European Journal of Education Studies
ISSN: 2501 - 1111
ISSN-L: 2501 - 1111
Available on-line at: www.oapub.org/edu

doi: 10.5281/zenodo.3240685 Volume 6 | Issue 2 | 2019

ACADEMIC SELF-CONCEPT, LEARNING STRATEGIES AND PROBLEM SOLVING ACHIEVEMENT OF UNIVERSITY STUDENTS

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Abstract:
This study investigated the level of academic self–concept of sophomore university students, assessed their extent of use of learning strategies as moderating variables on their math achievement specifically in problem solving. It also examined the association between the level of academic self-concept and problem–solving achievement in mathematics of the students' respondents. Descriptive correlational design was employed in the conduct of the study with 240 students' respondents randomly chosen as representative samples. A partial correlation was used to measures academic self-concept effect to students' accomplishment. Findings revealed that academic self–concept of students in mathematics is moderate. This suggests that higher self–concept in academics and extent of utilisation of learning strategies in solving mathematical problems would result to a high problem–solving achievement. In addition, problem solving achievement was partially moderated through learning strategies. As the students extensively used the learning approach, the more that they were confident in dealing word problems in mathematics. The higher the extent of use of the strategies, the higher the problem solving achievement will be incurred by the students. In conclusion, the students did not attain high level of problem solving achievement due to less interest in reading and solving numeric and word problems in math. This development showed that student's high problem solving achievement requires high level of self – concept with consistent use of learning techniques. The development of interesting, challenging problems and exercises in mathematics courses (or subjects) is hereby recommended with enhanced classroom-based problem solving activities conducive to the improvement of academic self–concept and learning strategies.

Keywords: academic self-concept, learning strategies, problem–solving achievement

1. Introduction

An essential element of the student–centered and effective teaching is content. The field of mathematics imposes a call to different learners which It often instigates success or

failure in school and career level (Jolejole-Caube, Dumlao and Abocejo, 2019). A lack of mathematical skill affects the ability of a person to make critical decisions in life (Dowker, Sarkar and Looi, 2016). The students are considered prime stakeholders in an academic institution (Abocejo and Padua, 2010). As such, they are the "heart" of the teacher's professional life. Generally, the success of students greatly depends not only on teachers, but also on the manner of how they be mentored (Nagata, et al., 2017). It is imperative that teachers understand how learners learn so that they would be more conscious of their role in the education process (Rodriguez and Abocejo, 2018).

The teachers' role in the entire students' learning environment categorically influence their academic–related activities (Cuñado and Abocejo, 2018). In essence, teachers must deliberately structure their lessons in such a manner that learners find meaning in them, eventually motivating them towards a holistic engagement in their academic endeavors (Acero, 2000). Mathematical literacy of an average person requires an important part of the basic skills in problem solving (Jolejole-Caube, Dumlao and Abocejo, 2019). Learning how to compute and solve problems does not ensure a person knows when and how mathematical operation and answer be utilized in a particular problem (Coburn, et al., 2009).

Academic achievement is a major determinant in the increase concept model. Based on this model, self-concept tends to increase on the involvement in explicit and implicit trainings of the students (Ahmed and Bruinsman, 2006). As an indicator of success in any scientific endeavour, student's achievement and other factors affect in any educational system in which this issues motivates and attract several researchers. Moreover, learning strategies utilisation moderately involve in the individual achievement and self–concept. So that by improving the latter and beliefs, especially academic success thru the extent of utilisation of learning strategies, students will be empowered. Many interrelated and mutually factors affect learner's academic achievement amidst learning strategy, social behaviour and academic self-concept.

1.1 Study Objectives

This study determined the sophomores students mathematics self–concept level and problem solving achievement, the degree of learning techniques and how it intervene the academic self-concept in relation to the problem solving achievement of the second year university students. In this endeavour, the association of self-concept to learning strategy and between the latter and problem solving acquirement are reviewed and analysed. It also determined how the problem solving success could help improved the academic self–concept of the university students.

2. Literature Review

Academic self-concept is one of vital key to academic achievement (Khalaila, 2015). Khalaila (as cited in Ahmad and Bruinsman, 2006) noted that the basis of students' academic excellence is the academic achievement in which understanding the different factors responsible in predicting, identifying, intervening, or having an effect in

academic achievement is crucial. He found out that individuals thought was favourably linked to the students' achievement. In addition, intrinsic motivation and anxiety indirectly affect the relatedness of the aforementioned variables.

