academically with a vision to instituting holistic, creative and motivated learners.

Self-efficacy: Moreover, significant relationships were found for self-efficacy and goal-setting; self-efficacy and achievement motivation which supported that self-efficacy and goal-setting were important factors of achievement motivation, with goal-setting making the largest unique contribution (Davids, 2015). Parallel to this, a qualitative study was conducted to High school students and college students in exploring the self-efficacy and academic motivation. It was found that the learners are struggling to maintain the self-efficacy and motivation needed to accomplish rigorous and challenging tasks in both high school and college (Bryant, 2017). Thus, students perceived that they are capable, and they think the conceptual change tasks are worthwhile to participate in, and their learning goal is to gain competence, then students will be willing to make a sustained effort and be engaged in making conceptual change (Pintrich et al., 1993).

Active Learning Strategies: Based on the study of Soltanzade et. al., (2013) using Achievement Motive Scale Test (AMST) and demographic questionnaire with respondents of 1013 students that studied in Karaj high schools, it concluded that the use of active learning method in classroom is essential to have a positive impact on the quality of the students learning process and achievement motivation. Thus, the meaningful differences obtained in the present research recommended that the active learning method has a significant role in achievement motivation rather than traditional learning method.

Similar to this, in the study of implementing an active learning environment to influence students; motivation in biochemistry, the student's motivation in the active learning environment was higher than or equal to other courses in pharmacy-biochemistry. Which it demonstrated that the active learning environment had a positive influence on students' motivation (Cicuto and Torres, 2016).

Science Learning Value: According to Corrigan (2014) said that when learning Science, students need to be aware of these values and their significance in other disciplines they are learning. Similar to this, in the study "The Role of Motivation and Perceptions about Science Laboratory Environment on Lower Secondary Students' Attitude towards Science" suggested the teachers to design their teaching considering motivational factors particularly the value of the task; self-efficacy and regulation (Chua and Karpudewan, 2017).

Meanwhile, of Lay and Chandrasegaran (2016), measured students' interest and liking of learning Science, students' understanding about the importance of the subject and usefulness of the subject, and students' self-confidence or self-concept in their ability to learn science. The study indicated liking and valuing of learning science were positively related with their science achievement in the eighth-graders'.

Performance and Achievement goal: Motivation has significant role especially in student learning in science classrooms. There are numerous factors influencing student learning concentrated in four motivational beliefs, namely self-efficacy, task value, interest, and achievement goals. Moreover, students' beliefs are influenced by various instructional activities, and these beliefs in turn, lead to increased student achievement. In contrast, the beliefs or strategies interact with instruction to influence student achievement (Bonney et. al, 2005)

Learning Environment Stimulation: In the year of 2014, The Roots of Physics Students' Motivation study by Van Dusen reviewed features of the learning environments that determined students' experiences in physics class. This highlighted the importance of feeling a sense of belonging in the context of physics and the power that teachers have in shaping students' motivation through the construction of their classroom learning environments. It demonstrated how the different ways that students experience in physics class influenced their performance and curiosity in physics. Thus, learning environment of students and stimulates learning motivation (Asvio, 2017).

Confirmatory Factor Analysis: According to Malo (2016) Confirmatory Factor Analysis (CFA) is used as a tool to validate the measurement model before specifying and estimating the structural model: Are the constructs unidimensional and valid?; How many indicators should be used for each construct?**; A**re the measures able to portray the construct or explain it?

According to Lani (2010), CFA researchers were able to specify the number of factors necessary in the data; and which measured variable is related to which latent variable. It is treatment that will be used to confirm or reject the measurement theory.

Model fitness must met the criteria of the given indexes Arbuckle and Wothke (1999) denoting that CMIN/DF should be less than 3.0, Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) should be close to 0.90. thus, the RMSEA and PCLOSE values are supported by MacCallum, Browne and Sugawara (1996) indicating 0.01, 0.05, and 0.08 as excellent, good, and mediocre fit respectively, with P of close fit (PCLOSE) that is greater than 0.05. Arbuckle (2009), posited that the CMIN/DF should be < 3.0 and the p-value should be greater than 0.05. Furthermore, P of close fit (PCLOSE) should be greater than 0.05 (Kenny, 2011) and the TLI, and CFI should exceed.90 to indicate good fit (Hu & Bentler, 1999).

Moreover, the process of model re-specification by MacCallum (1986) who highlighted that model re-specification is observed to improve the parsimonious fit of the model. In which a researcher may delete non-significant paths or add paths to the model based in empirical result (Pedhazur, 1982).

Thus, the above discussion of the related literature and study supported the constructs of students' motivation towards science learning. This include the six factors: Self-efficacy, self-efficacy, active learning strategy, science learning value, performance goal, achievement goal, and learning environment stimulation. STML questionnaire was used by international researches to assess the level of students' motivation toward science learning. Moreover, Confirmatory Factor Analysis is the best approach to be used in conforming the factors fit for student' motivation towards science learning of Filipino students.

Theoretical framework and Conceptual Framework

Linnenbrink and Pintrich (2002) asserted that student motivation is a complex construct composed of different domains. Hence, Tuan, Chin, and Shieh (2005) postulated the various factors comprising students' motivation towards Science learning. This includes students' self-efficacy, active learning strategy, science learning value, performance goal, achievement goal, and learning environment stimulation. They assert that these factors contribute to how students learn Science and fuel their drive to learn more. Deci and Ryan (2000) also stated in the Self-determination theory of motivation which addresses needs of students in terms of psychological relatedness, autonomy and competence. Thus, it supports that motivation is significant in science education. According to Brown (2006) the model identification pertains in part to the difference between the number of freely estimated model parameters and the number of pieces of information in the input variance-covariance matrix.

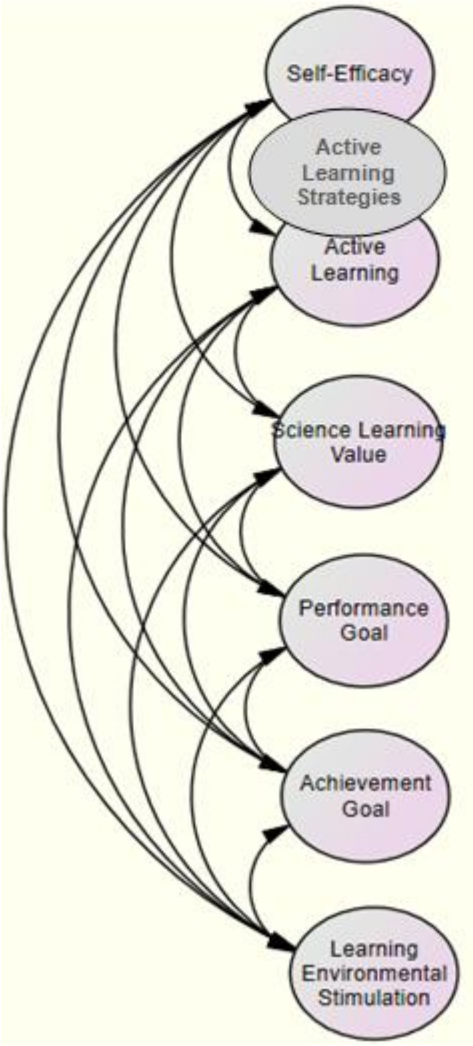

Figure 1: Research Paradigm for Confirmatory Analysis of Students' Motivation towards Science Learning

Significance of the Study

With the intention toidentify the factors suitable to the Filipino students' motivation towards Science, this study took it special significance to the following:

Students: This research would centered on the factors comprising Filipino students' motivation towards Science learning. Ultimately, they would benefit the most because the factors comprising their drive to learn would explored. Consequently, Science instruction would be more tailored to how their enthusiasm for learning develops.

