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Language Teaching Strategy and Grade 12 Learners' Metacognitive and Problem Solving Skills in General Physics 1

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Abstract: ***This quasi-experimental study aimed to determine the effect of Language Teaching Strategy on the metacognitive and problem-solving skills of Grade 12 STEM learners for school year 2020 – 2021.The participants were the Grade 12 STEM learners of Capiz National High School who opted online learning modality. They were matched paired according to their first quarter grade in General Physics 1, sex, and pretest scores. Validated and reliability tested researcher-made 10-item problem solving and revised metacognitive questionnaire were used to determine the metacognitive and problem-solving skills of the learners on universal law of gravitation, gravitational potential energy, periodic and simple harmonic motion, mechanical waves, density, pressure, Pascal's principle, Bernoulli's principle and temperature before and after the intervention. Results revealed a poor and novice level of metacognitive and problem-solving skills of both groups of learners before the implementation. They don't have a favorable knowledge in terms of the topic which is a good foundation for better problem solving. After exposure to language teaching strategy and non-language teaching strategy, learners' problem solving and metacognitive skills level skillful and very satisfactory. Learners, however still need to acquire different kinds of skills and strategies to help them solve physics problems successfully. Significant differences were noted in the pretest and posttest mean gain of the two groups in metacognitive and problem solving skills, favoring the one exposed to language teaching strategy. Results further showed that learners' metacognitive skills and performance in problem solving in Physics are correlated. The higher their metacognitive skills, the higher their problem solving skills. These findings may imply that language teaching strategy is deemed to be effective.***

Keywords*:* language teaching strategy; general physics 1; problem solving skills; metacognitive skills

1. Introduction

Problem solving is important in Physics as a tool for predicting and explaining many diverse phenomena (Gok, 2015). The ability to solve problems is the heart of science and mathematics and is essential and useful to the extent that it can be applied to particular situation (Ince, 2018).

Learners to be able to perform competently, they must understand the language used specifically in mathematics like subjects, for language is very important in learning. This language may differ between common language that is used in everyday activities, and therefore is less likely to be familiar or understood by the learners (Jourdain& Sharma, 2016).For them to enhance their problem solving skills and metacognitive skills, learners must be taught the concept and its language explicitly by giving a lecture in a collaborative manner and designed according to knowledge construction approach where learners need to recognize, assess, and connect new skills to old ones (Tanner, 2012). One way to achieve this is by letting them engage in academic tasks designed in constructivist environment. It gives them the chance to solve problems that will challenge them to use their capabilities in analyzing the correct solution to a problem.

Language is very important in students learning. In particular, students use features of physicists' conceptual metaphors to reason about physical phenomena, often overextending and misapplying these features, and draw cues from the grammar of physicists' speech and writing to categorize physics concepts (Brooke, 2006). For learners to enhance their problem solving skills and metacognitive skills, they must be taught the concept and its language explicitly by giving a lecture in a collaborative manner and designed according to knowledge construction approach where learners need to recognize, assess, and connect new skills to old ones (Tanner, 2012).

Language teaching strategy is referred to the process and action that are consciously deployed to the learners to help them to learn or use a language more effectively (Grenfell & Harris 2017). In language teaching strategy, learners organize and consolidate scientific and mathematical thinking through communication; communicate scientific and mathematical thinking coherently and clearly to peers, teachers, and others; analyze and evaluate the scientific and mathematical thinking of others; and use the language of science and math to express ideas precisely. Wherein also the teachers gain insight into their students' thinking, diagnose their students' misconceptions, assess students' thinking habits and attitudes and evaluate their own teaching techniques (Valdriz, 2018).

In Writing for Mathematics book of Rothstein et al (2006), there are featured language strategies that are primarily linking writing with mathematics and designed for use in science and mathematics that are adaptable to elementary and higher level. All activities are output-driven and will require both individual and collaborative efforts. The three

strategies that are commonly used are Building with Taxonomy, Composing of Keywords and Metacognition.

These are the reasons why this study is conducted. The researcher aims to improve the metacognitive and problem solving skills of Grade 12 STEM learners in General Physics 1 by means of Language Teaching Strategy. Specifically, the following questions are as follows:

1) What is the level of metacognitive and problem solving skills of the learners before and after exposure to language teaching and non-language teaching strategies?
2) Is there significant differences in the pretest and posttest results of metacognitive and problem solving skills of learners exposed to language teaching strategy and to non-language teaching strategy?
3) Is there significant differences in the posttest results of metacognitive and problem solving skills of learners exposed to language teaching strategy and non-language strategy?
4) Is there significant differences in the mean gain scores of the learners' metacognitive and problem-solving skills in the language teaching and non-language teaching strategies?
5) Is there a significant relationship between metacognitive and problem- solving skills of the learners exposed in language teaching strategy?

