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Academic Factors, Motivation And Self-Efficacy In Solving Word Problems In General Physics

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Abstract

This study was conducted to determine the relationship between academic factors, motivation, and self-efficacy of senior high school students in solving word problems in General Physics. Descriptive-correlational design supported by quantitative data was utilized in this study through a survey method. The participants of the study were the Grade 12 STEM students among the three mega schools in the municipality of Polomolok. Moreover, sets of survey questionnaires were used as an instrument to obtain information from the participants. Frequency count, Percentage, Mean, Pearson-r and Multiple Regression to find the significance of relationship between the independent and dependent variables. Structural Equation Modelling was used to identify the model that best fits the students' self-efficacy in solving word problems in General Physics. The study yielded the following salient findings: First, respondents had a moderate extent of academic factors such as curriculum, academic resources, school policies and academic support. Second, they had a high extent of motivation in solving word problems, thus a moderate extent of self-efficacy in the process of problem solving was revealed. Third, there was a significant relationship between self-efficacy, academic factors, intrinsic and extrinsic motivation. Finally, the influence of academic factors, intrinsic motivation and extrinsic motivation significantly predict self-efficacy of Senior High School students in solving word problem in General Physics. Finally, the best-fit model in academic factors, motivation and self-efficacy of senior high school students in solving word problems was developed, which passed all the goodness of fit indices criteria.

Keywords**:** Academic Factors; Motivation; Self-efficacy; Structural Equation Modelling

INTRODUCTION

Students' performance in learning Physics is brought by the different factors and also considered vital for assessing a student's standing in a certain school (Husaini, 2023). This apprehension towards the subject brought by the different factors. Thus, to perform well in the subject, it required confidence and limited hindering factors to learn effectively. Basically, motivation affected the performance of the learners to do further in their academic endeavor. It affected student learning and played an important role in directing behavior towards a certain goal, increasing the effort and energy towards a goal, increasing the initiative and perseverance of an activity, and improved individual performance (Saleh, 2014).

In relation to factors affecting learning Physics, it is mystified to be a tough and abstract discipline, it usually gave students a negative impression that Physics is difficult (Tekwani, 2020). Most students considered Physics a difficult subject, mainly due to the learning processes involved in understanding the subject matter, which required the learners to deal with different types of representations, such as formulas, calculations, graphics representations, and also a conceptual understanding at an abstract level (Henriksen, 2019). Hence, Physics has become a subject of least choice at schools, and most students have been reported to veer away from Physics related courses at the higher level of education (Saleh, 2014).

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Moreover, aside from those variables, there were existing academic factors that hindered successful learning. Generally, these factors included age, gender, geographical belongingness, ethnicity, marital status, learning environment and opportunities, socioeconomic status (SES), parents' education level, parental profession, language, income and religious affiliations. These were usually discussed under the umbrella of demography and in a broader context, demography was referred to as a way to explore the nature and effects of demographic variables in the biological and social context (Akessa & Dhufera, 2015). In some ways, educational support and system might affect as well on the learning of students including curriculum, resources, and policies.

It was well known that student`s motivation was influenced by both internal and external factors that could start, sustain, intensify or discourage behaviors (Yilmaz, 2017). Individual traits or dispositions, such as curiosity, responsibility for learning, effort, values, and perceived aptitude, that a student brings to his or her learning activity can have a significant impact on their academic endeavors as cited by Phillips (2016) in her study.

Another demarcation factors that improve learning is student's self-efficacy. It is highly believed that students with strong self-efficacy beliefs visualize success scenarios, which provide supportive resources, and guidance for learning (Doménéch-Betoret, 2017). It is also major predictor of students' academic achievement, career interest and course-taking. It has been found to correlate with academic achievement and people's choice of subjects and employability (Tentama & Abdillah, (2019). It encapsulated the confidence of the learners to exert control over one's own motivation, behavior, and social environment. These cognitive self-evaluations influenced all manner of human experience, including the goals for which people strive, the amount of energy expended toward goal achievement, and likelihood of attaining particular levels of behavioral performance (APA, 2021).

The quality of students' performance remains a top priority for educators. It is meant to make a difference locally, regionally, nationally, and globally (Siachifuwe, 2017). The current state of science education in the Philippines, particularly in the basic education level, lagged behind other countries in the world. The results of the Second International Science Study (SISS) and 2019 Trends in International Mathematics and Science Study (TIMSS) placed the Philippines in disadvantaged positions among participating nations where it ranked last out of 58 participating countries in both science and mathematics. From the Programme for International Student Assessment (PISA) in 2018, it showed that the Philippines ranked second lowest in Science and Mathematics from 79 countries that participated.

In an informal interview conducted among five senior high school teachers in the Municipality of Polomolok who were teaching General Physics 1, one of the most difficult aspects of teaching the subject was how to motivate and encourage the learners to learn the content as how they would learn other areas. According to them, students lost interest in learning Physics because it involved a lot of computations, dealing with numbers, required a lot of analysis and derivations of equations and formula. These five teachers agreed as well that it was a lot more difficult to encourage the learners to learn physics, especially with the current situations where the pandemic brought by COVID-19 had a lot of effect, most particularly on the communication level. The pandemic limited the communication between the teacher and learners which was very vital in discussing and explaining the concept. According to these teachers, the learners were less interested and motivated as they found it difficult to learn independently since most of them were relying on the concept presented from the Self-Learning Module. Fortunately, there were some students who were a bit interested especially those who had technological resources to join the virtual and online discussions.

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Consequently, this study aimed to determine how demographic profile, intrinsic motivation, and extrinsic motivation, and academic factors (curriculum, academic resources, school policies and procedures and academic support) affected self-efficacy of the Science, Technology, Engineering and Mathematics (STEM) students in solving word problem in General Physics.

METHODOLOGY

The researcher employed quantitative descriptive-correlational design through a survey method. Quaranta (2017) defined quantitative research as the systematic empirical investigation of observable phenomena via statistical, mathematical, or computational techniques. It involves counting and measuring events and performing the statistical analysis of a body of numerical data. Quantitative methodology is generally used in studies with research questions about who, what, and how many (Leavy, 2017). This design is assumed to provide a complete understanding academic factors, intrinsic motivation, extrinsic motivation, and self-efficacy of STEM students in solving word problems in General Physics.

The population came from the identified mega schools of Senior High schools of Polomolok, South Cotabato. The students who underwent the survey were those enrolled in STEM strand and currently taking General Physics subject for this school year 2022-2023.

Descriptive research gathers information about prevailing conditions or situations for description and interpretation. This research method is not simply tabulating facts but also includes proper analyses, interpretation, and relationships. In addition, Creswell (2014) emphasized that correlational design uses statistics to investigate the association and to what extent the variables are related from one to another.

