Students' Self-Efficacy, Epistemological Beliefs and Mathematics Performance

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ABSTRACT

This study sought to determine the mathematics performance, the levels of self-efficacy and epistemological beliefs of the students of Notre Dame of Dadiangas University. Furthermore, it determined the association between students' self-efficacy and epistemological beliefs and the influence they have on their mathematics performance. This is a predictive-correlational study. Results revealed that the students generally have sophisticated certainty of knowledge, stability of knowledge, structure of knowledge, speed of learning, and ability to learn beliefs, but have unsophisticated source of knowledge beliefs. Moreover, they too have high self-efficacy with generally low mathematics performance. It was also found that the students' academic performance is significantly related to their self-efficacy, certainty of knowledge, stability of knowledge, structure of knowledge, speed of learning, and ability to learn beliefs. No significant relationship was established between the students' source of knowledge beliefs and their mathematics performance. The students' epistemological beliefs are significantly and positively related to their self-efficacy. Through regression, it was found that the students' self-efficacy and epistemological beliefs have direct influence on their mathematics performance. With the aforementioned results, it was established that beliefs affect the students' learning of mathematics.

Keywords: epistemological belief; self-efficacy; mathematics learning; improving academic performance; effects of beliefs on learning

INTRODUCTION

Effective teaching is not just mere content delivery; it necessitates understanding and engaging diverse learners. To foster active learning, teachers must recognize the unique characteristics and internal factors that motivate each student. This includes acknowledging the varied abilities and learning styles present in the classroom. While students may enter with different mathematical skills, teachers are responsible for ensuring all students achieve the learning objectives. Beyond abilities, factors like epistemological beliefs and self-efficacy play a crucial role in academic success. Teachers can leverage these internal factors through instruction, ultimately enhancing students' mathematical performance. This study investigates the relationship between epistemological beliefs, self-efficacy, and mathematics achievement.

Po Hung Liu (2011) cites the studies of Fang (1996), Kang and Wallace (2004), Pajares (1992), and Schoenfeld (1985) which showed that belief systems affect the students' learning and responses to behaviors in the classroom. Beghetto and Baxter (2012) claimed that in the development of mathematics competence, ability alone is not sufficient. They explained citing Bandura (1997) that students who otherwise have the ability to be successful in learning math but believe otherwise will give up likely in the face of challenge, underperform, and ultimately focus their attention and effort on other pursuits and endeavors. Moreover, they added that there is a need for future studies to develop a better understanding of the specific role that epistemological beliefs play in the improvement of mathematical understanding. Tejano (1999) like Beghetto and Baxter also sees a pressing need to give due importance and concern to the students' epistemological beliefs since these beliefs in his view play an important part in every educational endeavour where learning and knowing are the principal emphases. As defined by Conley et al (2004), epistemological beliefs pertain to the beliefs about the nature of knowledge and knowing.

Schommer-Aikin and Duell (2013) narrate that the researchers on epistemological beliefs continue to grow as many different relationships have been found between epistemological beliefs and learning. They recommend like the recommendation of many other researchers to look into the effects of epistemological beliefs in combination with other variables. Harteis, Gruber, and Hertramph (2010) recounted the attention received by epistemological beliefs in the fields of educational and psychological researches (for example Hofer, 2004; and as seen in Harteis et al, 2010 are the researches of Harteis, Gruber and Lehner, 2006; Bauer, Festner, Gruber, Harteis, and Heid, 2004). Educational researches are interested in the role of epistemological beliefs in learning and academic achievement (De Backer, 2008). Hofer (2004) urges all that might be concerned to know about how students understand the epistemological aspects of their instructional environments, what practices are most salient, and how they are interpreted through the lens of existing beliefs and knowledge, which are also being altered in the process. Epistemological beliefs have become the focus of growing investigations as insights to students learning and motivation can be drawn from the understanding of these set of students' beliefs (Buehl and Alexander, 2001). It is interesting to note as well that in the study of Guo, et al (2022), they discovered that epistemological beliefs are even more strongly related to academic achievement than the motivational constructs.

It is supposed that students' beliefs about the learning of mathematics must be explored and addressed by changing these beliefs from their naïve (unsophisticated) state to their mature (sophisticated) state. Even how much effort educators exert and despite and in spite of the new and innovative strategies and instructional material they use if the student's beliefs in learning mathematics are negative, nothing will ever happen-no learning, nor can understanding take place within the learner.

Schommer (1990) posits that epistemological beliefs are multidimensional comprised of five dimensions, namely, omniscient authority (beliefs about the validity and the source of knowledge), certain knowledge (beliefs about the reliability of knowledge), simple knowledge (beliefs about the structure of knowledge), quick learning (beliefs about the speed of learning), and innate ability (beliefs about capacity for learning). These dimensions have been demonstrated to influence academic classroom learning and performance (Esterly, 2003; Schommer, 1990; Schommer, 1993). The study of Kardash and Scholes (1996) on the other hand found out that the students epistemological beliefs affect how they integrate and acquire new knowledge.