However, Bodkins-Andrew, et al. (2010) noted that several factors may help to unlock the disengagement of the students in school. It merely suggests that academic self–concept maybe a solution to unlock these trends happened in school due to disengagement. Learners' success is determined by three factors namely: self-concept, regulation and efficacy one's self (Kirmizi, 2015). Higher levels of self-confidence, regulation, and evaluation students got a high achievement. A high correlation was obtained through the variables with academic achievement (Ozkan, 2015; Abocejo and Padua, 2010). Igbo et al. (2015) indicated that gender stereotype as one of the predictor of learners' self–concept and achievement. Social stratification (Priest, 2015; Abocejo and Gubalane, 2013) is due to racial/ethnic and gender discrimination showed unsuccessful in eliminating achievement gaps.

The academic self-concept and math achievement associated commonly using the cognitive strategy (Jolejole-Caube, Dumlao and Abocejo; 2019). As noted, math achievement was not associated with epistemological beliefs and self–regulation but it was significantly predicted by academic self-concept (Dursun, et al., 2017). Moreover, Kirmizi (2015) pointed that self-efficacy posted a statistically significant result which predict the academic success. He additionally said that high achievers possessed a higher self-regulation level, self-efficacy and self-concept.

Psychological adjustment and social protection (Abocejo and Gubalane, 2013) showed an expressive correlation through self- concept and female high school achievement (Kobra, et al., 2016; Abocejo and Padua, 2010). Meanwhile, Millichap (1998) found out that children with epilepsy manifested have lower achievement due their negative attitudes towards illness and poor self-esteem. He further noted that parental expectations for the academic achievement of children with epilepsy should be lowered so as not to impair school performance of among these types of children.

Martin et al. (2015) stressed that developmental education has no adverse impact on the academic self–concept of university students. They argued however that university enrolled in several courses manifested lower academic self–concept than their peers. Due to the transition, the effect of the academic grades on self–concept in both Math (Gniewosz, 2010) and English (Trazo and Abocejo, 2019; Cuñado and Abocejo, 2018) on the students decreases while there is an increase due to maternal competence perceptions (Rodriquez and Abocejo, 2018). Later on the transition, the impact of academic grades increases but due to maternal perceptions decreases. They continuously said that students have lost their self–evaluations due to the change of references during and after the transition.

Cvencek, Kapur and Meltzoff (2015) noted that Singaporean elementary students, given a standard test, exhibited directly related self–concept and achievement in mathematics. Additionally, math (boys) stereotype were significantly correlated with boys who has stronger and with girls who has weaker math self–concept for both explicit and implicit degrees. Their study also showed that implicit mathematics self–

concepts (unrelated to school factors) were correlated with students' mathematics achievement. Their study suggested that individual differences may be used assess students' academic outcomes. In addition, stereotypes related to actual mathematics achievement pointed out to the gap between the boys and girls score in standard test, but already non–existent towards their last secondary school years (Hyde and Mertz, 2009; Hyde et al., 2008; Jolejole-Caube, Dumlao and Abocejo; 2019). However, if one examines the mathematics on international standardised achievement test, there still a gender gap favouring the United States (US) elementary school boys over the girls (Provasnik et al., 2012). But in Asian regions such as Singapore, Japan, China, Philippines, gender gap between math achievements at any age is not observed ("Organisation for Economic Cooperation and Development" [OECD], 2011; Abocejo et al., 2012).

Recently, Gu and Cheung (2016) found out that language self–concept affect the students' cultural modification process where it was correlated to students levels in intercultural communicative competence. The ideal language self is referred to as language specific element of individual ideal self (Arzu, 2016). It represents specific hopes, aspirations, and desires of language learners (Dornyei, 2014, Trazo and Abocejo, 2019). Since the language self is associated with an individual's mastery of language, it could be the decisive motivator of the learners language learning process (Ryan and Dörnyei, 2013; Trazo and Abocejo, 2019). Hence, recent researches done by Lanvers (2016) and Huang, Hsu and Chen (2015) stressed out the direct effect of ideal language self on the learners' eminence (Trazo and Abocejo, 2019).