Primarily, the demographic profile of the respondents was identified prior to the survey. The profile includes sex, educational attainment of both the father and the mother, the economic status which was the combined monthly income of the parents, and the technological resources available and utilized by the respondents. Subsequently, the quantitative data was collected through questionnaire survey on how extensive academic factors, intrinsic motivation, extrinsic motivation, and self-efficacy of STEM students in solving word problems in General Physics. After which, a significant relationship of self-efficacy among academic factors, intrinsic motivation, and extrinsic motivation was identified. The analysis was helpful when the researcher wanted to establish possible connections between the said variables. Then, the data gathered were the basis in developing the suited model for Self-efficacy of the Grade 12 STEM students in solving word problems in General Physics through Structural Equation Modelling. Therefore, the researcher used quantifiable data gathered to explain, describe, and answer the questions set for this study.

RESULTS AND DISCUSSION

Profile of Respondents

The respondents of the study were the grade 12 STEM students from the mega schools in the Municipality of Polomolok. They were officially enrolled in the school year 2022-2023 and took up General Physics subject. The data gathered includes sex, parent's educational attainment, socio-economic status, and their technological resources.

Table 1 shows the demographic profiles of the respondents including sex, parents' educational attainment, socio-economic status, and technological resources. Based on the data, the respondents are dominated by male with a frequency count of 126 which is equivalent to 58.60% as compared to females who have a frequency count of 89 which is equivalent to 41.40%. With regard to the educational attainment of their mothers, most of them are college graduates with a frequency count of 79 which is equivalent to 33.95% and followed by high school graduates with a frequency count of 61 which is

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equivalent to 28.37%. In terms of parent`s educational attainment of their father, majority of their father falls under college graduate category with a frequency count of 62 which is equivalent to 28.48% and there 61 fathers with a frequency count of 61 which is equivalent to 28.37%.

Table 1. Profile of the Respondents

Indicators	Frequency	Percentage
1. Sex		
Male	126	58.60
Female	89	41.40
Total	215	100.00
2.1 Parent's Educational Attainment (Mother)		
College Graduate	73	33.95
College Level	48	22.33
Tech-Voc Graduate	2	0.93
Tech-Voc Level	0	0
High School Graduate	61	28.37
High School Level	19	8.84
Elementary Graduate	7	3.26
Elementary Level	4	1.86
No Education	1	0.47
Total	215	100.01
2.2 Parent's Educational Attainment (Father)		
College Graduate	62	28.84
College Level	35	16.28
Tech-Voc Graduate	16	7.44
Tech-Voc Level	1	0.47
High School Graduate	61	28.37
High School Level	24	11.16
Elementary Graduate	9	4.19
Elementary Level	7	3.26
No Education	0	0
Total	215	100.01
3**. Socio-economic Status**		
Php 50,000 and above	14	6.51
Php 40,000 - Php. 49,000	8	3.72
Php 30,000 - Php. 39,000	24	11.16
Php 20,000 - Php. 29,000	42	19.53
Php 10,000 - Php. 19,000	56	26.05
Below Php 10,000	71	33.02
Total	215	99.99
4. **Technological Resources**		
Mobile Phone	22	10.23
Mobile Phone & TV	45	20.93
Laptop & Mobile Phone	17	7.91
Computer & Mobile Phone	7	3.56
Laptop, Mobile Phone & TV	57	26.51
Computer, Mobile Phone & TV	14	6.51
Laptop, Mobile Phone & Tablet	1	0.47
Laptop, Mobile Phone, TV & Tablet	7	3.56
Laptop, Mobile Phone, Audio Recordings & TV	10	4.64
Laptop, Computer, Mobile Phone, TV & Tablet	4	1.86
Laptop, Computer, Mobile Phone, & TV	17	7.91
Mobile Phone, TV & others	4	1.86
Mobile Phone, Audio Recordings & TV	4	1.86
Laptop, Computer, iPod, Mobile Phone & TV	4	1.86

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Laptop, Computer, Mobile Phone, Audio Recordings, TV & Table	1	0.47
Mobile Phone, Netbook & TV	1	0.47
Total	215	100.61

It can be gleaned also from the table that out from 215 respondents, there are 71 respondents which is equivalent to 33.02% who shared that their parent's monthly income is below Php 10,000.00 every month. This means that majority of the respondents fall under poor category as defined by the Philippine Institute Development Studies (2022) when analyzed based on the income brackets. Followed by the 26.05% families with monthly income of Php 10,000 - Php 19,000.

Subsequently, with regard to the technological resources used by the STEM students most of them have Laptops, Mobile Phones and Television with a frequency count of 57 which is equivalent to 26.51%.

Table 2 presents the extent of academic factors among Grade 12 STEM students in answering word problems in General Physics. This includes curriculum, academic resources, school policies and procedures and academic support. Curriculum covers the topics and concepts, their arrangement in terms of its increasing level of difficulty, time allotment per competencies, integrations of the topics and its purpose in addressing student's individual differences. Academic resources include the availability of the Self-Learning Modules (SLMs) and Learning activity sheets (LASs), the online, offline and printed resources. On the other hand, school policies and procedures include the support given by the school as to the distribution of the different resources, the recognitions given to the learners and the assessment of their individual performances. Lastly, the teachers` support which refers to the role of the teacher in terms providing relevant and interactive activities, guidance in answering the word problems, presentation of the lesson, assessment and feedbacking process.

Table 2. Extent of Academic Factors

Indicators	Mean	Interpretation
A. Curriculum (The topics/concepts…		
are properly arranged in increasing order of difficulty	3.73	Moderately Extensive
are provided with the appropriate time element	3.63	Moderately Extensive
are easy to understand since they are integrated in other subjects.	3.29	Moderately Extensive
allow students to be more creative and resourceful	3.93	Moderately Extensive
are presented in both words and figures that caters to individual differences	3.87	Moderately Extensive
Overall	**3.69**	**Moderately Extensive**
B. Academic Resources (Academic resources like…		
Self-Learning Modules (SLMs) are sufficient for all students	2.87	Less Extensive
Learning Activity Sheets (LASs) are provided and ready to be answered	3.56	Moderately Extensive
soft copies of the SLMs and LASs in Physics are accessible through mobile devices	3.83	Moderately Extensive
online platforms are accessible using electronic devices	4.11	Highly Extensive
books, encyclopedias and other printed resources are accessible for students in the library	3.25	Moderately Extensive
Overall	**3.52**	**Moderately Extensive**
C. School Policies and Procedures (School Policies and Procedures…		
provide students enough time to answer activities before the retrieval of the SLMs and	3.79	Moderately Extensive