Teachers: This research would aid teachers to use the revised STML questionnaire as instrument to assess motivational levels of their learners and strengthen the components of motivation that will help students to become more efficient learning Science and be academically successful.

Administrators: The result of this study would provide them a clearer view of the framework on the students' motivation towards Science learning. Furthermore, finding of this will pave the way to programs needed to enhance students' motivation leading to attainment of higher achievement in Science.

Other Researchers: Future researchers may use the study's questionnaire as this would evaluated based on the context of Filipino learners. Hence, by using this as an instrument for their research, they would able to arrive at data reflecting how Filipino learners' motivation is related with other learning domains.

Definition of Terms

The major terms used in this study are herein defined both conceptually and operationally:

Students' Motivation: It describes the aspects within an individual which arouse, maintain and channel behavior towards goals in learning activity (Deci & Ryan 2005). In this study, Students' Motivation is the domain upon which its constructs or factors are explored using the adapted Students' Motivation towards Science Learning (STML) questionnaire.

Science Learning: The students' ability to acquire knowledge and skills, how they learn through analyzing data, and create outcomes in science (Tuan et. al., 2005). In this study, Science Learning is one of the constructs or factors of the adapted Students' Motivation towards Science Learning (SMTSL) questionnaire.

Self-Efficacy: The students' confidence in their own skill in performing well in science tasks (Tuan et. al., 2005). In this study, Students' motivation is one of the constructs or factors of the adapted Students' Motivation towards Science Learning (SMTSL) questionnaire.

Active Learning Strategies: Learners have an active role to construct new knowledge based on their previous understanding using variety of strategies (Tuan et. al., 2005). In this study, Active Learning Strategies is one of the constructs or factors of the adapted Students' Motivation towards Science Learning (SMTSL) questionnaire.

Science Learning Value: Students will have the ability to acquire problem-solving competency, stimulate their own thinking, experience the inquiry activity, and find the relevance of science in daily life. Thus, learners who perceive these values will be motivated in learning science (Tuan et. al., 2005). In this study, Science Learning Value is one of the constructs or factors of the adapted Students' Motivation towards Science Learning (SMTSL) questionnaire.

Performance Goal: Getting the attention from the teacher and competing with other students are the goals of students in science learning (Tuan et. al., 2005). In this study, Performance Goal is one of the constructs or factors of the adapted Students' Motivation towards Science Learning (SMTSL) questionnaire.

Achievement Goal: As the students increase their competence and achievement during science learning they feel satisfied (Tuan et. al., 2005). In this study, Achievement Goal is one of the constructs or factors of the adapted Students' Motivation towards Science Learning (SMTSL) questionnaire.

Learning Environment Stimulation: The students' motivation in science learning is influenced by learning environment surrounding students, such as curriculum, teacher's teaching, and student interaction (Tuan et. al., 2005). In this study, Learning Environment Stimulation is one of the constructs or factors of the adapted Students' Motivation towards Science Learning (SMTSL) questionnaire.

3. Method

This chapter discusses the research design, research respondents, research instruments, data gathering procedures, and statistical treatment of data.

Research Design

This study used quantitative type of research. It is guided by the principles of Creswell (2003) who emphasized its appropriateness in terms of testing theories by examining the relationship among variables which can be measured on instrument and analyzed using statistical procedure. Furthermore, confirmatory factor analysis (CFA) employed as an approach by the researcher to confirm the theorized construct in a study load into certain number of underlying sub-constructs or component (Awang 2012).

As such, CFA was used to know whether the underlying dimensions of students' motivation towards Science as presented in the Students Motivation towards Science Learning byTuan, Chin, and Shieh (2005) confirms with the norms of students in the Philippine public high school setting, specifically, in Panabo National High School.

Consequently, this quantitative type of study used the Confirmatory Factor Analysis to conform the factors of students' motivation towards science using the standardized tool STML by Tuan et. al., (2015). Lastly, the approach is fit to this study wherein it specify the number of factors essential in the data; and which measure variable is connected to which underlying variable.

Research Locale

This study was conducted in the Panabo National High School, Division of Panabo. It is a public high school located at New Site, Gredu, Panabo City and is 0.8 km away from the National Highway. Figure 2 shows the map of Panabo City highlighting Panabo National High School (Google, n. d.).

The school is implementing four (4) different programs namely; Special Program in the Arts (SPA), Special Education (SPED), Science Technology and Engineering (STE) and the Basic Education Curriculum (BEC). Its goal is aligned with the mission and vision of the Department of Education which is to produce excellent graduates by providing them with the necessary knowledge, skills and attitude necessary to become productive citizens.