Helm, Mueller, Nagy and Moller (2016) revealed that an individual's perception of his abilities to strive academically will depend on their experiences with the environment. In relation to the academic achievement, specialised subject self–concept such as Math and English can be compared contrastively thru dimensional comparisons between mathematics and verbal subjects. The contrast effect of dimensional comparisons showed that students would manifest a lower mathematics self–concept when they excel in English as compared to those with lower English performance (Cuñado and Abocejo, 2018; Jolejole-Caube, Dumlao and Abocejo, 2019; Lanvers, 2016).
Marsh et al. (2015) articulated a difference between–domain and within–domain comparison. They revealed important changes for comparisons between subjects belonging to verbal or mathematical continuum that has small assimilation or contrast effects for comparison since they belong to the same domain. They further noted that five subjects using dimensional comparison effect math, physics, and chemistry have a contrast effects while a small assimilation effects were found between the three subjects. However, Helm et al. (2016) argued that subject–specific self-concepts have common academic continuum, no contrastive effects or assimilation of dimensional comparison usually indicating that self–concepts write firmly compared to achievements.

2.1 Theoretical Background

This study is embedded on social learning and multifaceted theory and one's management of self-concept. It explains the change of learner's learning behaviours due

to self–cognition and perceptions and self–evaluation of both self and others achievement (Chen et al., 2013). The self-management focuses individual's capability evaluated based on their personal standards. This behaviour was observing thru personal-observation, cueing strategies, goal specification, modification of incentives and practice. The schema in Figure 1 expose how learner's academic self–concept being associated to problem solving achievement. Atkinson et al. (as cited in Dadarigashti, Amoopour and Akbari, 2016) found out that self-concept and academic achievement are statistically associated.

This study anchored its theoretical structure on achievement motivation self–worth theory by Covington (1984). This theory seizes that self–acceptance was the primary aimed of a person and the worth of a human being comes is when the ability used to achieve competitively. In the community, there exists and tendency to equalise accomplishment with human importance but a person is thought to be worthy if they achieve something. For this reason, some students in many occasions mistakenly think ability with worth. In a basic nature, self-worth theory proves that, psychologically speaking, school achievement is most appropriate in terms of keeping a positive self-image of person's ability, especially when competitive failure is at risk (Covington, 1984).

From Covington's (1984) discussion of the interaction between human importance and achievement, there are two factors, *achievement* and *ability,* which ultimately show as crucial to many school children, and that this views likely conveys into adulthood.

Another theoretical model, which was significant to the study, was the theory of Hierarchy by Goetz, et al (2006) which is another supporting base of this study. Goetz, et al. (2006) stressed personal perception or academic self–belief or concept viewed not only as a sole structure but a social, physical, and as an organised of self–concept in academics. Through its dimensions, students' academic achievement was highly affected (Sanchez and Roda, 2003). Students perceived that it is a self–concept of school's activities and environment learning (House, as cited in Rodriquez, 2004). Certain studies indicated that it is in constriction with universal self–concept and was severely related to academic achievement (Goetz, et al 2006). Majority of the inquests believed that academic achievement affected and positively related to self–concept (Erkman et al., 2010).

Students' acquired learning and teachers' teaching style where guided by the self–regulated learning strategy (Pintrich, 1999). This learning strategy model is in line with the three general classes of strategies: surface approach, deep-approach and strategic approach. Learning strategy such as self–regulated explains that students have self–regulation if they are apprehensive of their abilities, meaning, to be more effective on their tasks, students apply other strategies to achieve their goals of learning. Most studies (Pintrich, 1999; Rodriquez, 2004; Provasnik et al., 2012; Fernandez and Abocejo, 2014) agreed that an affirmative relationship between learning strategy and achievement in academics is observed.