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LASs		
require teachers to give feedback on students' performance	3.73	Moderately Extensive
require that students' ratings are computed according to the standards on both performance and written tasks	3.96	Moderately Extensive
would mandate that students' ratings are given on time	3.70	Moderately Extensive
provide for the recognition of students with excellent performance	4.23	Highly Extensive
Overall	**3.88**	**Moderately Extensive**
D. Academic Support (Teachers…		
are supportive in providing the needs of students in terms of answering the SLMs and LASs	3.82	Moderately Extensive
assist and guide students in answering word problems and schematic diagrams	3.74	Moderately Extensive
provide the necessary feedback about the performance of students after the completion of SLMs and LASs.	3.55	Moderately Extensive
design Physics activities that are relevant and enjoyable as they work together with their classmates	3.74	Moderately Extensive
are available for consultation whenever students experience difficulties with their lessons	3.83	Moderately Extensive
Overall	**3.74**	**Moderately Extensive**
GRAND MEAN	**3.67**	**Moderately Extensive**

Table 2 reveals the result on the extent of academic factors among STEM students in solving word problems in General Physics. There are four indicators on the extent of academic factors that are presented in the table with corresponding mean. The indicators are: curriculum, academic resources, school policies and procedures, and academic support.

Among the four indicators, it can be gleaned in the table that school policies and procedures have the highest mean of 3.88 which is interpreted as moderately extensive. Meanwhile, academic resources garnered the lowest mean of 3.52 which moderately extensive. The overall mean rating on extent of academic factors is 3.67 which is interpreted as moderately extensive.

Polec-eo (2013) stated that academic problems caused by the academic factors defined the difficulties of students encountered including ability, attendance, study skills, and other academic related issues of the participants. Furthermore, the students viewed that one of things that does not bother them is the implementation of curriculum and academic resources. For the past few years, the students have been used to learning practice given by the teachers. This is the only academic factor where they give their trust. Since students view only effective curriculum implementation. They viewed curriculum implementation as the translation of theory into practice, or proposal into action. On the other hand, the curriculum planning process, the application of the curriculum in the form of a learning process, and other characteristics that become the identity of the institution (Neliwati et al., 2023).

As shown in the table, the category mean of curriculum is 3.69 which is interpreted as moderately extensive. Out from that indicator, it was found out that the topics and concepts allow students to be more creative and resourceful with a mean score of 3.93 and interpreted as moderately extensive. This is supported by the study of Wellington (2008) that learners become more creative and resourceful when they are exposed to topics and concepts that are part of the curriculum. It also allows them to apply, suggest, extend, model, and offer alternatives that can be modeled to their fellow students. On the other hand, the respondents perceived that topics and concepts in the curriculum is easy as it is integrated in other subjects which has a mean score of 3.29 and still interpreted as moderately extensive. This is in

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contrary with the study of Stainberg (1997) as cited by Baskan (2010). Since topics and concepts in Physics and Mathematics lessons are tightly related disciplines, students found it difficult to transfer their knowledge and skills in Mathematics to understand and solve problems in Physics.

On the other hand, academic resources indicators found to have a less extensive in the availability and sufficiency of Self-Learning Modules (SLMs) with a mean of 2.87. However, among the five indicators on academic resources, it is found out that the respondents have a good access in using electronic devices as academic resources with a mean score of 4.11 which is interpreted as highly extensive.

This result is supported by the study of Lee (2016) that learning is affected through the use of technology in the teaching and learning environments. His research has highlighted the benefits of web-based learning for students. Some studies indicate that the use of educational technology affords the learners greater anonymity and opportunities to practice a range of generic skills for instance, management of self, others, task, and information. With computer resources, learners are provided with the opportunity to interface with computers on a regular basis. Indeed, library resources are largely retrievable online and students do not have to be in a physical location like a library facility to be able to access most research articles and technical research reports.

In terms of school policies and procedure, it garnered a category mean of 3.88 which is interpreted as moderately extensive. Out from the five indicators, giving recognitions and rewards among students with excellent performance garnered the highest category mean of 4.23 which is interpreted as highly extensive. Thus, giving learners` recognition and rewards helped them to be more motivated, enhanced their self-esteem; improved their classroom behaviors; and let them complete their tasks and other classroom projects (Whitfield, 2021). In support of this finding, students can perform better when they are rewarded and appreciated by their academic achievements (Srivastava, 2014).

While the other indicators showed moderately extensive, however, students' ratings are given on time as a form of assessment feedback gained a mean score of 3.70 as lowest among the indicators and interpreted as moderately extensive.

Such result validates the study of Cohen and Singh (2020) that learning is significantly impacted by feedback. By giving immediate feedback towards learners` performance, it allowed them to justify how their mark or grade was derived; helped them recognize and reward particular traits in their work; it guided them on what steps to take in order to improve; motivate them to act on their assessments and develop their capability to monitor, evaluate and regulate their own learning (Nicol, 2010).

Lastly, academic support from their teachers had a category mean of 3.74 which is interpreted as moderately extensive. The data elucidated a moderately extensive mean score of 3.83 in terms of availability of teachers for consultations whenever students experience difficulties with their lessons. Such result was attested by the study of Kaufman (2023) that improving students' relationships with teachers through consultation and dialogue is important and it brings positive and long-lasting implications for both students' academic and social development. Solely improving students' relationships with their teachers will not produce gains in achievement. However, those students who have close, positive, and supportive relationships with their teachers help them to learn better and will attain higher levels of achievement than those students with more conflict in their relationships.

Meanwhile, the other indicators signified a moderately extensive interpretation, nonetheless, giving of feedback about the students' performance after completion of SLMs and LASs gained a mean of 3.55 as lowest in the academic support. This is in consonance on the studies of the impact of feedback on student learning achievement which indicate that feedback has the potential to have a significant effect on student learning (Hattie & Timperley, 2007). Hence, effective feedback helps the learner reflect on their own learning and their own learning practices so they can make changes to advance their learning more effectively (Hattie, 2009).

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Table 3 covers the extent of motivation among Grade 12 STEM students. It includes both intrinsic and extrinsic motivations which greatly affect their self-efficacy in solving word problems in General Physics. In context, intrinsic motivations include the challenge of learning General Physics, understanding and learning new concepts, sense of self-satisfaction and achievement of personal goals. Meanwhile, Extrinsic motivation includes student's personal desire to be great among others which include friends, classmates and parents. It also includes their extra motivations to achieve greatness through achieving personal goals such as becoming an honor student and be part of the list of students who excel in General Physics in terms of performance.