The other construct that this study focuses on is the learners' self-efficacy. It is a personal belief that one will be able to do or accomplish something successfully (Goetz, et al, 1992; Feldman, 2013). Bandura (1982) stated that one's judgment of his or her self-efficacy determines the type of tasks that he or she chooses, the amount of effort that will be put on those tasks, and eventually the level of performance one will have on those tasks.

Self-efficacy affects acquisition of learning in many ways. Those who have high self-efficacy do not give up easily on tasks where they first fail on and as such they accomplish more (Olson and Hergenhahn, 2009). Students with high level of self-efficacy have better control of the learning process, attribute failure not to absence or lack of ability but on lack of effort on their part, thus they persevere more, and they develop and engage on strategies by which they would be able to succeed (Woolfolk, 2013). Students' self-efficacy affects learning and motivation making it an important variable that is why researchers working on the educational setting are increasingly focusing on it (Dinther, Segers, and Mien, 2011).

The ultimate goal of this study is to improve the mathematics performance of the students. The Philippines has been participating since 2018 in the Programme for International Students Assessment (PISA) which is an international assessment that tests the mathematics, reading and science knowledge and skill of students. In the 2018 PISA participated by 79 countries, the Philippines received the second lowest rank in mathematics and science. In the 2022 PISA participated by 81 countries, the Philippines ranked sixth from the bottom in mathematics with 81 countries participating. These results clearly show that many of our students in terms of mathematics proficiency fall below the international standards. At Notre Dame of Dadiangas University, the students' mathematics performance in the basic college mathematics (GE 3) in school year 2018-2019 was only 2.75. A grade of 2.75 is a grade that is just one grade bracket better than barely passing. In that school year, 7.58% of the students failed while 18.72% barely passed (grade of 3.00). In the school year that followed there was no improvement recorded as the average grade in the basic mathematics remained at 2.75. However, 13% of the students failed in that school year which is a 5.42% percentage-point increase compared to the previous year, while 18% barely passed. Generally, then, the students' mathematics performance is poor.

While there are researches on self-efficacy and epistemological beliefs and their effects on academic performance available these researches are not focused on *mathematics* self-efficacy and *mathematics* epistemological beliefs in five dimensions and their influence on mathematics performance. In the locale where this study is conducted, these variables and their relationships have not been investigated.

Knowing the level of self-efficacy of the students and its relation with the other set of beliefs that they too hold are interesting areas of exploration if one also has the goal of improving the academic performance of the students. A goal that rightfully belongs to institutions of higher learning.

Objectives

This study sought to determine the mathematics performance and the levels of self-efficacy and epistemological beliefs of students as well as the association between these constructs and their influence on the mathematics performance of the students.

MATERIALS AND METHODS

This study used a predictive-correlational research design. In a predictive- correlational design the relationships of variables are being identified and outcomes are being anticipated using one or more predictor variables and an outcome (criterion) variable (Creswell, 2012). The criterion variable is sometimes called dependent variable, while the predictors are sometimes referred to as the independent variable.

In this study, the type and strength of the association between epistemological beliefs and self-efficacy was determined. This part was purely correlational. In the final phase of this study, it was investigated if the students' self-efficacy and epistemological beliefs (independent variables) can influence (predict) their mathematics performance (dependent variable). The Creswell (2012) characterization of the predictive-correlational design fits this study.

Respondents

The respondents of these study were the students of Notre Dame of Dadiangas University who took their GE 3 (Mathematics in the Modern World) in the first semester of school year 2021-2022 and had completed that course.

Sampling Design

The total number of students enrolled in the first semester of SY 2021-2022 was 3,711. Using the Slovin's formula with margin of error set at 5%, the computed sample size was 361. There were three hundred ninety-three (393) students who participated in this study randomly selected from the colleges of health sciences, arts and sciences, business, education, and engineering and architecture.

Research Instruments

Two instruments were used in this research, namely, the Epistemological Beliefs Inventory Questionnaire (EBIQ) and the Academic Self-Efficacy Questionnaire (ASEQ).

The instrument for the determination of the students' epistemological beliefs was adapted from the questionnaire developed by Ondaro (2016) which was patterned after the instrument developed by Wheeler (2007). Modifications were made in order to suit the purposes of this study. The questionnaire consists of 45 items and measures the GE 3-related epistemological beliefs of the students on the five dimensions proposed by Schommer (1990) in her model. These dimensions are (a) structure of knowledge, (b) source of knowledge,

(c) stability or certainty of knowledge, (d) speed of learning, and (e) ability or control of learning. The items in every dimension were rated by the respondents using a 4 -point Likert scale ranging from strongly disagree (a rating of 1) to strongly agree (a rating of 4). Table 1 below contains the specifications for this instrument.

To measure the self-efficacy of the students, a researcher-made questionnaire was utilized based on the review of related literature. The items in the questionnaire were assessed by the respondents using a 4-point Likert. The questionnaire is called the "Mathematics Self-efficacy Questionnaire" or MSEQ. Three experts validated the MSEQ. An indicator for the mathematics self-efficacy was retained only if at least two of the experts have adjudged it as valid. If and when a validator gives suggestion for the improvement of an indicator, such was incorporated only if the suggestion gained the approval of the other validators.