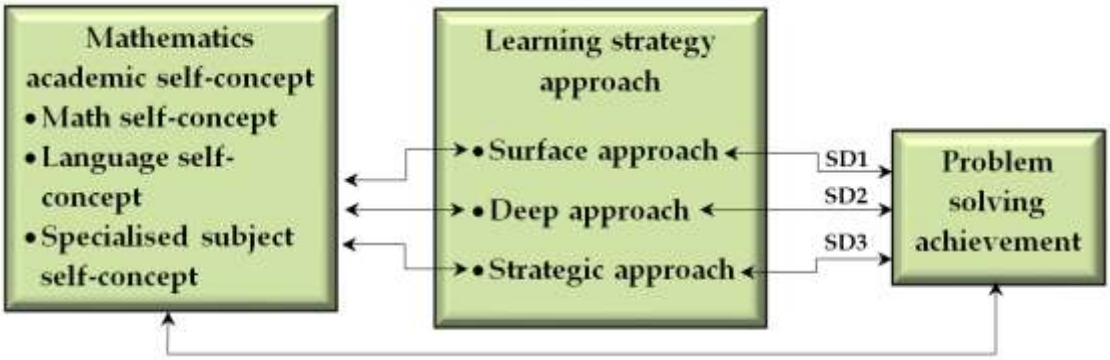

Figure1: Conceptual Framework of the Study

Self-concept in academics is not only and important result but also serves as an indicator of scholastic outcome. It is noted that self-beliefs or concept are correlative over time with achievement, and academic self-concept is a significant predictor of professional preference in and out of school (Parker et al., 2015). Standard deviations (SD1, SD2, and SD3) indicated the closeness and spread of the scores of the students in problem solving within the surface, Deep, and Strategic approach. The smaller the value suggest that student's achievement are more closer indicating that they are in common in terms of their learning achievement.

3. Research Methodology

This study utilised the descriptive correlational survey research design. Parametric statistical tools were employed to determine students' level of self–concept and problem–solving achievement in academics and its relationship.

The respondents were the second year university students enrolled from the main campus and different external campuses of the University under study in the province of Leyte, Philippines. A total of 240 sophomore university students were involved in the study selected through multi-stage sampling which involved cluster, stratified and simple random sampling. They were all enrolled in the college algebra course (or subject).

The 12-item five-point scale that utilized to measure the academic self–concept in problem solving of students. The instrument used to express students' self–concept judgment based on the following subscales: self–concept in mathematics, language and specialized course. Each of the categories contains four selves-structured questions that aimed to elicit level of academic self-concept and personal assessment in problem solving. The items of the instrument was adapted from the works of Chen et al. (2013).

This is a 15 item 5-point scale instrument adapted from the "Revised Approaches to Studying Inventory" (RASI) by Duff (2003) which measured the extent of learning strategies' utilization. The instrument-elicited responses based on the three learning approaches in problem solving achievement: namely; deep approach, strategic and surface approaches.

The achievement test consists of 50–item multiple-choice questions based on the topics covered in College Algebra. There were five (5) questions for each problem–solving situation. Each question was pattern on the steps of solving mathematical problems developed by Polya (1973) and Brandsford et al. (1986). The problem–solving test questions taken from the different references in algebra.

However, the researcher adapted the items included in the previous researches (Chen et al., 2013) minor modifications made to suit the learning context required in the locale of the study. A table of specifications made to ensure the quality of the problem–solving test. The researcher used a curriculum guide or syllabi based on Outcome Based Education (OBE) curriculum. Selected instructors and professors from the selected campuses of HEI under study to ensure quality of the test evaluated the problem test situations taken from the different reference books.

Problem–solving test and different survey forms tested with the students enrolled in the HEI's campus not included in the study. The pilot testing determined which items needed to be revised, improved and/or deleted. An item analysis was done using the split–half reliability test. Moreover, the Spearman–Brown formula used to calculate the reliability index of the instrument. The Pearson product moment correlation coefficient (Pearson r) was 0.78, indicating that the measure of the instrument have a good reliability in the sample. The purpose of conducting the item analysis was to eradicate ambiguous and misleading items of the problem–solving test. This process examined individual responses to test items enable to assess the validity of the questions and the problem–solving test as a whole.

The researcher secured prior permission from the Dean and Campus Administrators of the selected campuses of the HEI under study. Upon approval from the Campus Administrators, the researcher sought permission from the teachers, instructors, professors for legal and ethical access to the identified respondents.

The researcher then conducted a random sampling of the second year college students enrolled in business, engineering and Mathematics courses. The selected students were oriented on the importance and significance of the study, on the data to be collected out their responses and their participation in the study. They reminded of the purpose of the study and the items included in the survey forms. The respondents informed that the study would not affect their actual performance in their mathematics class and confidentiality of their answers assured beforehand.