2. Methodology

The quasi-experimental, pretest –posttest research design, was employed. The investigation involved 60 purposively chosen Grade 12 STEM learners through matching and pairing, 30 were assigned to the language teaching strategy (experimental group) and the other 30 to the non-language teaching strategy (control group). The learners were comprehensively match-paired based on their first quarter grades in General Physics 1, sex, and pretest scores. The 2 groups differed ontheir modules and learning activity sheets. The experimental group used modules and the Division's learning activity sheets with language teaching strategy as an approach in metacognitive and problem solving skills while the control group used the same modules and the Division's learning activity sheets without language teaching strategy.

Problem solving test consisted of 10-item word problem solving on universal law of gravitation, gravitational potential energy, periodic and simple harmonic motion, mechanical waves, density, pressure, Pascal's principle, Bernoulli's principle and temperature was usedto determine learners' metacognitive and problem-solving skills before and after the intervention. An adapted and revised metacognitive questionnaire was used after solving the problems.

The research procedure is shown in Figure 1.

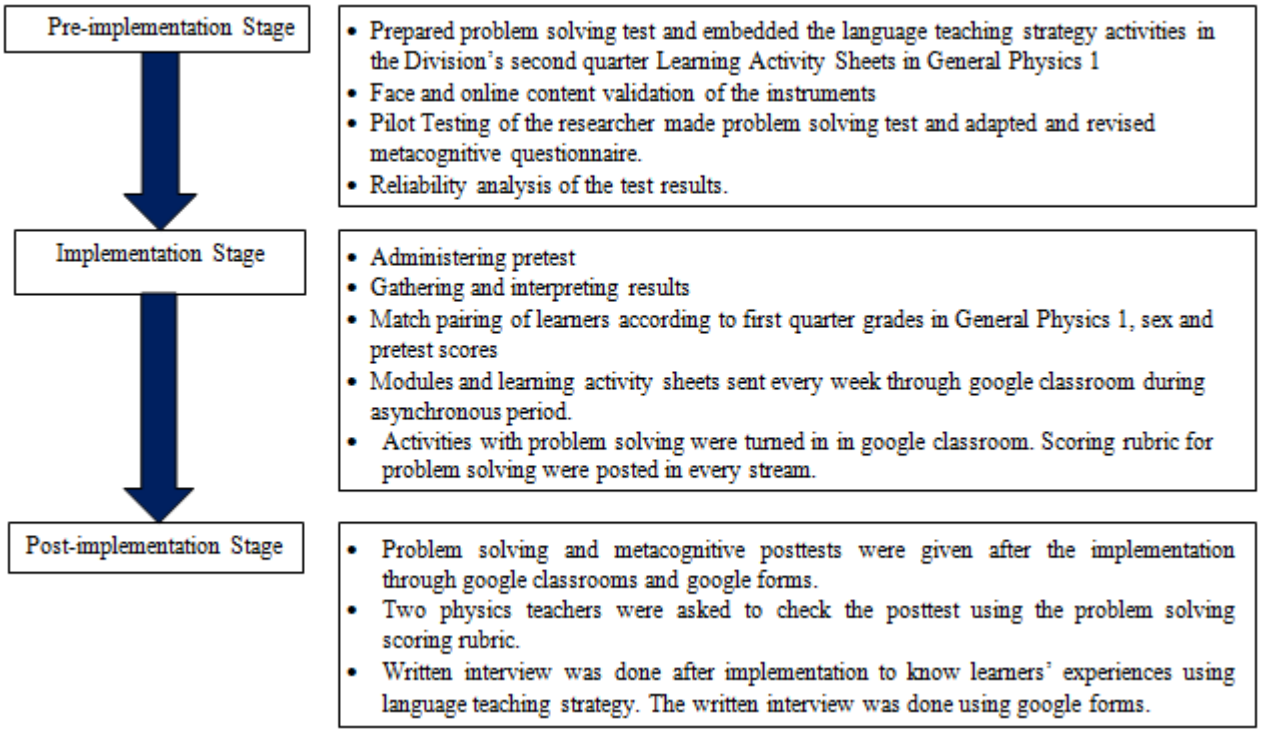

Figure 1: Research Procedure

3. Results

Level of Metacognitive and Problem Solving Skills of Grade 12 STEM Learners Before Exposure to Language Teaching Strategy (LTS) and Non-Language Teaching Strategy (NLTS)