The MSEQ was tested for its internal reliability using the Cronbach's alpha. Thirty students participated in the pilot testing. The Cronbach's alpha returned a value of .83. The EBIQ' reliability was established using the test-retest method. The responses of those who participated in the pilot testing were correlated using the Pearson r and were tested for significant relationship. Results of the correlation showed a very high positive significant relationship between the scores in the first and the second testing. The r value was .87. Thus, it can be concluded that the two instruments are both highly reliable.

The EBIQ consists of beliefs for particular dimensions which are classified either as sophisticated or unsophisticated. The recording of the respondent's rating used the "sophisticated" perspective. That is, an agreement for the beliefs viewed as unsophisticated would mean that the respondent holds an unsophisticated stance on a particular epistemological beliefs dimension, while a disagreement on beliefs viewed as unsophisticated would mean that the respondent holds a sophisticated stance on a particular dimension. Similarly, agreement for the beliefs viewed as sophisticated would mean that the respondent holds a sophisticated stance on a particular epistemological beliefs dimension, while disagreement on beliefs viewed as sophisticated would mean that the respondent holds an unsophisticated stance on a particular dimension. Thus, in recording, whatever rate which will be marked by a respondent in the instrument for beliefs classified as sophisticated was recorded as the respondent's rate for that item. For the items classified as unsophisticated, the respondent's rating would be taken in reverse.

In interpreting the mean rates, the following continuum was utilized together with their descriptions:

Mean Rating	Sophisticated Beliefs	Unsophisticated Beliefs	Level
1.00 – 1.75	Strongly Disagree	Strongly Agree	Very Unsophisticated
1.76 – 2.50	Disagree	Agree	Unsophisticated
2.51 – 3.25	Agree	Disagree	Sophisticated
3.26 – 4.00	Strongly Agree	Strongly Disagree	Very Sophisticated

Since the EBIQ quantitatively reports on the math related epistemological beliefs of the respondents, an overall mean rating on a dimension ranging from 1.00 to 2.50 would mean that the respondent generally holds an unsophisticated set of epistemological beliefs in that particular dimension, while an overall mean rating of 2.51 to 4.00 would mean that the respondent holds a sophisticated set of epistemological beliefs in that particular dimension.

The MSEQ also used a 4-point scale and scored the same way as the EBIQ. Items that do not show or pertain to an individual who is efficacious was reversely scored. The mean obtained was interpreted verbally as follows.

Mean Rating	Level
1.00 – 1.75	Very low self-efficacy
1.76 – 2.50	Low Self-efficacy
2.51 – 3.25	High Self-efficacy
3.26 – 4.00	Very High Self-efficacy

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Data Gathering Procedures

The researcher administered online through google forms the Epistemological Beliefs Inventory Questionnaire (EBIQ) to determine the students' level of mathematics related epistemological beliefs and the Mathematics Self-Efficacy Questionnaire (MSEQ) to determine the students' self-efficacy level. The respondents were asked to answer in the sincerest and most honest way possible and confidentiality of responses was assured. The assistance of the college professors was sought to facilitate the distribution of the questionnaires.

The semestral grades of the students in their GE 3 were the basis of determining the mathematics academic performance of the students. These data were obtained from the university registrar.

The respondents' responses on the EBIQ and the MSEQ were then organized, classified, and statistically analyzed in order to determine their general level of self-efficacy, epistemological beliefs and mathematics performance; establish the relationships between epistemological beliefs, mathematics performance and self-efficacy; and to ascertain if indeed epistemological beliefs and self-efficacy could influence the mathematics performance of the students.

RESULTS AND DISCUSSION

Presented in this section are the data gathered in this study as well as the discussion of the key findings.

Students' Self-Efficacy Level

Table 1 shows that the mathematics students of Notre Dame of Dadiangas University generally have high level of self-efficacy (M= 2.84, SD = 0.45). There were ten indicators surveyed of which five had been rated low while the other five have been rated high to very high.

Results show that the respondents take time trying to solve mathematics problems even if those problems were difficult. They believe that through perseverance and effort their mathematics capabilities are improvable. They participate in class activities and make their ideas known as they are confident that their ideas can contribute to the pair or their group's performance or output. They are confident that by themselves they can satisfactorily answer the questions and solve the problems given in their math quiz, assignment, and/or seat works. They are convinced that they can pass their math examination. They believe in their capabilities to understand the lessons/topics in their math class and to learn the mathematical skills needed in those lessons/topics. Lastly, they believe that they could achieve the goals that they set in their math class.