The researcher administered the academic self-concept questionnaires and learning strategy scale to students. The administration of the problem–solving test was done after the administration of the test questionnaires. Collected data through the survey questionnaire and problem–solving test were scored, tallied, analyzed and interpreted. Frequency, percentage and mean were used to describe students' academic self–concept, learning strategies and their problem solving achievement in mathematics. Test of correlations between students' academic self–concept and mathematics problem solving achievement, with learning strategies as moderator variable, were determined. Partial correlation was computed to determine indirectly the academic self-concept using the different learning strategies to the problem–solving achievement of the

students. The Statistical Package for Social Sciences (SPSS) software was employed to treat and analysed the generated data. Results were interpreted at 5 percent level of significance.

4. Results and Discussion

The results, analysis and discussions on the level of academic self-concept of university students and their extent of use of learning strategies are presented in table and figure formats. Figure 2 shows the distribution of sophomore students by their level of self – concepts using the different indicators as shown in Table 1. The extent of the students' use of learning techniques are also shown in Figure 3 with their indicators reflected in Table 2.

Students having a "very high level" of mathematics self-concept has the lowest frequency of 2 percent. However, 130 or 54 percent of them have a "moderate level" (Figure 2). It is indicative that sophomores in the university are not extremely confident in expressing their self-concepts concerning mathematics. It can be noted further that majority of them are temperate in specialized subject self–concept.

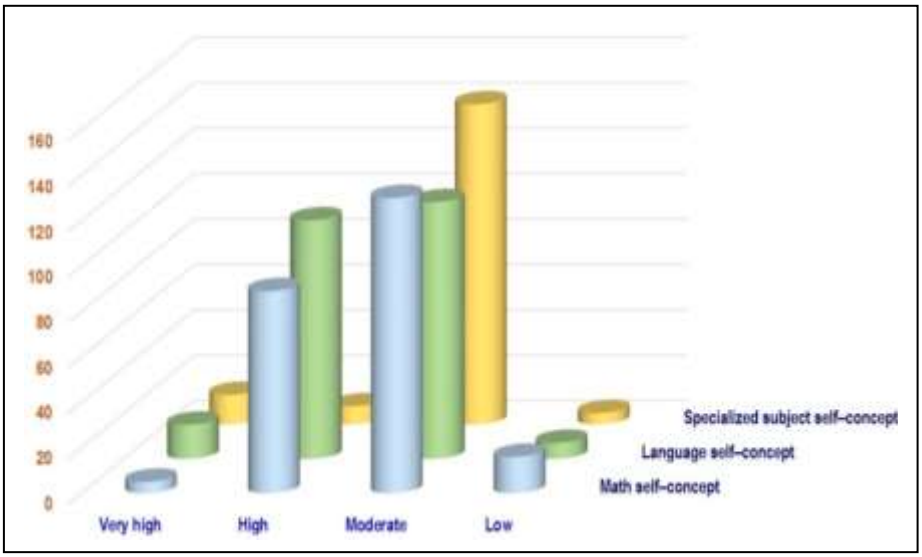

Figure 2: Distribution of university students by level of self-concept

As shown in Table 1, students with "very high level" of Mathematics self-concept and a "low level" of specialized subject self–concept comprised have the lowest 2 percent of the students. However, majority of the respondents have "Moderate level" of academic self - concept. As revealed in Table 1, the overall mean of 3.26 shows that the students have "Moderate level" of Math self–concept. This is the fact that mathematics self-concept has a vital role in math achievement of the students. Attention must paid to the students' self–evaluations of competence and pave the way to develop confidence and beliefs. In addition, students' language skills in problem solving posted a "Moderate level" with overall mean of 3.11. An indication that students were not fully

confident in expressing their competence, self-beliefs and attitudes towards Mathematics.

Table 1: Students' overall academic self–concept

Indicator	Mean	SD	Description
Math self–concept	3.26	0.192	Moderate
Language self–concept	3.11	0.317	Moderate
Specialized subject self–concept	3.02	0.153	Moderate
Grand mean	3.13		Moderate
Overall SD		0.221	
Ranges for the Weighted Mean	**Level of academic self-concept**		
1.00 – 1.80	Very low		
1.81 – 2.60	Low		
2.61 – 3.40	Moderate		
3.41 – 4.20	High		
4.21 – 5.00	Very high		

The extent of the strategies used by the students in dealing problem solving was determined using the mean and percentage distribution by subscales: "deep approach, surface approach and strategic approach". Deep learning strategy moderately utilized by the students in problem solving. It shows the mean extent of use of the technique in dealing with mathematical problems.