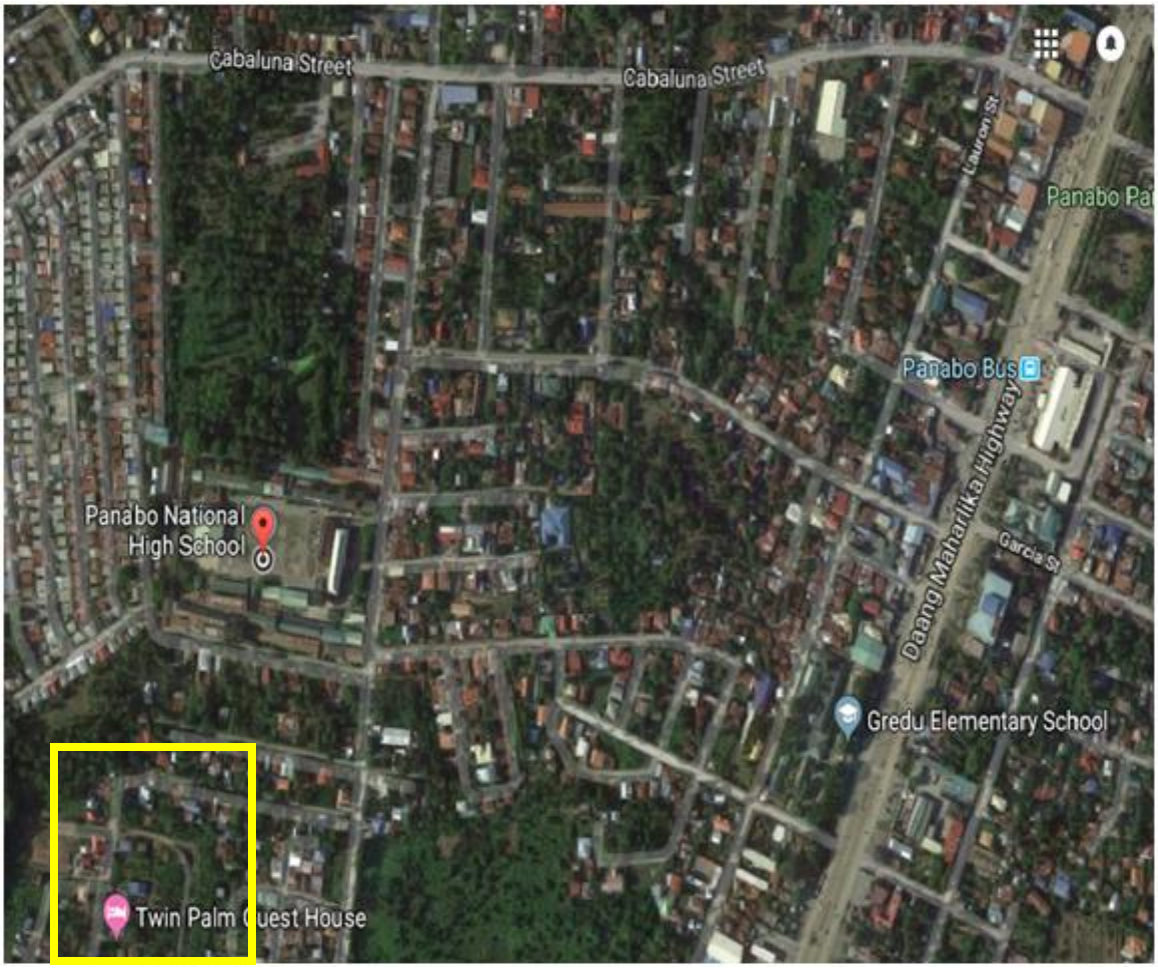

Figure 2: Map of Panabo City highlighting the Panabo National High School (Google, n. d.).

Research Respondents
The respondents of this study were the junior high school students enrolled in SY 2018-2019. Stratified random sampling technique was used in the selection of the respondents in which the percentage for each stratum is multiplied to its corresponding population to determine the number of respondents needed (Shi, 2015). Raosoft sample size calculator was used to determine the appropriate number of sample from the population. Table 1 shows the distribution of the respondents. From the population of 6 380, a total number of 363 respondents were recruited in grade 10 (Raosoft. com, 2014).

Research Instrument
A standardized validated questionnaire, The Students' Motivation towards Science Learning adapted from Tuan, Chin, and Shieh (2005) with 35 questions, was used as an instrument in gathering data to be distributed to the respondents. It is consisted of six (6) domains: Self-Efficacy, Active Learning Strategies, Science Learning Value, Performance Goal, Achievement Goal, and Learning Environment Stimulation. Tuan, Chin, and Shieh (2005) claimed that the questionnaire has both construct and criterion-related validity and had been used to correlate with Science attitude and achievement scores.

Table 1: Distribution of Respondents

Grade Level	Population	Percentage	Sample size
7	1, 943	30	**109**
8	1, 604	25	**91**
9	1, 465	24	**87**
10	1, 368	21	**76**
Total	**6, 380**	**100**	**363**

The parameter limits for students' motivation towards science learning items on the scales were anchored at 1.00-1.49 =Strongly Disagree (the student strongly disagrees to the statement), 1.50-2.49= Disagree (the student disagrees to the statement), 2.50-3.49= Neutral (the student has no opinion to the statement), 3.50-4.49= Agree (the student agrees to the statement), 4.50-5.00= Strongly agree (the student strongly agree to the statement).

Data Gathering Procedure
In collecting the data needed, the following procedure were observed:

Seeking Permission to Conduct the Study: The researcher asked permission and approval from the Dean of the Graduate School of St. Mary's College, Inc. Then, to the Schools Division Superintendent and to the School Principal regarding the conduct of the study at Panabo National High School. The content of the letter is to allow the researcher to conduct her study on the extent of manifestation of Students' Motivation towards Science Learning.

Administration and Retrieval of the questionnaire: Three (3) experts were invited to perform content validity of the questions and check the suitability of the items that captured the underlying dimensions on students' motivation towards Science learning with the purpose of ensuring the readability and comprehensibility of the scale. The researcher personally distributed and administered the SMTSL Questionnaire to the respondents in their classrooms with the assistance of class advisers or Science teachers of the respondents to ensure the reliability of data.

Checking, Collating and the Processing of data: After the retrieval of the questionnaire, the responses were checked, collated and tabulated. The tabulated data were treated, analyzed and interpreted statistically by the statistician. Specifically, CFA was used by the researcher to test whether the obtained factor structure in Students' Motivation towards Science Learning Model is the best fitting model or could still be improved. Latent variables were allowed to correlate with caution on negative and high correlations. Additional within-factor error covariance was not allowed. Thus, it answered whether the latent dimensions that were derived in the model would exhibit a parsimonious fit. Moreover, several statistical tools were considered in making decisions on the best fitting model such as Chi-square test, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA) and p of Close Fit (PCLOSE).

Lastly, the reliability was test of the obtained factor structure and each item of the factors were subjected to inter-item correlation and determination of the Cronbach's alpha.

Statistical Treatment of Data
After collecting the data needed, the following statistical treatment were used:

Confirmatory Factor Analysis: The goal of this analysis was to assess the fit of the measurement model of the SMTSL and to verify whether its dimensions present reliable and valid representations. It was also used in discovering the underlying factors for a set of items and estimating how strongly they relate to the factors through the use of Analysis of Moment Structures [AMOS] Software. According to Lani (2011), CFA researchers will be able to specify the number of factors necessary in the data; and which measured variable is related to which latent variable. It was a treatment that was used to confirm or reject the measurement theory. Particularly, answers the research questions items number 2 and 3.

Reliability Testing: The Cronbach's Alpha was used to measure the scale of reliability of this study and answer the research question item number 4. SMTSL questionnaire tested the internal consistency and strength through inter-item correlation.