Table 1. Respondents Ratings on their Self- Efficacy

Indicators	Average Rating	Level
I am not embarrassed or shy to ask my math teacher questions or clarifications whenever there are things I do not understand or get in the discussion/lecture or on his/her instructions.	2.48	Low Self-Efficacy
I participate in pair or group works whenever such activities are given and I make my ideas known to my classmates as I am confident those ideas can contribute to the pair or our group's performance or output.	3.35	Very High Self-Efficacy
I welcome the opportunity to recite and explain my answer to the whole class.	2.50	Low Self-Efficacy
I am confident that I can on my own satisfactorily answer the questions and solve the problems given in my math quiz, assignment, and/or seat works.	2.78	High Self-Efficacy
I am convinced that I can pass my math examination.	2.93	High Self-Efficacy
Even if the problems in my math class are difficult, I still take the time in trying to solve them.	3.58	Very High Self-Efficacy

I believe in my capabilities to understand the lessons/topics in my math class and to learn the mathematical skills needed in those lessons/topics.	3.25	High Self-Efficacy
I believe that I could achieve the goals that I set in my math class.	3.14	High Self-Efficacy
I believe that my mathematics capabilities can be improved with perseverance and effort on my part.	3.54	Very High Self-Efficacy
I am easily discouraged whenever I experience failure or difficulty in my math class.	2.32	Low Self-Efficacy
I feel anxious whenever I attend my mathematics class.	2.04	Low Self-Efficacy
In times that I fail or do not achieve my expectation or goals in an activity or assessment in my math class, I feel that it is due to the math abilities that I have and not due to lack of effort or persistence on my part.	2.22	Low Self-Efficacy
General	2.84	High Self-Efficacy

Levels of Students' Epistemological Beliefs

There are five dimensions of epistemological beliefs according to Schommer's Model, namely, source of knowledge, stability of knowledge, structure of knowledge, speed of learning, and ability to learn beliefs. As to the levels, the students could either have sophisticated or unsophisticated level of these beliefs. The degree of sophistication or unsophistication of these beliefs had also been determined.

Presented in table 2 are the source of knowledge beliefs. Only two of these beliefs had been determined as sophisticated to very sophisticated while the other seven had been determined to be unsophisticated to very unsophisticated. Generally, the source of knowledge beliefs of the students are unsophisticated with the overall mean of 2.10 and a standard deviation of 0.31. This means that they believe that their mathematics knowledge comes mainly and mostly from their teachers, they will learn best watching their teacher work on examples rather than working on the practice problems themselves, for them to solve the mathematics problems they needed to be taught the correct or right procedures, they accept whatever their teachers say, and they also believe that the success of mathematics instruction is determined entirely by their teacher.

Table 2. Respondents Ratings on their Source of Knowledge Beliefs

Source of Knowledge Beliefs	Average Rating	Level
Learning mathematics depends MOST on having a teacher who explains each and every detail in the book.	1.60	Very Unsophisticated
I learn mathematics BEST when watching my teacher work on example problems rather than I working on the practice problems myself.	1.58	Very Unsophisticated
If my mathematics teacher gave really clear lectures with plenty of good example problems, I would NOT have to practice so much on my own.	2.29	Unsophisticated
The quality of a mathematics instruction is determined ENTIRELY by the teacher.	1.90	Unsophisticated
What I get from my mathematics class depends mostly on the effort I invest.	3.40	Very Sophisticated
I accept anything that my mathematics teacher says.	1.84	Unsophisticated
Mathematics is something I could not learn on my own.	1.95	Unsophisticated
To solve problems in mathematics I have to be taught the right or correct procedure.	1.42	Very Unsophisticated
In my mathematics class, I can be creative and discover things on my own.	2.89	Sophisticated
General	2.10	Unsophisticated

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Table 3. Respondents' Ratings on their Stability of Knowledge Beliefs

Stability of Knowledge Beliefs	Average Rating	Level
Most of what are proven as valid conclusions in mathematics are already known.	2.02	Unsophisticated
Mathematics is really just knowing the right formula for the problem.	2.02	Unsophisticated
I prefer a mathematics teacher who shows students different strategies in solving problems.	3.56	Very Sophisticated
Mathematics is nothing but numbers, symbols, shapes & figures, and/or formulas.	2.63	Sophisticated
The application of the concepts taught in mathematics to different disciplines changes as knowledge on those disciplines grows.	3.29	Very Sophisticated
There is usually one best way to solve problems in mathematics.	1.89	Unsophisticated
In mathematics, the answers are always either right or wrong.	1.94	Unsophisticated
Creativity has no place in a mathematics class.	3.03	Sophisticated
All mathematics professors would probably come up with the same answers to questions in their field.	2.27	Unsophisticated
General	2.52	Sophisticated

Table 3 above presents the stability of knowledge beliefs of the students. Five of these beliefs are unsophisticated while the other four have levels ranging from sophisticated to very sophisticated. The grand mean is 2.52 interpreted as sophisticated with a standard deviation of 0.31. The students have a sophisticated stability of knowledge (M= 2.52, SD = 0.31) beliefs. They believe that there are different ways by which mathematics can be solved as such creativity has a place in a mathematics class. They also believe that mathematics is more than numbers, symbols, shapes, figures; and that the way mathematics concepts are applied in other disciplines changes as knowledge in those disciplines grows.