Greater quantity of students sometimes used the different learning strategies in problem solving as shown in Figure 3. Students that "Always utilize" the deep learning technique has the lowest frequency of 6 or 2.5 percent of students. However, majority of the students have "sometimes utilized" the strategy with frequency of 149 or 62.08 percent of them. Students "Rarely utilized" the surface and strategic learning approach with lowest frequency of 3 or 1.25 percent of students. This only mean that sophomore students in the university preferred deep learning rather than the surface and strategic learning technique. It can be noted further that no students never utilized the learning strategies.

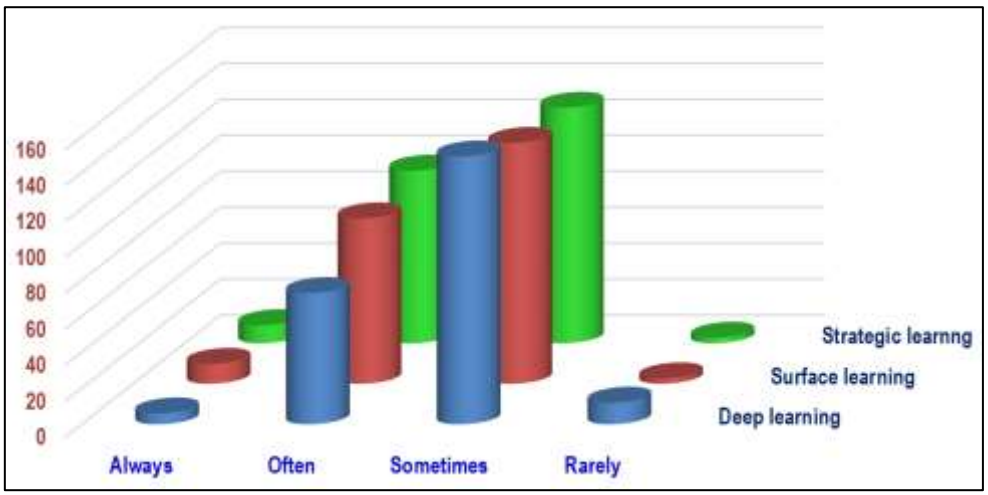

Figure 3: Extent of students' use of learning strategies

As presented in Table 2, the students "Sometimes utilize" the deep approach as a learning strategy in problem solving with an overall mean of 3.34. It is shown from the table that no student utilized the deep learning strategy. It also reveals from Fig.2 that the highest number of students which is 149 (62 percent) sometimes utilize the deep learning approach. It implied from the table that most of the students have utilized learning strategy such as deep approach in problem solving. The frequency value of 134 (56 percent) tells that students have "Sometimes utilized" the surface learning approach, while the lowest frequency of 3 or 1 percent of students have "Rarely Utilised" the surface learning approach. It can be noted from the data that the higher number of students have "Sometimes utilized" surface learning approach in problem solving.

Table 2: Learning strategies in problem solving

Learning strategies	**Mean**	**SD**	**Description**
Deep Learning	3.34	0.285	Sometimes utilise
Surface learning	3.15	0.470	Sometimes utilise
Strategic learning	3.18	0.421	Sometimes utilise
Grand Mean	3.22		Sometimes utilise
Overall SD		0.392	
Ranges for the Weighted Mean	**Description**		
1.00 – 1.80	Not utilise		
1.81 – 1.60	Rarely utilise		
2.61 – 3.40	Sometimes utilise		
3.41 – 4.20	Often utilise		
4.21 – 5.00	Always utilise		

The highest number of the students "Sometimes utilized" strategic learning approach in problem solving. This consists of 131 or 54.58 percent out of 240 students, while the lowest frequency of three (1.25 percent) of the students have "rarely utilized" strategic approach in problem solving. No student has never utilized strategic approach in problem solving. It goes to show that they have already knowledge on the techniques or strategies in solving mathematical or worded problems but for any reason they only use it moderately.