Ethical Consideration
The Belmont Report has striking response to the ethical issues in the field of research. Moreover, there are three basic principles the principles of respect for persons, beneficence and justice (Friesen et. al., 2017). This quantitative research rigorously abide by the following facets for ethical consideration:

Respect for Persons: According to Mazur (2007) this ethical principle wherein respondents have the opportunity to decide on what shall or shall not happen to them. Thus, in this study the respondents in this study were informed and allowed to make a voluntary decision to participate based on their desire to add to the body of literature. And given informed assent. The researcher considered and respect the respondents' choice to withdraw at any stage of the research without requiring them to explain. Parallel to this, before the respondents answered the questionnaires the researcher secured informed assent and parental consent which ensured the approval of the respondents and their parents. Further, the permission and approval to conduct the study was also requested from the Office of the Schools Division Superintendent of Panabo City Division.

Beneficence: This ethical principle refers to responsibility of the researcher to make the most of benefits for the participants and society (Adams, 2014). Hence, in this study personal information of the respondents held highly confidential and in no way included in the discussion of the results. Further, filling up of their names was not required in the questionnaire. Only the researcher would have access to the data to ensure that sanctity of their responses is safeguarded. This study ensured that the benefit the recipients would have would outweigh any possible disadvantage.

Justice: This is the benefits and ideal distribution of risk throughout population in which individual should have unbiased access to the latent benefits of the intervention and share in the potential risk (Mazur, 2007). Accordingly, the researcher secured permission from the author of the questionnaire which was used as the study's instrument. Further, respondents in this study were randomly selected to ensure that everyone had equal chances of being selected as part of the study's sample population.

4. Results

This chapter exhibits the results, analysis and interpretation of findings of the investigation. The data are presented in model diagram, tabular and textual forms.

Face Validity

The questionnaire used in this study, Students' Motivation Towards Science Learning, was crafted in 2005 by Hsiao-Lin Tuan, Chi-Chin Chin & Shyang-Horng Shieh in their research work entitled, "The development of a questionnaire to measure students' motivation towards science learning" published in the International Journal of Science Education. This study adapted the said questionnaire in the attempt to uncover the extent to which their hypothesized model is consistent with the data gathered from 1407 respondents.

The 35-item survey tool on students' motivation comprised of nine (9) negatively stated item-statements to decrease bias in the responses. These items were 2, 4, 5, 6, 7, 21, 22, 23, and 24. This necessitated for the researcher to do reverse scoring in order to remain consistent with the concept conveyed by each factor.

In this study, three validators who are experts in the field of study

Table 2: The Validated SMTSL Survey Tool

STUDENTS' MOTIVATION TOWARDS SCIENCE LEARNING SCALE
A. SELF-EFFICACY
1. Whether the science content is difficult or easy, I am sure that I can understand it.
2. I am not confident about understanding difficult science concepts.
3. I am sure that I can do well on science tests.
4. No matter how much effort I put in, I cannot learn science.
5. When science activities are too difficult, I give up or only do the easy parts.
6. During science activities, I prefer to ask other people for the answer rather than think for myself.
7. When I find the science content difficult, I do not try to learn it
B. ACTIVE LEARNING STRATEGIES
8. When learning new science concepts, I attempt to understand them.
9. When learning new science concepts, I connect them to my previous experiences.
10. When I do not understand a science concept, I find relevant resources that will help me.
11. When I do not understand a science concept, I would discuss with the teacher or other students to clarify my understanding.
12. During the learning processes, I attempt to make connections between the concepts that I learn.
13. When I make a mistake, I try to find out why.
14. When I meet science concepts that I do not understand, I still try to learn them.
15. When new science concepts that I have learned conflict with my previous understanding, I try to understand why.
C. SCIENCE LEARNING VALUE
16. I think that learning science is important because I can use it in my daily life.
17. I think that learning science is important because it stimulates my thinking.
18. In science, I think that it is important to learn to solve problems.
19. In science, I think it is important to participate in inquiry activities.
20. It is important to have the opportunity to satisfy my own curiosity when learning science.
D. PERFORMANCE GOAL
21. I participate in science courses to get a good grade.
22. I participate in science courses to perform better than other students.
23. I participate in science courses so that other students think that I'm smart.
24. I participate in science courses so that the teacher pays attention to me.
E. ACHIEVEMENT GOAL
25. During a science course, I feel most fulfilled when I attain a good score in a test.
26. I feel most fulfilled when I feel confident about the content in a science course.
27. During a science course, I feel most fulfilled when I am able to solve a difficult problem.

28. During a science course, I feel most fulfilled when the teacher accepts my ideas.
29. During a science course, I feel most fulfilled when other students accept my ideas.
F. LEARNING ENVIRONMENT STIMULATION
30. I am willing to participate in this science course because the content is exciting and changeable.
31. I am willing to participate in this science course because the teacher uses a variety of teaching methods.
32. I am willing to participate in this science course because the teacher does not put a lot of pressure on me.
33. I am willing to participate in this science course because the teacher pays attention to me.
34. I am willing to participate in this science course because it is challenging.
35. I am willing to participate in this science course because the students are involved in discussions.

LEGEND	1 = if you **strongly disagree** tothe statement 2 =if you **disagree** to the statement 3 = if you have **no opinion** to the statement 4 = if you **agree** to the statement 5 =if you **strongly agree** to the statement

were invited to perform face validation of the questionnaire. Experts reviewed the items as to whether the tool could validly measure students' motivation towards learning Science just on the face of it. This was a necessary step prior to the questionnaire administration to ascertain that students would understand and respond coherently.

In detail, self-efficacy consisted of the following items: (*1) Whether the science content is difficult or easy, I am sure that I can understand it, (2) I am not confident about understanding difficult science concepts., (3) I am sure that I can do well on science tests (4) No matter how much effort I put in, I cannot learn science., (5) When science activities are too difficult, I give up or only do the easy parts., (6) During science activities, I prefer to ask other people for the answer rather than think for myself., and (7) When I find the science content difficult, I do not try to learn it.*

On the other hand, Active Learning Strategies, was measured in terms of the following items: *(8) When learning new science concepts, I attempt to understand them. (9) When learning new science concepts, I connect them to my previous experiences. (10) When I do not understand a science concept, I find relevant resources that will help me. (11) When I do not understand a science concept, I would discuss with the teacher or other students to clarify my understanding. (12) During the learning processes, I attempt to make connections between the concepts that I learn. (13) When I make a mistake, I try to find out why. (14) When I meet science concepts that I do not understand, I still try to learn them. (15) When new science concepts that I have learned conflict with my previous understanding, I try to understand why.*

Model Specification and Identification

Figure 3 presents the SMTSL model specification and identification. Unobserved variables are termed latent factors or constructs. These are illustrated graphically with circles or ovals. Consistent with this premise, the unobserved variables SE (Self-efficacy), AL (Active Learning Strategies), SLV (Science Learning Value), PG (Performance Goal), AG (Achievement Goal) and LES (Learning Environment Stimulation) are presented in oval. Since the latent constructs cannot be measured, each of the constructs was linked to 35 observed variables otherwise considered as its indicators. These observed variables are represented by squares. Data contained in these variables were generated from the responses of the students for each of the items.