Table 4. Respondents Ratings on their Structure of Knowledge Beliefs

Structure of Knowledge Beliefs	Average Rating	Level
It is important to know why a theorem/assumption is valid rather than just memorize it.	3.44	Very Sophisticated
When learning mathematics, I can understand the material better if I relate it to the real world.	3.28	Very Sophisticated
When applying the properties or concepts taught in the mathematics, it is important to understand how these properties/concepts relate to one another to arrive at a solution.	3.43	Very Sophisticated
Concepts taught in mathematics are NOT related to each other.	2.98	Sophisticated
Mathematics is mostly facts that have to be memorized.	2.40	Unsophisticated
I learn BEST if I am given the opportunity to make conjectures and validate them on my own.	2.87	Sophisticated
I like to develop my skills in deductive reasoning.	3.23	Sophisticated
Understanding how the topics or concepts in mathematics are being used in other disciplines helps me comprehend those topics/concepts.	3.32	Very Sophisticated
General	3.12	Sophisticated

The beliefs on the structure of knowledge are presented in table 4. Seven of these beliefs have levels ranging from sophisticated to very sophisticated. Only one of these beliefs has an unsophisticated level. Generally, the beliefs on the structure of knowledge of the students are sophisticated (M = 3.12, SD = 0.32). The students' beliefs on the structure of knowledge are also sophisticated (M = 3.12, SD = 0.32). In fact, this is the set (or dimension) of epistemological beliefs which is the most sophisticated. The students believe that they should know how a mathematical theorem or assumption is valid instead of just memorizing it; they would be able to understand a material used in a mathematics class if they are able to relate it the real world; and they believe that mathematical concepts can be better comprehended if they are able to understand how these concepts are being used in other disciplines. For them to arrive to a solution, they must be able to understand first how the

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mathematical properties and concepts relate to one another. Mathematics for them is learned best if they are given the opportunity to make conjectures and validate them in their own which will eventually develop their skills in deductive reasoning.

For the speed of learning beliefs shown in table 5, four out nine fall in the category of sophisticated, three are very sophisticated, while only two are unsophisticated as depicted in table 5 above. The students' beliefs in speed of learning are generally sophisticated (M= 2.81, SD = 0.32). The students' beliefs on the speed of learning acquisition are generally sophisticated (M=2.81, SD = 0.32). The students believe that given enough time everyone can learn mathematics provided they really try. They believe that every time difficult mathematics problem is encountered, they have to stick to it until they have solved it, and it will help them if they will go back over on something presented in class that they did not understand. They believe that in order for them to perform better in their math class they have to spend more time looking for learning resources. For the students, it takes time to learn mathematics.

Table 5. Respondents Ratings on their Speed of Learning Beliefs

Speed of Learning Beliefs	Average Rating	Level
It takes time to learn mathematics.	3.59	Very Sophisticated
If I cannot solve a problem quickly, I get frustrated and tend to give up.	2.42	Unsophisticated
When I encounter a difficult mathematics problem, I stick with it until I solve it.	3.01	Sophisticated
Given enough time, almost everyone could learn mathematics if they really tried.	3.45	Very Sophisticated
If I don't understand something presented in class, going back over it later isn't going to help.	2.75	Sophisticated
If I can't solve a problem in a few minutes, I am not going to solve it anymore.	2.94	Sophisticated
If I know what I am doing, I should not spend more than a few minutes to complete a homework problem.	2.23	Unsophisticated
It is frustrating to read a problem and not know immediately how to begin to solve it.	1.70	Very Unsophisticated
In my mathematics class, I could have done better if I spend more time looking for learning resources.	3.23	Sophisticated
General	2.81	Sophisticated

Table 6. Respondents Ratings on their Ability to Learn Beliefs

Ability to Learn Beliefs	Average Rating	Level
When I am having trouble in my mathematics class, understanding the source of my difficulty can make a big difference.	3.31	Very Sophisticated
I am confident I could learn mathematics if I put in enough effort.	3.48	Very Sophisticated
When I do not understand something, I keep asking questions.	3.12	Sophisticated
Working on my difficulties in learning mathematics can improve my mathematical skills.	3.46	Very Sophisticated
Mathematics is like a foreign language to me and even if I work hard, I will never really get it.	2.57	Sophisticated
I knew at an early age that I will never learn mathematics.	2.94	Sophisticated
If mathematics were easy for me, then I would not have to spend so much time on homework.	2.09	Unsophisticated
It is frustrating when I have to work hard to understand a problem.	2.03	Unsophisticated
I can learn new things, but I cannot really change the mathematics ability I was born with.	2.29	Unsophisticated
With the right attitude and perseverance, I can learn mathematics.	3.60	Very Sophisticated
General	*2.89*	*Sophisticated*

Presented in table 6 are the ability to learn beliefs of the students. Seven of which have levels ranging from sophisticated to very sophisticated' while three are unsophisticated. The ability to learn beliefs of the students are generally sophisticated (M = 2.89, SD = 0.40). Lastly, the ability to learn beliefs (M = 2.89, SD = 0.40) of the students are sophisticated. It is in their view that a big difference is made if they are able to determine the source of their difficulties in mathematics and by working on those difficulties their mathematical skills can be improved. For them with the right attitude and perseverance and if they put enough effort and work hard mathematics could be learned. They as well believe that they have to ask questions if they do not understand something.