Table 3. Extent of Motivation

Indicators	Mean	Interpretation
A. Intrinsic Motivation		
I am challenged as I learn new Physics concepts.	4.32	Highly Extensive
I am able to use new concepts in understanding other subjects.	3.83	Moderately Extensive
I feel satisfied when I get good grades.	4.64	Highly Extensive
I have that sense of accomplishment as I progress in my performance.	4.40	Highly Extensive
I need to avoid failing in Physics.	4.49	Highly Extensive
Overall	4.34	Highly Extensive
B. Extrinsic Motivation		
I want my parents to be proud of my performance.	4.54	Highly Extensive
I need to set a good example for my siblings and other family members.	4.37	Highly Extensive
I want to impress my classmates and friends.	2.99	Less Extensive
I desire to be included in the list of honor students	4.35	Highly Extensive
I need to belong among those who also excel in Physics.	3.74	Moderately Extensive
Overall	4.00	Highly Extensive
GRAND Mean	4.17	Highly Extensive

Table 3 reveals the extent of motivation among STEM students. As gleaned in the table, intrinsic motivation tops over extrinsic motivation which has a category mean of 4.34 which is interpreted as highly extensive which means that the respondents are intrinsically motivated to learn topics and concepts in Physics. On the other hand, extrinsic motivation is rated as 4.00 which is still interpreted as highly extensive. Generally, the result of the descriptive analysis on the extent of motivation reveals to have an overall mean of 4.17 which is interpreted as highly extensive.

In terms of intrinsic motivation, the indicator on the usage of integrative approach or connecting new concepts in understanding other subjects garnered the lowest mean score of 3.83 among other indicators which is interpreted as moderately extensive. However, the indicator on performing further in the subject through good grades can make them feel satisfied garnered the highest mean score of 4.64 which is interpreted as highly extensive. This coincides the result on the study of Morin (2020) that getting good grades help the learners to improve their social life as they earn the respect of their teachers and peers. It also revealed that it boosts their confidence academically. Thus, students will be interested in the studies when they have high achievement score (Mewat, 2016).

Meanwhile in the extrinsic motivation, most of the students believed that their performance is not motivated in impressing their classmates and friends with a mean of 2.99 which is interpreted as less extensive. This contradicts the findings on the study of Schwartz (2009) that for learners who have friends, those friendships motivated them and contribute to the development of pro-social skills, help define self

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and self-worth therefore inspiring greater self-confidence, positively influencing school performance, and assisting in encouraging or discouraging deviant behaviors. In support of this, research has shown that in middle school having reciprocal friendships increases levels among motivation, prosocial behavior, and academic achievement (Wetnzel et al., 2004).

However, the data revealed that their extrinsic motivation is highly extensive when they perform to make their parents proud of their performance which garnered a mean score of 4.54. Thus, the performance of the students can greatly enhance as parents give care and different encouragement across all areas of social life (Igbo et al., 2015). According to Lowe and Dotterer (2013), parental supervision is one of the most powerful motivators. Parents made an effort to support their pupils based on what they had learned in the past (Garn et al.2010). This was done to help their kids develop their academic talents. With the same magnitude of motivation, students perform well to serve as good examples for their siblings and other family members which has a mean score of 4.37 which is interpreted as highly extensive. Thus, setting good examples or being role models can exercise a formative influence in the life of an individual. In autobiographies and interviews, prominent people often recount how role models have inspired or influenced them positively (Lockwood, 2006). Lastly, their desire to be included in the list of honors garnered a mean score 4.35 which is also interpreted as highly extensive.

Table 4 covers the extent of self-efficacy among the students in solving word problems in General Physics. It includes their efficacy on the actual procedures and process such as analysis of the word problem, identification of the given variables, determination of appropriate formula, derivation, solution development, conclusion and checking and organization and presentation of answers. This general procedure identifies students' strength, efficiency, accuracy, critical thinking, creativity and presentation skills.

Table 4. Extent of Self-Efficacy

Indicators	Mean	Interpretation
A. Analysis of word problem		
identifying the problem in the situation	3.67	Moderately Extensive
understanding the role of the variables	3.58	Moderately Extensive
determining the relationship between the variables involved	3.52	Moderately Extensive
Overall	3.59	Moderately Extensive
B. Identification of the given variables		
pointing out the main variable in the problem	3.63	Moderately Extensive
identifying the values of the given variables	3.71	Moderately Extensive
determining the unknown in the problem	3.56	Moderately Extensive
Overall	3.63	Moderately Extensive
C. Determination of appropriate formula		
highlighting the underlying concept in the problem	3.57	Moderately Extensive
listing the possible formula to be used	3.95	Moderately Extensive
determining the appropriate formula for the problem	3.83	Moderately Extensive
Overall	3.78	Moderately Extensive
D. Formula derivation		
utilizing the basic operations required in formula transformation	3.73	Moderately Extensive
transforming the formula into the required format	3.57	Moderately Extensive
checking if the formula transformation is correct	4.00	Highly Extensive
Overall	3.76	Moderately Extensive
E. Solution development		
taking the initial steps in presenting the solution	3.89	Moderately Extensive

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with the appropriate formula		
presenting clearly the solution in a logical way	3.61	Moderately Extensive
providing a methodical manner of showing how to arrive at the correct answer	3.65	Moderately Extensive
Overall	3.72	Moderately Extensive
F. Conclusion and checking		
providing a concluding statement in support of the final answer	3.62	Moderately Extensive
establishing a scheme to check the solution	3.48	Moderately Extensive
checking the correctness of the entire process	3.80	Moderately Extensive
Overall	3.63	Moderately Extensive
G. Organization and presentation of answers		
organizing the entire solution for class presentation	3.58	Moderately Extensive
explaining the solution with clarity	3.48	Moderately Extensive
answering questions from the teacher and classmates	3.52	Moderately Extensive
Overall	3.53	Moderately Extensive
OVERALL MEAN	**3.65**	**Moderately Extensive**

Table 4 shows that the overall mean on the extent of self-efficacy is 3.65 which is interpreted as moderately extensive. This denotes that the self-efficacy among STEM students in answering Physics problems is at a moderate level. All indicators are described as moderately extensive. Out from the seven indicators, determination of appropriate formula tops over other indicators which has a category mean of 3.78 which is interpreted as moderately extensive. Formula derivation has category mean score of 3.76, solution development garnered a category mean score of 3.72, both identification of the given variables and conclusion checking indicators garnered a category mean of 3.63; analysis of word problems has a category mean score of 3.59. Meanwhile, organization and presentation of answers has the lowest mean of 3.53, but still interpreted as moderately extensive.

The analysis of the word problems as lowest in terms of its category mean score is in harmony in the study of Huda and Kencana (2013) that students' error analysis in solving word problems can be associated with found that linguistic difficulties, such as ability to understand vocabulary, translate daily vocabulary to mathematical expressions, and understand symbols; were predominantly found. One study showed that in solving word problems, students could not understand vocabulary, which information to use, or found the text to be confusing (Klymchuk et al., 2010). These difficulties towards the analysis of the word problems can affect transforming meaning among visual representation, symbol, and solution in the given problems. Difficulty due to multiple representation systems refers to the difficulty to make meaning among the three systems: daily language, symbols, and visual representation (Fatmanissa et al, 2020).