The model presents the item for each factor being linked by a single-headed arrow towards the six unobserved variables in order to measure their factor loading towards the said variable. SE (Self-efficacy) with S1_1 to S1_7, AL (Active Learning Strategies) with S2_8 to S2_15, SLV (Science Learning Value) withS3_16 to S3_S20, PG (Performance Goal) with S4_21 to S4_S24 measure factor, AG (Achievement Goal) with S5_25 to S5_29, and LES (Learning Environment Stimulation) with S6_30 to S6_35. The six unobserved variables where then linked with a double-headed arrow to measure the extent to which they covary.

Further, each of the items, being considered as the endogenous variables, were provided with residual terms that represent error in their prediction from the exogenous factors, the domains of students' motivation. For example, the residual e1 in Figure 3 represents error in prediction of item S1_6 on the measurement for Self-Efficacy.

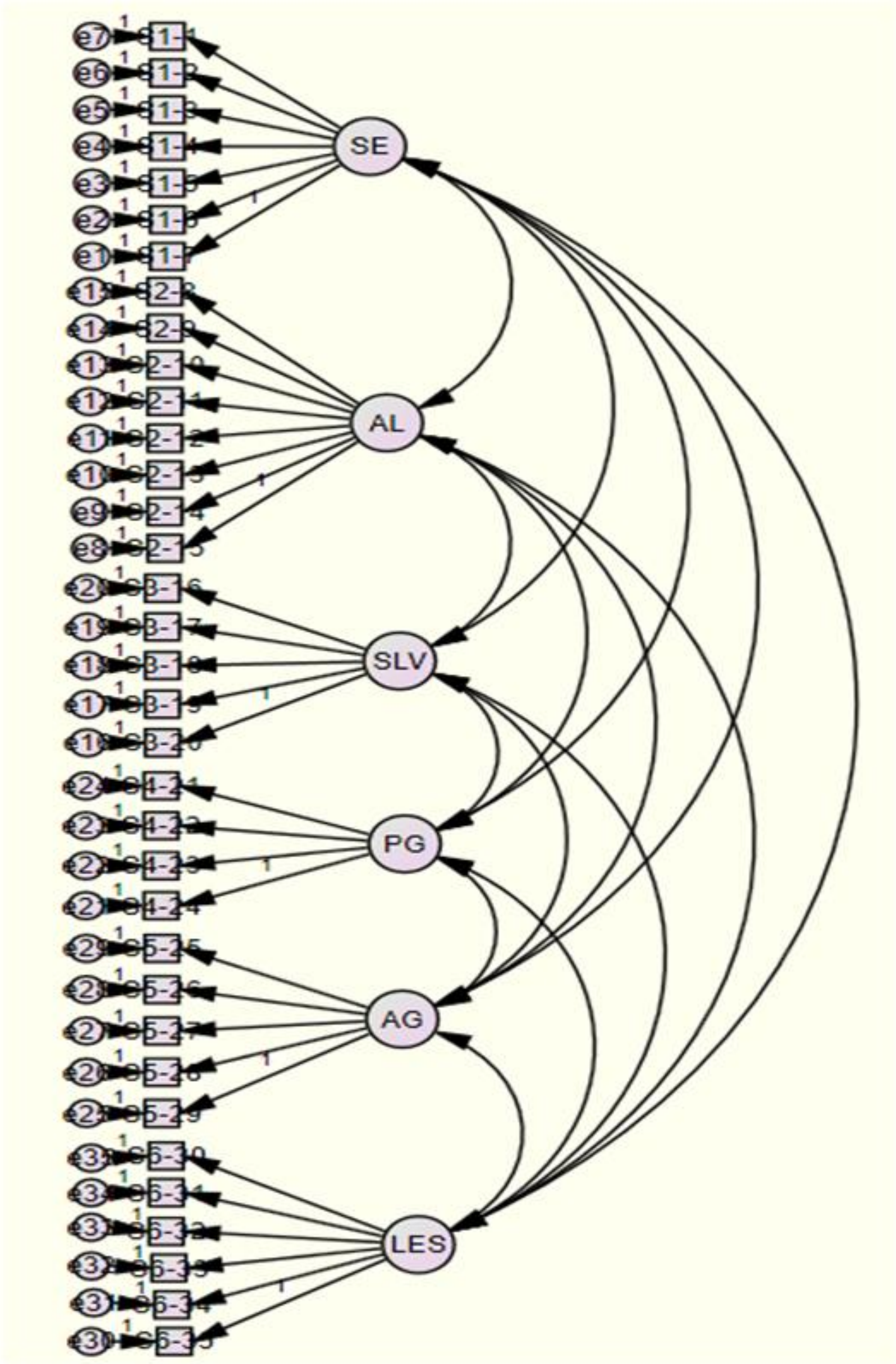

Figure 3: Model Specification and Identification

Table 3: Model Fit Values of the Specified SMTSL Model

Index	Criterion	Model Fit Value
CMIN/DF	< 3.0	2.570
p-value	>0.05	0.000
TLI	>0.90	0.754
CFI	>0.90	0.775
RMSEA	<0.08	0.066
PCLOSE	>0.05	0.000

Model Estimation and Assessment

The Students Motivation towards Science Learning Questionnaire was evaluated to determine whether it exhibits a parsimonious fit. Table 4 shows an overview of the model fit indices. It can be observed that CMIN/DF has a value of 2.570. This implies that the model satisfied the said criterion as it required for the values to be <3.0. This is aligned with the assertion of Arbuckle and Wothke (1999) denoting the premise that CMIN/DF should be less than 3.0. The Value of

RMSEA is 0.066 which also satisfied the threshold of <0.8. However, other fit indices of the model such as p-value, TLI, CFI, and PCLOSE indicate poor fit and do not meet the criteria set by each index.

Arbuckle and Wothke (1999) emphasized the need for Tucker-Lewis Index (TLI) and Comparative Fit Index (CFI) to be close or greater than 0.90. In addition, RMSEA and PCLOSE values may be used to classify model fitness. MacCallum, Browne and Sugawara (1996) enumerated 0.01, 0.05, and 0.08 as excellent, good, and mediocre fit, respectively with P of close fit (PCLOSE) that is greater than 0.05. Furthermore, P of close fit (PCLOSE) should be greater than 0.05 (Kenny, 2011).

Model Re-specification

The data in table 4 suggest the need for model re-specification since most of the fit indices do not satisfy the criteria. Hence, modification indices were reviewed to look for logical means to re-specify the model based on the modification indices.