In summary, the respondents have sophisticated stability of knowledge, structure of knowledge, speed of learning, and ability to learn beliefs. They generally have unsophisticated source of knowledge beliefs. These results are similar to the findings of Ondaro (2016) in a study that sought to improve the epistemological beliefs and the geometric understanding of the pre-service teachers of the major higher educational institutions in South Cotabato. In an earlier study of Doronila (2012) that developed a 3P Model on problem solving, the college students from Region XII have been found to have sophisticated beliefs in all the five dimensions, that is, including the source of knowledge beliefs.

Students' Academic Performance

The average grade of the students (N = 393) enrolled in GE 3 in the 1st semester of school year 2021-2022 who were part of this study is 2.21 with the standard deviation of 0.51. One-hundred fifty-two of the respondents (38.68%) have grades 2.00 to 1.00 while two-hundred forty-one of them (61.32%) have grades 3.00 to 2.25.

Relationship between Self-efficacy, Epistemological Beliefs, and Academic Performance

One of the objectives of this study is to determine if the students' academic performance relates to their self-efficacy and epistemological beliefs. The correlation (Pearson r) results together with their t and p-values are in table 8 below.

Table 8. Correlation between academic performance, self-efficacy and epistemological beliefs

Beliefs	Academic Performance
Self-Efficacy	r = .21; t(391) = 4.19, p <.001
Source of Knowledge	r = .02; t(391) = 0.40, p =.688
Stability of Knowledge	r = .15; t(391) = 2.95, p = <.005
Structure of Knowledge	r = .12; t(391) = 2.38, p = .02
Speed of Learning	r = .13; t(391) = 2.65, p = .008
Ability to Learn	r = .16; t(391) = 3.26, p =.001

As shown in the table, the students' mathematics performance has significant positive relationship with their self-efficacy (r = .21; t(391) = 4.19, p <.001), ability to learn beliefs r = .16; t(391) = 3.26, p =.001, stability of knowledge beliefs r = .15; t(391) = 2.95, p = <.005, speed of learning beliefs r = .13; t(391) = 2.65, p = .008, and structure of knowledge beliefs (r = .12; t(391) = 2.38, p = .02). It has to be noted that the source of knowledge beliefs and the academic performance have not been found to have a significant correlation r = .02; t(391) = 0.40, p =.688. Self-efficacy has been found to have the strongest correlation with academic performance while the weakest correlation is found to exist between academic performance and the structure of knowledge belief. These results suggest that students with high levels of self-efficacy and epistemological beliefs (except source of knowledge beliefs) have been observed to have higher mathematics performance.

Soldo (2023) in his study on the correlation of self-efficacy and mathematics academic achievement also found that these two constructs are positively correlated. A strong positive relationship between self-efficacy and academic performance was also determined in the study of Meng and Zhang (2023). According to Zakariya et al (2020) students with high self-efficacy use deep approaches to learning while students with low self-efficacy use only surface approaches. Students that use deep approaches to learning have better mathematics performance than those who utilize surface approaches. The results in this study are similar as well to that of

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Pamuk and Oztekin (2016) where they have discovered that the students with sophisticated epistemological beliefs are more successful in science. Moreover, the students' epistemological beliefs have been found to be even more strongly correlated to their academic achievement than motivation (Guo, 2022).

Relationship between students' self-efficacy and epistemological beliefs

The students' epistemological beliefs have also been correlated with their self-efficacy. As shown in table 9, the different dimensions of students' epistemological beliefs are significantly positively correlated with their self-efficacy. The ability to learn belief dimension has the strongest correlation with self-efficacy ($r = .50$; $t(391) = 11.44$, $p < .001$) while the stability of knowledge belief dimension has the weakest correlation with self-efficacy ($r = .11$; $t(391) = 2.11$, $p = .035$).

Table 9. Correlation between students' self-efficacy and epistemological beliefs

Epistemological Beliefs	Self- Efficacy
Source of Knowledge	r = .21; t(391) = 4.32; p <.001
Stability of Knowledge	r = .11; t(391) = 2.11, p = .035
Structure of Knowledge	r = .29; t(391) = 6.03, p <.001
Speed of Learning	r = .44; t(391) = 9.69; p <.001
Ability to Learn	r = .50; t(391) = 11.44, p <.001

These findings mean that students with higher levels of sophistication in their epistemological belief have higher levels of self-efficacy as well. These results find concurrence in the study of Panergayo (2023) where a direct relationship was also found between the students' self-efficacy and epistemological beliefs.

Influence of Self-efficacy and Epistemological beliefs on Academic performance

In order to determine if the students' mathematics performance can be influenced by their self-efficacy and epistemological beliefs multiple regression analysis was carried out.