In analyzing word problems in Physics, students have a moderately extensive self-efficacy in determining the relationship between variables which was indicated with a mean score of 3.52 while they manage to identify the problem in a given situation at a moderate extent which is implied by the mean score of 3.67.

The relationships of the variables to the problems become sensible to the learners if the connections are taken in real life situations. In the analysis process, it really is important to establish the questions in the problem and its setting. As indicated, to better understand these difficulties of word problem, it is important to understand the linguistic aspects of constructing it; students who fail to understand the constructing aspects, will have difficulty in solving word problems (Fatmanissa et al., 2020). To further understand the making relationships with situations, schema-based strategy is one of the strategies. Schema-based strategy instruction is known to benefit students in exercising their ability to understand and apply the linguistic aspects of word problems (Fatmanissa et al., 2020).

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In identifying given variables, students have a moderate extent of self-efficacy in determining the unknown in the problem which was implied by mean score of 3.56 while they can easily identify the values of the given variables at a moderate extent or 3.71 mean score.

Real-world problems seem to present other difficulties for the problem solver than standard problems do. In dealing with word problems, students used the familiarity of the units and variables. This means that the problem framing stage of the problem-solving process emphasizes how important real-world problem solving has already been done when the problem is presented to the solver (Roth, 1995).

With regard to determining the appropriate formula, students have a moderate extent of self-efficacy among three indicators, highlighting the underlying concept in the problem being the lowest mean at 3.57 and listing the possible formula to be used being the highest mean at 3.95.

The same results have been found out on selecting the principle choice and concept choice; several empirical studies show that both cause difficulties for standard problems. Though some of the students may assume that they understood the problems, however, in terms of conceptualizing the appropriate principles they misinterpret its usage. Hardiman, Dufresne, and Mestre (1989) found that beginning Physics students who had completed a Physics course had trouble identifying major laws or principles that could be applied to solve a problem. Other studies show that while students may be able to state the definitions of scientific concepts, they often do not know what to do to apply these definitions in specific cases (Labudde et al., 2008).

In formula derivation, the students have a moderate extent of self-efficacy in transforming the formula into a required format which is implied by the mean score of 3.57 while they have a high extent of self-efficacy in checking if the formula transformation is correct with a mean 4.00.

Poor problem solvers fail or are unable to carry out the necessary qualitative analysis to construct an adequate representation. Understanding why and how a feature is important thus involves conceptual knowledge of the problem (Niss, 2012). Fortus (2008) stresses that making assumptions is crucial when transforming a real-world problem into a well-defined question. This involves a process of derivation of formula through thorough assumptions; he finds that two types of assumptions are involved such as assumptions about the Physics variables and the principles involved in the problem; and assumptions about the absolute or relative magnitudes of the variables. Thus, if the students have seen some proficiency in formula derivation, they have a good background in mathematics and Physics principles.

In developing a solution, the students have a moderate extent of self-efficacy in all three indicators, clearly presenting their solution in a logical way being the lowest mean with 3.61 and taking the initial steps in presenting the solution with the appropriate formula having the highest mean at 3.89.

While not intending to characterize difficulties, Redish (2005) argued from a theoretical point of view that the ability to use mathematics in solving Physics problems requires something other than what is learned in the mathematics classroom. In particular, physicists interpret and use equations in a different way than mathematicians, because they combine conceptual physics and mathematical symbolism. With regard to selecting formulas as anchored to a mathematical point of view, students can actualize the concepts, however, dealing with solutions through mathematics seems difficult. Understanding the problem itself can be an important solving process, such as the identification of necessary prerequisite skills as well as the design of activities that scaffold the development of problem-solving competency (Niss, 2012).

In formulating their conclusions and checking their answers, the students have a moderate extent of self-efficacy in all three indicators. Establishing a scheme to check the solution with 3.48 being the lowest while checking the correctness of the entire process with a mean of 3.80 being the highest. Checking the solution itself of the problem, the entire process is evaluated with respect to both the original purpose as well as validity (Niss, 2012).

Finally, organization and presentation of answers, students have a moderate extent of self-efficacy in all three indicators. Explaining the solution with clarity being the lowest with a mean of 3.48 and organizing the entire solution for class presentation being the highest mean with 3.58. The better

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understanding of the problem is taken with a valid and reliable explanation of the whole process. If the answer is driven by situation, principles, and mathematical process it can ensure that the procedure is valid (Niss, 2012). Finally, a conclusion about the real-world situation is drawn based on the obtained results. However, to formally take everything into practice, the teaching may not maximally utilize the use of schema in facilitating exercises. The process must be taught to the students from the first procedure down to the organization and checking to be effective in familiarizing students with word problems (Chan, 2015).

Table 5 presents the summary on the correlation between self-efficacy and academic factors, self-efficacy and intrinsic motivation and self-efficacy and extrinsic motivation. It shows the relationship among the three variables with regards to the Grade 12 STEM student's efficacy in solving word problems in General Physics. The table also includes the p-value which is one of the important elements in determining if the relationship between these variables is significant or not.

Table 5. Summary of table for Correlation

Correlation between Self-Efficacy and…	*Correlation Coefficient*	*t-stat (N=215; df=213)*	*p-value*	*Interpretation*
Extent of Academic Factors	0.56	9.76	<.001	Highly Significant
Intrinsic Motivation	0.55	9.69	<.001	Highly Significant
Extrinsic Motivation	0.31	4.76	<.001	Highly Significant

As a result of the test, it was found out that r for academic factors towards endogenous variables is 0.56, df = 9.76, and p-value of <.001. For the intrinsic motivation revealed r of 0.55, df = 9.69, and p-value of <.001, meanwhile, extrinsic motivation showed also a highly significant relationships of r = 0.31, df = 4.76, and p-value of <.001, and these show that the model has a perfect fit and is interpretable.

Technically, the self-efficacy positively correlates with academic factors as indicated to the moderately in extent as manifested in self-efficacy's subscales and academic factors. According to these results, the high extent of self-efficacy in solving Physics problems has actually a positive impact on the academic factors. Akgün et al., (2014), in which they found out that the level of science and literacy in learning Physics affects self-efficacy beliefs and other academic factors positively. It was also in accordance to the results from the study of Motlagh et al., (2011) that self-evaluation, self-directing and self-regulation are correlated with academic achievement which is taken from student's self-efficacy in general.