Figure 4 presents the re-specified SMTSL model. Double-headed arrows are used to provide covariance among error terms within similar latent factor. Connecting the error terms of endogenous variables from a different exogenous variable was not performed even if this was suggested by the software's modification indices. Further, this was done gradually, checking for changes in the model's fit indices from time to time. This was observed because as stated by Jain and Sharma (2012) it is not right to correlate error terms with observed variables, or with error terms that are not part of the same factor. Which means that the error terms must correlate on the same factor. Hence, the following endogenous variables were covaried in the attempt to improve the model's fit indices: (1) e5-e7, (2) e12-e15, (3) e12-e13, (4) e11-e12, (5) e9-e11, (6) e8-e11, (7) e19-e20, (8) e16-e18,

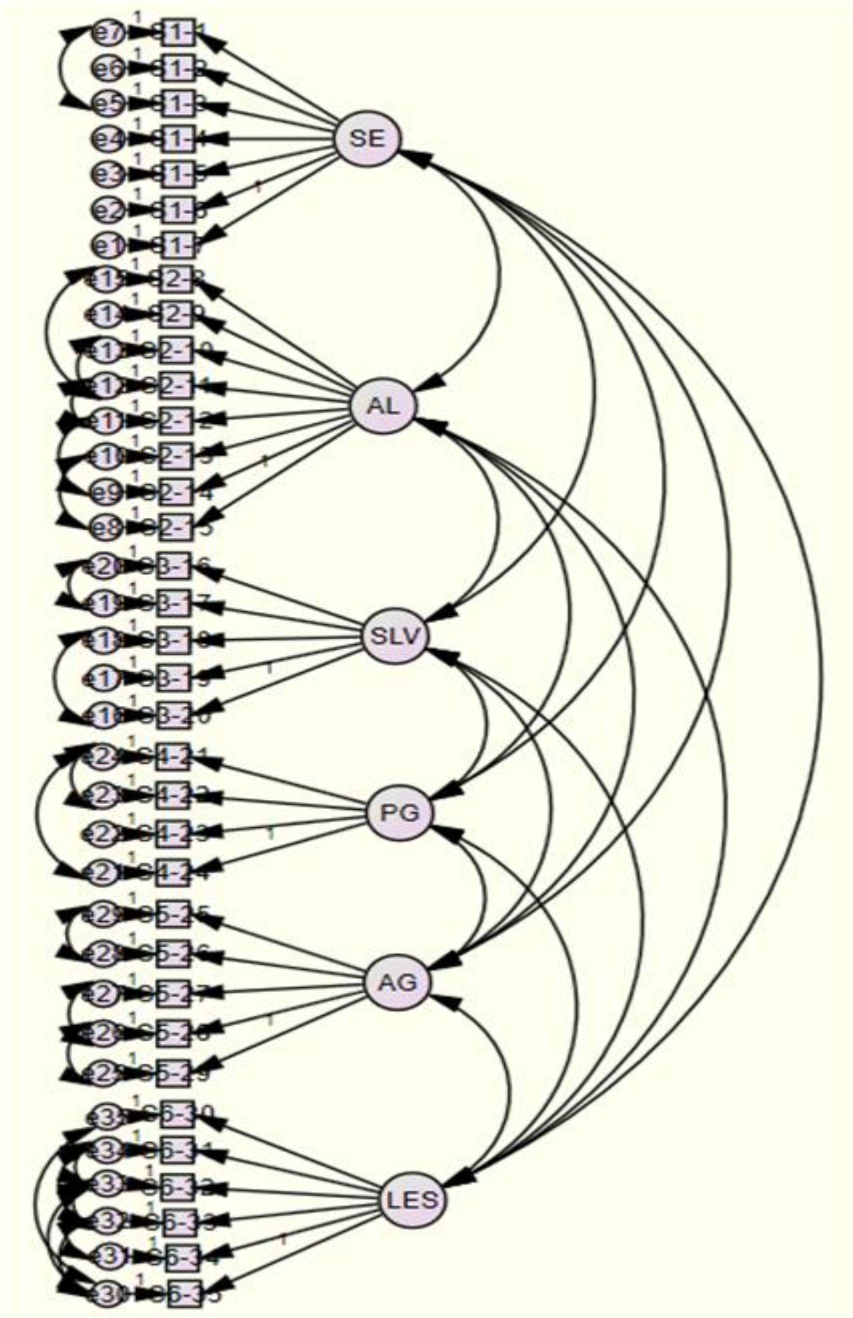

Figure 4: Model Re-specification

(9) e21-e24, (10) e23-e24, (11) e28-e29, (12) e25-e26, (13) e26-e27, (14) e30-e35, (15) e30-e33, (16) e32-e33, (17) e32-24, and (18) e33-e34.

Consequently, the re-specified model was evaluated to evaluate whether the new model fit values have already satisfied the criteria set for the best fitting model. Thus, table 5 provides the new values generated by the model.
The result displayed a parsimonious fit for CMIN/DF with the value of 2.085 < 3.0. This is supported by Arbuckle and Wothke (1999) denoting that CMIN/DF should be less than 3.0. While RMSEA is 0.055 closer to <0.08 regarded as good fit by MacCallum et al. (1996) upon which he set three classifications based on the values 0.01, 0.05, and 0.08 to indicate excellent, good, and mediocre fit respectively. Meanwhile, the TLI fit value of 0.880 and CFI value of 0.852 may already be considered as a good fit as these values are closer to >0.90 as compared to the previous model (Kim et. al., 2016). Thus, it is suggested to use of at least three fit indices (Wan Mohamad, 2013).

The process of model re-specification was done in accordance to the principle of MacCallum (1986) who highlighted that model re-specification is observed to improve the parsimonious fit of the model. In which a researcher may delete non-significant paths or add paths to the model based in empirical result (Pedhazur, 1982).

Table 4: Model Fit Values for Re-specified Model

Index	Criterion	Model Fit Value
CMIN/DF	< 3.0	2.085
p-value	>0.05	0.000
TLI	>0.90	0.880
CFI	>0.90	0.851
RMSEA	<0.08	0.055
PCLOSE	>0.05	0.050

Convergent Validity

Convergent validity is shown when each measurement item correlates strongly with its assumed theoretical construct. In other words, the items that are the indicators of a construct should converge or share a high proportion of variance in common. The ideal level of standardized loadings for reflective indicators is 0.60 - 0.70 (Barclay et al., 1995). However, Fornell and Larcker (1981) emphasized that if AVE is less than 0.5, but composite reliability is higher than 0.6, the convergent validity of the construct is still adequate.

Table 6 shows the Average Shared Variance (AVE) for each item comprising the six domains. This value determines whether a construct really measures what it intends to measure (Saunders and Thornhill, 2003). Upon initial assessment, only the domain Achievement Goal satisfied the threshold of 0.40, leaving the rest of the domains with values lesser than acceptable as illustrated in table 5.