Grouping	Variable	*n*	*SD*	*M*	Descriptive Rating
LTS	Problem Solving Pre-Test	30	3.69	2.03	Novice
	Metacognitive Pre-Test	30	0.34	1.18	Poor
NLTS	Problem Solving Pre-Test	30	4.10	2.39	Novice
	Metacognitive Pre-Test	30	0.38	1.22	Poor

Note: *Problem Solving Skills* *32.10 – 50.00 (Skillful), 16.01 – 32. 00 (Developing), 0.00 – 16.00 (Novice)*
Metacognitive Skills *4.51 – 5.00 (Outstanding), 3.51 – 4.40 (Very Satisfactory), 2.51 – 3.50 (Satisfactory), 1. 51 – 2. 50 (Unsatisfactory), 1.00 – 1.50 (Poor)*

Level of Metacognitive and Problem Solving Skills of Grade 12 STEM Learners After Exposure to Language Teaching Strategy (LTS) and Non-Language Teaching Strategy (NLTS).

Grouping	Variable	*n*	*SD*	*M*	Descriptive rating
LTS	Problem Solving Post-Test	30	5.72	36.69	Skillful
	Metacognitive Post-Test	30	0.37	4.12	Very Satisfactory
NLTS	Problem Solving Post-Test	30	5.71	32.09	Skillful
	Metacognitive Post-Test	30	0.46	3.86	Very Satisfactory

Note: *Problem Solving Skills* *32.10 – 50.00 (Skillful), 16.01 – 32. 00 (Developing), 0.00 – 16.00 (Novice)*
Metacognitive Skills *4.51 – 5.00 (Outstanding), 3.51 – 4.40 (Very Satisfactory), 2.51 – 3.50 (Satisfactory), 1. 51 – 2. 50 (Unsatisfactory), 1.00 – 1.50 (Poor)*

Difference in the Posttest Results of Metacognitive Skills (MS) and Problem Solving Skills (PSS) of Grade 12 STEM Learners Exposed to Language Teaching Strategy (LTS) and Non-Language Teaching Strategy (NLTS)

Test	Grouping	Mean Posttest Scores	Mean Difference	95% Confidence Interval of the Difference		t value	df	Sig (2 tailed)
				Lower	Upper			
MS Posttest	LTS	4.12	0.26	0.04	0.47	2.40*	58	0.02
	NLTS	3.86						
PSS Posttest	LTS	36.69	4.60	1.65	7.59	3.12*	58	0.003
	NLTS	32.09						

*p<0.05 **p<0.01

Relationship Between Metacognitive Skills (MS) and Problem Solving Skills (PSS) of the Learners exposed in Language Teaching Strategy

Variables		Metacognitive Skills
Problem Solving Skills	Pearson's r	.686*
	Sig (2tailed)	.000
	N	60

Note: **p<0.001*

4. Discussion

Both groups of learners showed"poor" and "novice" problem solving and metacognitive skills before exposure to language teaching and non-language teaching strategies respectively. After exposure to language teaching and non-language teaching strategies, both groups attained "very satisfactory" metacognitive skills and "expert" problem solving skills respectively.

Pretest and posttest results of learners' metacognitive and problemsolving skills exposed to language teaching strategy had a significant difference. This is similar with learners exposed to non-language teaching strategy. Both posttest results were higher compared with their pretest results. This indicates that the learners performed well after their exposure to language and non-language teaching strategy. It can be assumed that when learners are comfortable with the

strategy, they used to solve certain problems, their problem solving and metacognitive skills are also enhanced.

Posttest results of metacognitive and problem solving skills of learners exposed to language teaching strategy is significantly higher compared with the posttest results of metacognitive and problem solving skills of learners exposed to non-language teaching strategy.This revealed that the learners performed well after their exposure to language teaching strategy. Responses from learners' journal and written interview justified their feelings that they find language teaching strategy helpful in dealing with Physics word problems.

Mean gain scores of the learners' metacognitive andproblem-solving skills using language teaching strategyis significantly higher compared withthose using non-language teaching strategy. Cohen's D results of 0.6 and 0.8 respectively revealed that the strategy had a large effect to the learners.

Learner's metacognitive skills had a significant relationship withtheir problem- solving skills in the LTS group.The study upholds the findings of Trisnani and Winarsio (2019) that students' metacognition in problem solving and mathematical literacy has quite diverse effects. It is noted that students with high learning outcomes in solving have high levels of metacognition.