Furthermore, intrinsic motivation towards self-efficacy gives a positive relationship with the endogenous variables. The same results have been confirmed by Poluakan (2012) that positive self-efficacy among students can actually help them in their success and motivation. The indicator of having accomplishments and recognitions is technically a strong drive among students to perform better in their learning experience. Self-efficacy in learning physics is stated to be a strong and positively significant relationship between science literacy and science self-efficacy (Latifah et al.,2019).

With the same multitude of significance towards intrinsic motivation, the extrinsic motivation revealed as well as promising relationships with self-efficacy. A positive and significant relationship was found between motivations driven by their social exposures towards their self-efficacy beliefs (Al Sultan et al., 2018). Social exposure includes the influence of their peers, parents, and siblings in their learning journey. Moreover, in the study of Flores (2019), examining the science self-efficacy of secondary school stated that high science literacy means high self-efficacy, and as science literacy increases, self-efficacy belief towards science learning also increases.

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Table 6 displays the findings of the regression analysis designed to identify the significant predictors of self-efficacy in answering word problems in General Physics. The findings show that academic factors and intrinsic motivation reveal a highly significant predictors on self-efficacy. However, the extrinsic motivation shows a not significant predictor toward self-efficacy using regression analysis.

Table 6. Predictors of Self-efficacy in Answering General Physics Word problems

Independent Variables	*Correlation Coefficient*	*Standardized Coefficients*	*t-value*	*p-values*	*Interpretation*
Extent of Academic Factors	0.46	0.07	6.34	.001	Highly Significant
Intrinsic Motivation	0.39	0.09	4.34	.001	Highly Significant
Extrinsic Motivation	0.12	0.06	1.94	.05	Not Significant

Note: R = .648, R^2 = .419, F-ratio = 50.793, p = 0.00

The indicated R^2 of .419 demonstrates a positive standardized beta which amplifies on the overall significant predictors which is highly significant. This means 92% of the variation can be taken from the other independent variable. The result is also in consonance to the study of Akgün et al., (2014) that the learning in Physics can truly influence by the academic factors affects on the learning experience. Moreover, students' motivation in learning different concepts can improve individual's belief or self-efficacy. Those with high self-efficacy often have high motivation and vice versa, but it is not a foregone conclusion (Ackerman, 2023).

Structural Equation Modelling

This study adopted a more comprehensive technique called structural equation modeling (SEM) in which the previous models were combined together to form an overall single model, where adjustments could be made for it to work better. Hair (2010) purported that apart from SEM, no multivariate technique enables any researcher to test his entire theory that considers all possible information in one comprehensive analysis. Thus, this technique was adopted because, theoretically, the philosophical and psychological constructs all influence performance in problem solving, but confirmatory analysis such as SEM improves the acceptability of the model or theory.

The full model in Figure 3 has several variables with Self-efficacy as exogenous variables (independent) with 7 encapsulated subscales and 3 endogenous variables (dependent) in the form of intrinsic motivation with 5 indicators, extrinsic motivation with 5 indicators, and academic factors with 4 indicators.

The results reveal that the three predictors (academic factors, p = 0.00; intrinsic motivation = 0.00, and extrinsic motivation p = 0.05) have a significant direct effect on self-efficacy of the STEM students. This shows that as self-efficacy increased is due to the increased in the academic factors, intrinsic motivation, and extrinsic motivation of the STEM students.

The correlation implies a positive and strong relationships among the variables towards self-efficacy in answering word problems in Physics. Moreover, the R square of 0.42 tells that the model explains 96% of the variance of self-efficacy. This further explain that the 4% of the variance of the self-efficacy can be attributed to other factors other than the exogenous variables in this study.

Full Model

The figure presented a significant correlation from each other as indicated on their regression weights: Self-efficacy towards intrinsic motivation (.338), Self-efficacy towards extrinsic motivation (.083), self-efficacy towards academic factors (.372), intrinsic motivation towards academic factors (.597), and intrinsic motivation towards extrinsic motivation (.510), and extrinsic motivation towards academic

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factors (-.136).