In order to meet the criteria for convergent validity, the researcher removed items for each factor with loadings that are less than 0.50. As presented in table 5 the items were complete, but after computing the Average Variance Extracted (AVE) there are items drop by the researcher. Hence, the following items were dropped: (*1) Whether the science content is difficult or easy, I am sure that I can understand it; (3) I am sure that I can do well on science tests; (6) During science activities, I prefer to ask other people for the answer rather than think for myself; (8) When learning new science concepts, I attempt to understand them; (9) When learning new science concepts, I connect them to my previous experiences; (10) When I do not understand a science concept, I find relevant resources that will help me; (11) When I do not understand a science concept, I would discuss with the teacher or other students to clarify my understanding; (16) I think that learning science is important because I can use it in my daily life; (20) It is important to have the opportunity to satisfy my own curiosity when learning science*; (*21) I participate in science courses to get a good grade; (32) I am willing to participate in this science course because the teacher does not put a lot of pressure on me; and (33) I am willing to participate in this science course because the teacher pays attention to me.*

Table 5: Standardized Regression Weights: (Group number 1-Default model)

			Estimate	Squared Loading	AVE
S1-7	<---	SE	0.568	0.322624	0.292497
S1-6	<---	SE	0.419	0.175561	
S1-5	<---	SE	0.545	0.297025	
S1-4	<---	SE	0.693	0.480249	
S1-3	<---	SE	0.132	0.017424	
S1-2	<---	SE	-0.864	0.746496	
S1-1	<---	SE	0.09	0.0081	
S2-15	<---	AL	0.656	0.430336	0.347506
S2-14	<---	AL	0.741	0.549081	
S2-13	<---	AL	0.61	0.3721	
S2-12	<---	AL	0.622	0.386884	
S2-11	<---	AL	0.315	0.099225	
S2-10	<---	AL	0.559	0.312481	
S2-9	<---	AL	0.523	0.273529	
S2-8	<---	AL	0.597	0.356409	
S3-20	<---	SLV	0.482	0.232324	0.362665
S3-19	<---	SLV	0.621	0.385641	
S3-18	<---	SLV	0.606	0.367236	
S3-17	<---	SLV	0.725	0.525625	
S3-16	<---	SLV	0.55	0.3025	
S4-24	<---	PG	0.758	0.574564	0.372033
S4-23	<---	PG	0.859	0.737881	
S4-22	<---	PG	0.394	0.155236	
S4-21	<---	PG	-0.143	0.020449	
S5-29	<---	AG	0.563	0.316969	0.45073
S5-28	<---	AG	0.651	0.423801	
S5-27	<---	AG	0.715	0.511225	
S5-26	<---	AG	0.724	0.524176	
S5-25	<---	AG	0.691	0.477481	
S6-35	<---	LES	0.486	0.236196	0.310016
S6-34	<---	LES	0.638	0.407044	
S6-33	<---	LES	0.196	0.038416	
S6-32	<---	LES	0.354	0.125316	
S6-30	<---	LES	0.79	0.6241	
S6-31	<---	LES	0.655	0.429025	

The removal of the abovementioned items increased the capacity of the tool to measure the construct it intends to measure. Table 6 reveals that indicator S1_2 earned the highest loading of-0.864 while S1_5 got the lowest loading of 0.45 for the construct SE (Science Environment) thereby reaching an AVE of 0.461599.

On the other hand, indicator S2_14 obtained the highest loading of 0.741 with S2_13 at 0.61 for AL (Active Learning Strategies) to gain an AVE of 0.4346. Additionally, SLV (Science Learning) has an AVE of 0.426167 with S3_17 bearing the highest loading of 0.725 and S3_18 with the lowest loading of 0.606. Correspondingly, an AVE of 0.489227 was recorded for PG (Performance Goal) bearing indicators S4_24 with a loading of 0.758 and S2_22 with 0.394. AG (Achievement Goal) marked an AVE of 0.45073 whereby S5_25 gained the highest loading of 0.724 and S5_29 with 0.563. Lastly, LES (Learning Environment Stimulation) earned an AVE of 0.424091 comprised of indicator S6_30 with the highest loading of 0.79 and lowest of 0.486 for S6_35.

Table 6: Convergent Validity Measures for SMTSL Questionnaire

Items		Factors	Estimate	Squared Loading	AVE
S1-7	<---	SE	0.568	0.322624	0.461599
S1-5	<---	SE	0.545	0.297025	
S1-4	<---	SE	0.693	0.480249	
S1-2	<---	SE	-0.864	0.746496	
S2-15	<---	AL	0.656	0.430336	0.4346
S2-14	<---	AL	0.741	0.549081	
S2-13	<---	AL	0.61	0.3721	
S2-12	<---	AL	0.622	0.386884	
S3-19	<---	SLV	0.621	0.385641	0.426167
S3-18	<---	SLV	0.606	0.367236	
S3-17	<---	SLV	0.725	0.525625	
S4-24	<---	PG	0.758	0.574564	0.489227
S4-23	<---	PG	0.859	0.737881	
S4-22	<---	PG	0.394	0.155236	
S5-29	<---	AG	0.563	0.316969	0.45073
S5-28	<---	AG	0.651	0.423801	
S5-27	<---	AG	0.715	0.511225	
S5-26	<---	AG	0.724	0.524176	
S5-25	<---	AG	0.691	0.477481	
S6-35	<---	LES	0.486	0.236196	0.424091
S6-34	<---	LES	0.638	0.407044	
S6-30	<---	LES	0.79	0.6241	
S6-31	<---	LES	0.655	0.429025	

Discriminant Validity

According to Fornell & Larcker (1981) discriminant validity is the extent to which a construct is truly distinct from other constructs. It means that a latent variable should explain better the variance of its own indicators than the variance of other latent variables. To examine discriminant validity, the shared variances between factors were compared with the Average Variance Extracted (AVE) of the individual factors.

This means that the values for squared correlations should not be greater than the value of the AVE for each factor. Table 7 shows that the squared correlations between SE and AL of 0.168921 is lower when compared to the AVE of SE and AL. The same is true to the shared variance between AL and SLV bearing squared correlations of 0.432964 which is still less than the AVE of both AL and SLV.

Meanwhile, this trend was also observable among all the other variables like SLV and PG, PG and AG, SE and SLV, AE and PG, SE and AG, AL and PG, SLV and LES, PG and LES, and AG and LES. The data satisfy the criteria and suggest that each factor covered in the study exhibits discriminant validity. Thus, it proves that each item per factor only measures to the factor it belongs.

Scale Reliability

The final items of the questionnaire are presented below. The questionnaire underwent reliability testing for internal consistency using Cronbach's alpha as a measure of internal consistency. The Cronbach's alpha for the different constructs satisfy the criteria for internal consistency bearing the following values: Self-Efficacy (α=0.82), Active Learning Strategies (α=0.86), Science Learning Value (α=0.87), Performance Goal (α=0.90), Achievement Goal (α=0.89), and Learning Environment Stimulation (α=0.85). This depicts that the set of items within these constructs are closely related. In all, the survey questionnaire on Students' Motivation towards Science Learning Questionnaire got a Cronbach's alpha of 0.93. This indicates that the tool has good internal consistency. This is supported by Nunnally (1978) that instruments used in basic research should have reliability of.70 or better.