5. Conclusion

Based on the findings of the study, the following conclusions were formulated:

The learners seemed not to have a favorable knowledge of the subject since the topics under the General Physics 1 were new to them. This is the reason why the level of metacognitive and problem solving skills of Grade 12 STEM learners were poor andnovice prior to the implementation. They exhibited the lack of exposure to problem solving activities and exercises. However, this was a good foundation for both groups for better problem solving skill.

The learners in both groups performed well and obtained higher score after their exposure to language teaching strategy and non-language strategy. Thus, it can be said that the learners tend to use strategies that they are familiar with, where the processes are not complicated. However, learners exposed in language teaching strategy gained higher mean gain scores than learners exposed in non-language teaching strategy. The result deemed to show that language teaching strategy enhanced the problem solving and metacognitive skills better than in non-language strategy.

The learners under language teaching strategy obtained higher mean gain scores in both metacognitive and problem solving skills compared to the learners under non-language teaching strategy. It signifies that language teaching strategy seemed to be more effective in enhancing the metacognitive and problem solving skills of the learners. Thus, language teaching strategy may be used in enhancing the problem solving and metacognitive skills of learners in General Physics 1. In addition, it implied that the higher the metacognitive skills, the higher the problem solving skills of the learners. It may also signify that language teaching strategy is effective. Concepts and establishing relations between all the information and concepts in the problem really matter. It builds rapport to the learners in order to understand and solve the problem solving accurately.

The findings of the study have led to certain implications for theory and practice in relation to Language Teaching strategy, metacognitive and problem solving skills of Grade 12 STEM learners in General Physics 1.

The results revealed that language teaching strategy seemed effective in enhancing metacognitive and problem solving skills of the Grade 12 STEM learners. The development of meta-cognitive skills gives the learners the ability to organize their thought processes and to refine their thinking skills in problem solving, both of which are important in the development of academic achievement. Thus, language teaching strategy is based on cognitive developmental theory which the learners interact with the world around them, continually add new knowledge, build upon existing knowledge, and adapt previously held ideas to accommodate new information.

The results of the study brought several implications for practice most especially to the learners and teachers. Science education is rooted strongly in a belief that an understanding of science is so important that it should be a feature of every young person's education. Problem solving is a very real part of the science curriculum. It requires both cognitive (problem solving skills) and metacognitive skills. It provides learners with chances to use their newly acquired knowledge in meaningful, real-life activities and assist them in working at higher level of thinking.

Exposing learners to a strategy related between language, number and formula help them to understand the subject. As well as, exposing them with activities that build understanding about the concepts, formulae and steps on how to solve would enhance their skills and acquire new knowledge.

Learners could be provided with more learning activities that would help them improve their metacognitive and problem solving skills. This can be acquired by adapting or exposing the learners to new strategies and techniques in teaching General Physics and more activities wherein the students encounter and discover by themselves firsthand the concept and knowledge being taught. The results of the study may make the learners realize that they have to further improve their performance in physics problem solving, since they will soon graduate and will face the real-world head on with a lot of decisions and choices to be made. Furthermore, to allow them to undergo trial and error experiences – a discovery type of learning where they can learn from their mistakes and devise their own techniques. In the classroom, whenever there will be problem solving exercises they may be able to improve their problem solving performance through practice, board work activities, and the common problem solving steps learned.

References

[1] Grenfell, M.J., & Harris, V., (2017). Language Learner Strategies: Contexts, Issues and Applications in Second Language Learning and Teaching. Bloomsbury Academic, Australia.
[2] Gök, T. (2015). An Investigation of Students' Performance after Peer Instruction with Stepwise Problem-Solving Strategies. International Journal of Science and Mathematics Education, 13(3), 562-582. https://doi.org/10.1007/s10763-014-9546-9/
[3] Ince, E. (2018). An Overview of Problem Solving Studies in Physics Education. Journal of Education and Learning, 7(4). https://doi.org/10.5539/jel.v7n4p191
[4] Jourdian, L and Sharma, S. (2016). Language Challenges in Mathematics Education: A literature review. Waikato Journal of Education, 21(2).
[5] Rothstein, A & Rothstein E. Writing for Mathematics. Corwin Publication. New York City, USA. 2006
[6] Tanner, K. D. (2012). Promoting Student Metacognition. CBE—Life Sciences Education, 11(2), 113-120. https://doi:10.1187/cbe.12-03-0033
[7] Trisnani, M., &WinarsoW.,(2019). Identification of Students Metacognition Levels in Problem-Solving and Mathematical Literacy. CahayaPendidikan, 5(2), 13-29.
[8] Valdriz, J., (2018). Language Strategies in Teaching Mathematics. https://www.slideshare.net/joeyvaldriz/language-strategies-in-teaching-mathematics