Table 10. Multiple Regression Analysis Results on the Predictive Ability of Self-efficacy and Epistemological Beliefs on Academic Performance

Sources of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	p-value	R	R^2
Regression	6.428	6	1.071	4.372	<.001	.252	.064
Residual	94.586	386	0.245				
Total	101.015	392					

It has been found that when taken all together, the students' self-efficacy and epistemological beliefs can influence the students' academic performance ($F(6,386) = 4.372$, $p<.001$, $R^2 = .064$). Further analysis revealed that only the students' stability of knowledge beliefs and their self-efficacy have the ability to influence their mathematics academic performance. In particular, an increase in the level of self- efficacy and the more sophisticated the students' stability of knowledge beliefs become, the better their academic performance will be. The coefficient of determination reveals that 6.40% of the variations in students' mathematics academic performance are attributable to the variations in the students' self-efficacy and stability of knowledge beliefs. This implies that self-efficacy and stability beliefs both have a significant direct influence on the students' mathematics performance. In other words, an increase in the levels of these constructs produces an increase in the mathematics academic performance of the students.

Results in the study of Aurah (2013) showed self-efficacy to have a strong influence on academic performance. In the studies of Negara, et al (2021) and Ugwuanyi et al (2020), it has been established that mathematics self-efficacy is a significant predictor of mathematics performance. The study of Belecina and Ocampo (2016) discovered not only a significant correlation between epistemological beliefs and mathematics performance, but the ability of the former to influence the latter. The more recent study of Meng and Zhang (2023) supports this result as well as they found that self-efficacy has a direct influence on academic performance of university students and has an indirect influence on their academic performance with the intermediating effect of academic engagement.

CONCLUSION

The NDDU students have a good mathematics performance who believe in their ability to gain and achieve the standard and goals they set in their mathematics subject. They believe that it takes time to learn mathematics and they are capable of learning mathematics with perseverance, hard work, and the right attitude. For them, mathematics is growing and that mathematical concepts are interrelated and best understood if applied in real life. However, they believe more that mathematical knowledge comes from external sources rather than self-generated (internal).

The student's self-efficacy and ability to learn beliefs have a significant influence in their mathematics academic performance. Moreover, students with more sophisticated ability to learn, structure and stability of knowledge beliefs and who have higher levels of self-efficacy have better performance in mathematics.

It is therefore imperative that mathematics teachers develop, design and use teaching strategies and class activities that enable and support students to develop sophisticated epistemological beliefs and enhance their self-efficacy as these beliefs promote learning. It has to be aspired in terms of teaching that students become generators or discoverer of mathematical knowledge so that learning becomes enduring and gratifying. Building on their successes students would be able to view mathematics as something that could be learned successfully and would increase their confidence in confronting more complex problems in mathematics.

Future researchers may consider other students' beliefs that could have a stronger influence on their learning of mathematics. The different factors affecting the students' beliefs like effectiveness of teaching strategies, students' motivation and the impact of these factors may be explored to shed more light on the complex process of how students learn mathematics especially in the environment where technology is advancing and is being used. The scope of the study to include other institutions of higher learning may be integrated in the research design to improve the acceptability of the results and findings. Lastly, as beliefs take time to develop and mature, a longitudinal study may be done to explore the impact of these beliefs on the students' learning.

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REFERENCES

1. Aurah, Catherine. (2013). The Effects of Self-efficacy Beliefs and Metacognition on Academic Performance: A Mixed Method Study. American Journal of Educational Research. 1. 334-343. 10.12691/education-1-8-11.
2. Bandura, A (1977). Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review, 84, 191-215.
3. Bandura, A. (1982). Self-Efficacy Mechanism in Human Agency. American Psychology, 37, 122-177.
4. Beghetto, Ronald and Juliet Baxter (2012). Exploring Student Beliefs and Understanding in Elementary Science and Mathematics. Journal of Research in Science Teaching, Vol 29, No 7, pp 942-960.