Table 7: Discriminant Validity Measures for SMTSL Questionnaire

Items		Domain	Estimate	Square Correlations
SE	<-->	AL	0.354	0.125316
AL	<-->	SLV	0.658	0.432964
SLV	<-->	PG	0.22	0.0484
PG	<-->	AG	0.116	0.013456
SE	<-->	SLV	0.485	0.235225
SE	<-->	PG	0.326	0.106276
SE	<-->	AG	0.424	0.179776
AL	<-->	PG	0.129	0.016641
AL	<-->	AG	0.443	0.196249
SLV	<-->	AG	0.555	0.308025
SE	<-->	LES	0.411	0.168921
AL	<-->	LES	0.479	0.229441
SLV	<-->	LES	0.639	0.408321
PG	<-->	LES	0.031	0.000961
AG	<-->	LES	0.6	0.36

Table 8: Revised Students' Motivation towards Science Learning (SMTSL) Scale

REVISED STUDENTS' MOTIVATION TOWARDS SCIENCE LEARNING SCALE
A. SELF-EFFICACY
1. I am not confident about understanding difficult science concepts.
2. No matter how much effort I put in, I cannot learn science.
3. When science activities are too difficult, I give up or only do the easy parts.
4. When I find the science content difficult, I do not try to learn it
B. ACTIVE LEARNING STRATEGIES
5. During the learning processes, I attempt to make connections between the concepts that I learn.
6. When I make a mistake, I try to find out why.
7. When I meet science concepts that I do not understand, I still try to learn them.

8. When new science concepts that I have learned conflict with my previous understanding, I try to understand why.
C. SCIENCE LEARNING VALUE
9. I think that learning science is important because it stimulates my thinking.
10. In science, I think that it is important to learn to solve problems.
11. In science, I think it is important to participate in inquiry activities.
D. PERFORMANCE GOAL
12. I participate in science courses to perform better than other students.
13. I participate in science courses so that other students think that I'm smart.
14. I participate in science courses so that the teacher pays attention to me.
E. ACHIEVEMENT GOAL
15. During a science course, I feel most fulfilled when I attain a good score in a test.
16. I feel most fulfilled when I feel confident about the content in a science course.
17. During a science course, I feel most fulfilled when I am able to solve a difficult problem.
18. During a science course, I feel most fulfilled when the teacher accepts my ideas.
19. During a science course, I feel most fulfilled when other students accept my ideas.
F. LEARNING ENVIRONMENT STIMULATION
20. I am willing to participate in this science course because the content is exciting and changeable.
21. I am willing to participate in this science course because the teacher uses a variety of teaching methods.
22. I am willing to participate in this science course because it is challenging.
23. I am willing to participate in this science course because the students are involved in discussions.

LEGEND	1 = if you **strongly disagree** tothe statement 2 =if you **disagree** to the statement 3 = if you have **no opinion** to the statement 4 = if you **agree** to the statement 5 =if you **strongly agree** to the statement

5. Summary, Conclusion and Recommendation

This chapter represents the summary of findings, conclusions, and recommendations.

5.1 Summary of Findings

Based from the analysis, the following are the summary of findings:

1) The Students' Motivation towards Science Learning Questionnaire contained 35 items measuring Students' Motivation towards Science Learning.
2) Model estimation and assessment of the identified model of Students' Motivation Towards Science Learning revealed poor fit indices of with p-value 0.000 (>0.05), TLI 0.754 and CFI 0.775 (>0.90), and PCLOSE 0.000 (>0.05)
3) The model re-specification of Students' Motivation Towards Science Learning exhibits parsimonious fit as all model fit values have successfully met the criteria set by index of (CMIN/DF < 3.0), (RMSEA < 0.08), and closer fit value to the criteria of (TLI, CFI, and GFI >.90). This means that the model fits well with the data and therefore assert as the new best fit model of Students' Motivation towards Science Learning.
4) The convergent validity SMTSL scale necessitated the removal of 12 items to increase the capacity of the tool to measure the construct it intends to measure which is suitable in the evaluation of students' motivation towards science learning scale. Hence, item numbers 1, 3, 6, 8, 9, 10, 11, 16, 20, 21, 32 and 33 were dropped to satisfy the threshold and suit the set of data. In addition, there are only 23 items included in the revised SMTSL scale.
5) The divergent validity of SMTSL Scale was achieved since the squared correlations of the variables (SE and AL, AL and SLV, SLV and PG, PG and AG, SE and SLV, SE and PG, SE and AG, AL and PG, AL and AG, SLV and AG, SE and LES, AL and LES, SLV and LES, PG and LES, AG and LES**)** are lesser than their respective AVEs
6) The overall reliability of the SMTSL Scale was high with a Cronbach's alpha value of 0.93. The subscales are also above 0.70 which is the criteria of high reliability, namely: Self-Efficacy (α=0.82), Active Learning Strategies (α=0.86), Science Learning Value (α=0.87), Performance Goal (α=0.90), Achievement Goal (α=0.89), and Learning Environment Stimulation (α=0.85).

5.2 Conclusions

Based on the findings of the study, the following are the conclusions:

1) The Students' Motivation towards Science Learning Questionnaire satisfies the norms for face validity.
2) The identified model of Students' Motivation towards Science Learning revealed poor model fit values. The result concluded that the model specification and identification indicate poor fit.
3) The re-specified model of Students' Motivation towards Science Learning satisfied the different model fit indices and therefore exhibit a parsimonious fit.
4) Criteria for convergent validity necessitated the deletion of some items from the questionnaire.
5) Self-Efficacy, Active Learning Strategies, Science Learning Value, Performance Goal, Achievement Goal, and Learning Environment Stimulation are distinct constructs and therefore satisfied the criteria for divergent validity.
6) The reliability of the Students' Motivation towards Science Learning Questionnaire is high which provides evidence that the items being measured are consistent in measuring the underlying factors.

5.3 Recommendation

Based from the findings, analysis, and conclusion drawn in this the study, the following recommendations are summarized.

1) One of the limitations of this study was the exclusivity of its respondents who are from Panabo National High School Junior high school students, Panabo City Division. Hence, this research suggests that the study may include the Senior High School Students and should be administered to the entire division since the increase in population size may enhance the generalizability of the scale.
2) The revised STML questionnaire may be used or adapted as a tool by the teachers to assess motivational levels of their learners and strengthen the components of motivation that would help students to become more efficient learning Science and be academically successful.
3) The future researchers may add items and improve the revised SMTSL scale since the questionnaire is from other country. The items dropped may not be relevant or suitable to the Filipino student of the entire division of Panabo or entire Region XI.

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