The achievement of the students in problem solving was determined using the problem-solving test. The mean percentage score or MPS measured the performance. Table 3 presents the level of achievement test of the students.

Table 3: Distribution of problem test achievement

Problem Solving Achievement Level	**Frequency**	**Percent (%)**
High Achievement	9	3.75
Average Achievement	36	15.00
Low Achievement	121	50.42
Very Low Achievement	74	30.83
Total	240	100.00
Grand mean = 37.82 (Low achievement)		

Students have "low achievement" in problem solving. The overall mean percentage score of 37.82 reveal this. It shows that the highest frequency of 121 or 50.42 percent of the students have "low achievement" in problem solving test, followed by a frequency of 74 or 30.83 percent of the students with "very low achievement" in problem solving test. It is probably because the foundation of learning of these students were probably weak and their interest and skills in learning mathematics especially problem solving were not been fully developed prior to higher education level. It noted that relatively few students have "average achievement" consisting of 36 or 15 percent students, and only 9 or 3.7 percent of the students have "high achievement" in problem solving test. The Table also reveals that no student has attained a "very high achievement" in the given problem-solving test. In general, majority of the students have low to very low achievement in the problem-solving test.

An intermediate relation of the academic self–concept and the problem solving achievement by subscales: math self–concept (r-value = 0. 261, p-value = 0.000), language self–concept (r-value = 0.233, p-value = 0.017), specialized subject self–concept (r-value = 0.245, p-value = 0.000). The academic self–concept and problem solving achievement were positively associated with Mathematics self–concept. Specialised subject self–concept was also directly associated with the problem solving achievement with r-value = 0.261 and r-value = 0.245 respectively, suggesting a highly significant positive relationship between language self–concept and problem solving achievement. The table also shows that all p–values are less than the level of significance of 0.05, which indicates that students' academic self–concept such as mathematics, language and specialized subject related to their problem solving achievement.

Table 4: Correlation between academic self–concept and problem solving achievement

Students' Academic Self - Concept	r-value	p-value	Interpretation
Math Self–Concept	0.261**	0.000	Highly significant
Language Self–Concept	0.233*	0.017	Significant
Specialized Subject Self–Concept	0.245**	0.000	Highly significant
** - Significant at $\alpha \leq 0.05$ ** - Highly significant at $\alpha \leq 0.01$*			

Table 4 showed that learning strategies in terms of deep, surface and strategic approaches does not moderate the association of academic self–concept and problem solving attainment of the students. A partial correlation coefficient of r-value = -0.054 with p–value = 0.395, r-value = -0.050 with p–value = 0.431, and r–value =0.048 with p–value = 0.450 between the two latter variables with the learning strategy approaches used serve as moderator which interpreted as not significant at 0.05 level of significance. This could mean that, as the study has provided evidence for a positive relationship along the above-mentioned variables, the students, learning strategies has no control over the said relationship. This result contradicts the study conducted by Cheng et al. (2012). Their study carefully examined the directional effect of academic self–concept and learning techniques towards students' achievement. They depicted that learning strategies, as a predictor, moderate the academic self-concept as a variable.

The study indicated that deep and surface approach partially moderate effects on mathematics achievement. These imply that individual students with high academic self–concept study harder and perform academically well compared those with low academic self–concept.

5. Conclusion and Recommendations

The academic self–concept of students has direct bearing on their problem solving achievement. The higher the academic self-concept the higher the corresponding problem solving achievement of the sophomore university students. Accordingly, their problem solving achievement goes hand in hand on the extent of their used strategies rather than their beliefs and thoughts. There were lack of motivations, insufficient learning strategies and inadequate effective instructions introduced for the enhancement of the self-concepts and beliefs in mathematics which could help university students acquire mathematics a lifelong skill.

Teachers in mathematics should be trained and effective in developing student's beliefs and interests, which can eventually improve their problem solving achievement. They must introduce and developed effective instruction and strategies that will improved the students learning capacity and ability to deal with different solving problems.

About the author

Rodell E. Tan is an Instructor of Eastern Visayas State University (EVSU), Burauen Campus, Burauen, Leyte, Philippines. His research interests include statistical modeling and forecasting in the fields of agriculture, education, economics, health, statistics, mathematics, and social sciences. He is the designated Research Coordinator of the Campus where is oversee the campus wide research activities both for the faculty and university students.

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