5. Belecina, Rene R. & Jose M. Ocampo, Jr. (2016). "Mathematical Curiosity, Epistemological Beliefs, and Mathematics Performance of Freshman Preservice Teachers" in MIMBAR PENDIDIKAN: Jurnal Indonesia untuk Kajian Pendidikan, Vol.1(1) Maret, pp.123-136. Bandung, Indonesia: UPI Press.
6. Buehl, Michelle and Patricia Alexander (2001). Beliefs About Knowledge. Educational Psychology Review, Vol 13, No 4, 385-418.
7. Conley, Anne Marie et al (2004). Changes in Epistemological Beliefs in Elementary Science Students. Contemporary Educational Psychology ,29, 186-204.
8. Creswell, John W. (2012). Educational research 4th edition. Pearson Education, Inc. Boston, MA
9. De Backer, Teresa (2008). The Challenge of Measuring Epistemic Beliefs: An Analysis of Three Report Instrument from www.redorbit.com/news/health/1322247/the challenge of measuring epistemic beliefs an analysis of three/#0iDr4qTETkJSAJY7.99 retrieved on January 2015.
10. Dinther, van, et al. (2011). Factors Affecting Students' Self-Efficacy in Higher Education. Educational Research Review, Volume 6, No. 2, pp 95-108
11. Doronila, Rogen (2012). *The 3P Model On Problem Solving Among Pre-service Mathematics Teachers*. Unpublished Dissertation
12. Esterly, Elizabeth (2003). A Multi-Method Exploration of the Mathematics Teaching Efficacy and Epistemological Beliefs of Elementary Preservice and Novice Teachers. Dissertation, Ohio University.
13. Feldman, David. (2016). Hope as a Mediator of Loneliness and Academic Self-efficacy Among Students with and without Learning Disabilities during transition to college. Learning Disabilities Research & Practice, 31(2), 63-74
14. Goetz, Ernest, Patrica Alexander and Michael Ash (1992). Educational Psychology a Classroom Perspective. Macmillan Publishing Company. USA.
15. Guo, J., Hu, X., Marsh, H. W., & Pekrun, R. (2022). Relations of epistemic beliefs with motivation, achievement, and aspirations in science: Generalizability across 72 societies. *Journal of Educational Psychology, 114*(4), 734–751. https://doi.org/10.1037/edu0000660
16. Harteis, Christian et al (2010). How Epistemic Beliefs Influence e-learning in Daily Work-life. Educational Technology and Society, 13(2), 201-211.
17. Hofer, Barbara K. (2004). Exploring the Dimensions of Personal Epistemology in Differing Classroom Contexts: Student Interpretations During the First Year of College. Contemporary Psychology 29, 129-163.
18. Kardash, C. M., & Scholes, R. J. (1996). Effects of Preexisting beliefs, Epistemological Beliefs, and Need for Cognition on Interpretation of Controversial Issues. Journal of Educational Psychology, 88(2), 260–271.
19. Liu, Po Hung and Shiang-Yao Liu (2011). A Cross Subject Investigation of College Students' Epistemological Beliefs of Physics and Mathematics. The Asia-Pacific Education Research, 20(2), pp 336-351.
20. Meng, Qian, and Qi Zhang. 2023. "The Influence of Academic Self-Efficacy on University Students' Academic Performance: The Mediating Effect of Academic Engagement" *Sustainability* 15, no. 7: 5767. https://doi.org/10.3390/su15075767
21. Negara, HRP, et al (2021). Mathematics self-efficacy and mathematics performance in online learning. Journal of Physics: Conference Series. doi:10.1088/1742-6596/1882/1/012050
22. Olson, Matthew and B.R. Hergenhahn (2009). *An Introduction to Theories of Learning (8th edition)*. Pearson Prentice Hall. New Jersey.
23. Ondaro, Jet Edward (2016). *Improving Students' Epistemological Beliefs and Geometric Understanding through Van Hiele's Phase-Based Instruction*. Unpublished Dissertation
24. Pamuk, S., Sungur, S. & Oztekin, C. (2016). A Multilevel Analysis of Students' Science Achievements in Relation to their Self-Regulation, Epistemological Beliefs, Learning Environment Perceptions, and Teachers' Personal Characteristics. *Int J of Sci and Math Educ* **15**, 1423–1440 (2017). https://doi.org/10.1007/s10763-016-9761-7
25. Panergayo, Albert Andry (2023). Self-efficacy, Epistemological Beliefs, and Academic Performance in Physics: A Mediation Analysis. Philippine Social Science Journal, Volume 6 No.2, pp 46-52.
26. Schommer-Aikins, Marlene and Orpha Duell (2013). Domain Specific and General Epistemological Beliefs Their Effects on Mathematics. Revista de Investigacion Educativa, 75, 317-330.

27. Schommer, Marlene (1990). The Effects of Beliefs About the Nature of Knowledge on Comprehension. Journal of Educational Psychology, 82, 298-504.
28. Schommer, Marlene(1993). Epistemological Development and Academic Performance Among Secondary Students. Journal of Educational Psychology, 85, 406-411.
29. Soldo,R. (2023) The correlation between self-efficacy and academic acheivement in mathematics in mathematics teaching, INTED 2023 Proceedings, pp. 410-413.
30. Tejano Jr., Capistrano (1999). MSU Tawi-tawi Students' Epistemologies and Perceptions About Knowing and Learning Introductory Physics. Unpublished Dissertation. De La Salle University-Manila.
31. Ugwuanyi, C. S., Okeke, C.I.O. & Asomugha, C.G., (2020). Prediction of learners' mathematics performance by their emotional intelligence, self-esteem, and self-efficacy. Cypriot Journal of Educational Science. 15(3), 492- 501. DOI: 10.18844/cjes.v%vi%i.4916
32. Woolfolk, Anita (2013). Educational Psychology (12th edition). Pearson Education, Inc., Singapore.
33. Zakariya, Y. F., Nilsen, H. K., Goodchild, S., & Bjørkestøl, K. (2020). Self-efficacy and approaches to learning mathematics among engineering students: empirical evidence for potential causal relations. International Journal of Mathematical Education in Science and Technology, 53(4), 827–841. https://doi.org/10.1080/0020739X.2020.1783006