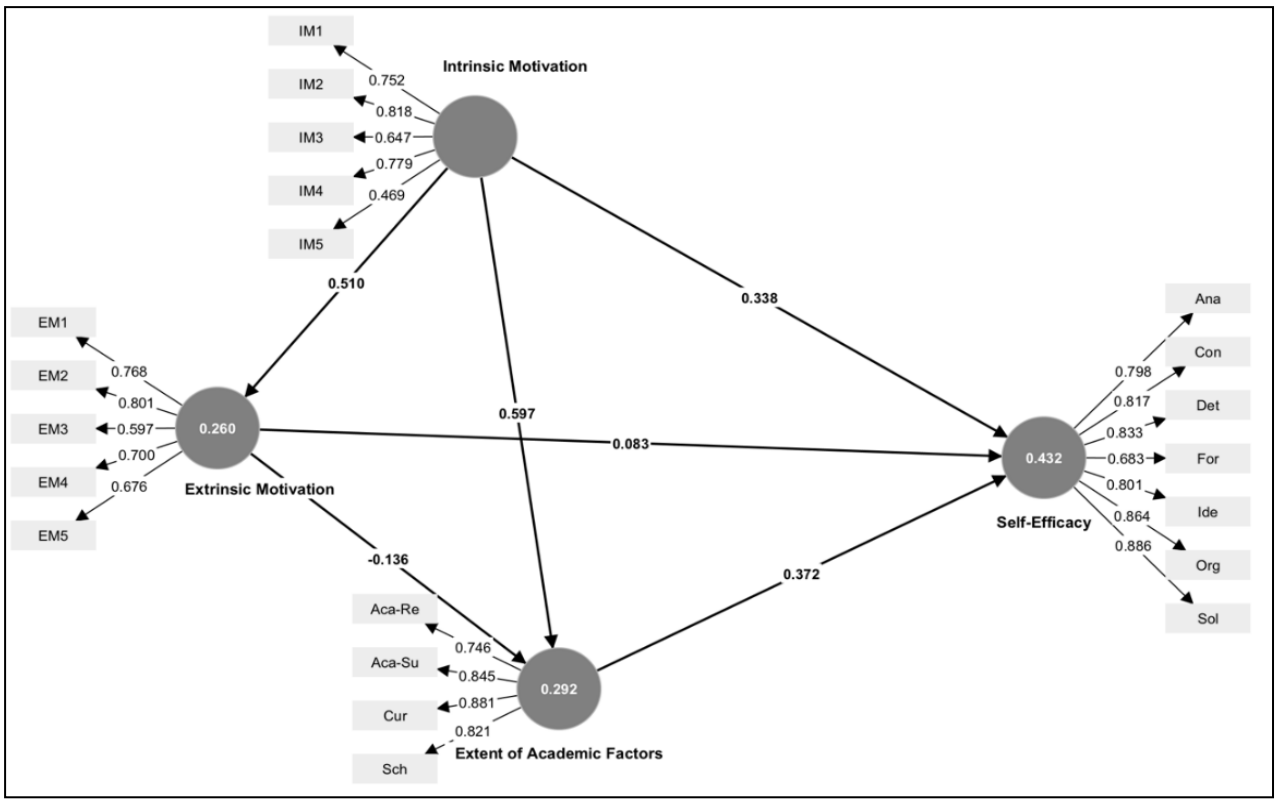

Figure 3. Full Model

Table 7. Measures of Fit of Structural Equation Modelling

Assessments	*Criteria*	*Saturated Model*	*Estimated Model*	*Interpretation*
SRMR	< 0.10	0.087	0.087	Correct Model
NFI	≥ 0.90	0.747	0.747	Not Fit
Chi-square (X^2)	p > 0.05	628.751	628.751	Fit Model
d_ULS	d_{ULS} < 95%	1.768	1.768	Fit Model
d_G	d_G > 95%	0.533	0.533	Fit Model

Using the SmartPLS to further determine the best fit model using the following fit measures: SRMR (Standard Rooth Mean Squared Residual) and NFI (Normed Fit Index).

The SRMR is defined as the difference between the observed correlation and the model implied correlation matrix. Thus, it allows assessing the average magnitude of the discrepancies between observed and expected correlations as an absolute measure of (model) fit criterion. A value less than 0.10 or of 0.08 (Hu and Bentler, 2009) are considered a good fit. Both saturated model and estimated model revealed a SRMR of 0.087 which is within the threshold for goodness of fit. With the stated SRMR, it tells that the model is 91.3% correct.

As presented NFI value of 0.747 for both Saturated Model and Estimated Model, respectively, tell that the model is not that fit since the values are lesser than 0.90. From this data, the values did not fit on the given model on the NFI parameter. This means that not all given data on the SEM does not fit on the specified model.

However, the value of the d_ULS (the squared Euclidean distance) and d_G (the geodesic distance) in itself do not pertain any value. For the bootstrap-based test for the exact overall model fit (d_ULS and

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d_G), you compare their original value against the confidence interval created from the sampling distribution. The confidence interval should include the original value. Hence, the upper bound of the confidence interval should be larger than the original value of the d_ULS and d_G fit criteria to indicate that the model has a "good fit". Choose the confidence interval in a way that the upper bound is at the 95% or 99% point.

Saturated model d_{ULS} exposed a value of 1.768 bound at 82.32% while its d_G has a 0.533 with a confidence interval of 94.7%. Thus, d_{ULS} is less than 95% while d_G is greater than 95%. With the stated confidence interval that fall in the upper bound the model is considered to be a "good fit". Meanwhile, estimated model revealed a d_{ULS} a 1.768 which falls within 82.32%. The d_G gave a 0.533 within 94.7% percentile. Therefore, even the estimated model is a "good fit" considering all the criteria.

Parsimonious Model

Table 8. Measures of Fit on the Parsimonious Model

Assessments	*Criteria*	*Saturated Model*	*Estimated Model*	*Interpretation*
SRMR	< 0.10	0.073	0.073	Correct Model
NFI	≥ 0.90	0.797	0.796	Not Fit
Chi-square (X^2)	p > 0.05	428.928	429.605	Fit Model
d_ULS	d_{ULS} < 95%	0.815	0.822	Fit Model
d_G	d_G > 95%	0.355	0.355	Fit Model

Table 8 shows a significant value on the goodness of the model. As indicated on the saturated model and estimated model revealed a SRMR of 0.073 which is within the threshold for goodness of fit. With the stated SRMR, it tells that the model is 93% correct. This means that all values of variables fit on the given SEM in the SRMR criterion.

Meanwhile, the NFI value of 0.797 and 0.796 in Saturated Model and Estimated Model, respectively for the parsimonious model. It tells that the model is not that fit since the values are lesser than 0.90. From this data, even the parsimonious model did not fit on the given model on the NFI parameter. Therefore, other parameters can still be utilized to determine the fitted model for self-efficacy.

On the parameters of saturated model using d_{ULS} with a value of 0.815 bound at 91.85% while its d_G has a 0.355 with a confidence interval of 96.45%. Thus, d_{ULS} is less than 95% while d_G is greater than 95%. From this confidence interval that fall in the upper bound the model is considered to be a "good fit" in the parsimonious model. On the other hand, estimated model shows a d_{ULS} a 0.822 which falls within 81.22%. The d_G gave a 0.355 within 96.45% percentile. Therefore, even the estimated model is a "good fit" considering all the criteria.

With these values indicated on this model as shown on Figure 8, it can deduce that the self-efficacy with given parameters is highly significant and correlated with the intrinsic motivation, extrinsic motivation, and academic factors on the learning experience of the STEM students.

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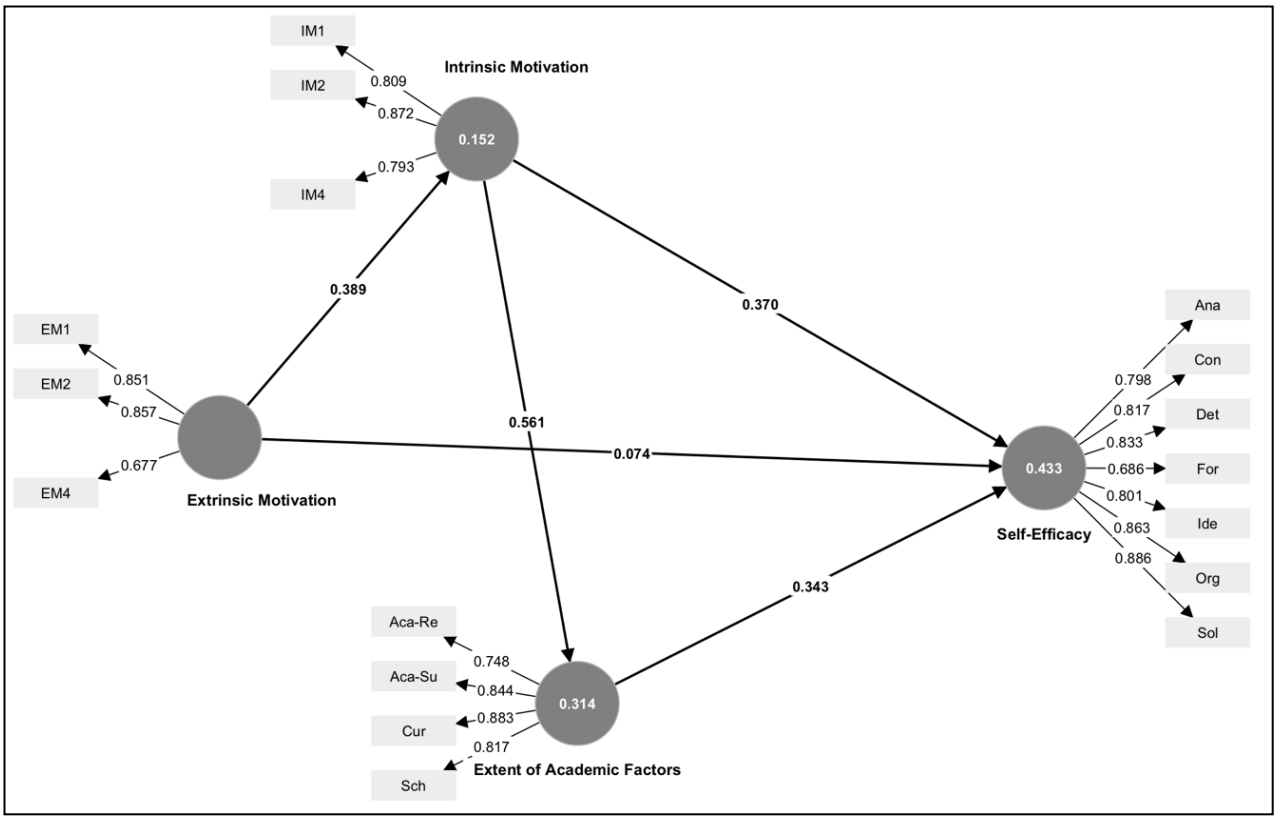

Figure 8. Parsimonious Model

CONCLUSIONS

Summary of Findings

1. The profile shows that the respondents are dominated by male (58.60%) as compared to females (41.40%). With regard to the educational attainment of their mothers, most of them are college graduates with 33.95% and followed by high school graduates (28.37%). Meanwhile, most of the father's educational attainment are college graduates (28.84%) and high school graduates (28.37%). Based on the data, 33.02% of the respondents shared that their parent's monthly income is below Php 10,000.00 every month. Followed by the 26.05% families with monthly income of Php 10,000 - Php 19,000. Subsequently, with regard to the technological resources used by the STEM students most of them have Laptops, Mobile Phones and Televisions (26.51%).
2. The extent of academic factors among STEM students has an overall mean of 3.67 which was interpreted as moderately extensive. Among the four indicators, it can be gleaned in the table that school policies and procedures have the highest mean of 3.88 which is interpreted as moderately extensive. Meanwhile, academic resources garnered the lowest mean of 3.52 which moderately extensive.

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3. The result of the descriptive analysis on the extent of motivation reveals to have an overall mean of 4.17 which is interpreted as highly extensive. Intrinsic motivation tops over extrinsic motivation which has a category mean of 4.34 which is interpreted as highly extensive which means that the respondents are intrinsically motivated to learn topics and concepts in Physics. On the other hand, extrinsic motivation is rated as 4.00 which is still interpreted as highly extensive.
4. The overall mean on the extent of self-efficacy among STEM students is 3.65 which is interpreted as moderately extensive. This denotes that the self-efficacy among STEM students in answering Physics problems is at a moderate level. All indicators are described as moderately extensive. Out from the seven indicators, determination of appropriate formula tops over other indicators which has a category mean of 3.78 which is interpreted as moderately extensive. Formula derivation has category mean score of 3.76, solution development garnered a category mean score of 3.72, both identification of the given variables and conclusion checking indicators garnered a category mean of 3.63; analysis of word problems has a category mean score of 3.59. Meanwhile, organization and presentation of answers has the lowest mean of 3.53, but still interpreted as moderately extensive.
5. The p-value among three variables is lesser than 0.05 level of significance which means that there is a significant relationship between self-efficacy and extent of academic factors, self-efficacy and intrinsic motivation, and self-efficacy and extrinsic motivation. This result strongly suggests that the null hypothesis will be rejected.
6. The indicated R^2 of .419 demonstrates a positive standardized beta which amplifies on the overall significant predictors which is highly significant. This means 92% of the variation can be taken from the other independent variable.
7. The full model has several variables with Self-efficacy as exogenous variables (independent) with 7 encapsulated subscales and 3 endogenous variables (dependent) in the form of intrinsic motivation with 5 indicators, extrinsic motivation with 5 indicators, and academic factors with 4 indicators. The results reveal that the three predictors (academic factors, p = 0.00; intrinsic motivation = 0.00, and extrinsic motivation p = 0.05) have a significant direct effect on self-efficacy of the STEM students.

Conclusions

Based on the results and findings, the following conclusions were drawn:

1. STEM students from the three identified schools have varied profiles particularly on their technological resources. Their parent's educational attainment and economic status varied as well though most of them are college level and college graduate.
2. Students have a moderate extent of self-efficacy in all indicators such as curriculum, academic resources, school policies and procedures and academic support.
3. Students have high extent of motivation in solving word problem in General Physics. They are more intrinsically motivated as they get greater self-satisfaction rather than impressing their classmates upon getting higher grades.
4. Students have a moderate extent of self-efficacy in all seven indicators in solving word problem in General Physics. Though they have difficulties in organizing and presenting their answers, they find it relatively easier to determine appropriate formula to be used in solving the word problems.
5. There is a significant relationship between self-efficacy and extent of academic factors, self-efficacy and intrinsic motivation, and self-efficacy and extrinsic motivation. This result strongly suggests that the null hypothesis will be rejected.
6. The influence of academic factors, intrinsic motivation and extrinsic motivation significantly predict self-efficacy of Senior High School students in solving word problem in General Physics.
7. The developed model is a good model for satisfied the thresholds on the different parameters. It fits on the different predictor variables: academic factors, intrinsic motivation, and extrinsic motivation towards self-efficacy.

Based on the findings and conclusions, the following recommendations are offered:

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Recommendations

1. Students must be provided with enough learning resources such as self-learning modules and learning activity sheets. The school has to make sure that these resources are easily accessed both online, offline, and printed.
2. Teachers must continue to provide varied activities to encourage more learners to be more intrinsically motivated in learning General Physics.
3. In solving word problems in General Physics, teachers have to make sure that the learners will follow the proper procedure in solving word problems. Thus, they must be trained in given exercises on how to analyze problems properly, organize and present it with clarity.
4. Since self-efficacy have very high correlation with academic factors and motivation, teachers have to make sure that teaching General Physics needs to be anchored with students' interest particularly in presenting their lessons so that students will be motivated even more. Learning resources and learning must be maximized and sufficient to cater students' educational needs.
5. The Parsimonious Model can be utilized by the Physics teachers to improve and maximized students' learning particularly in teaching Physics concepts that involves problem solving.

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