International Journal of Learning, Teaching and Educational Research
Vol. 21, No. 10, pp. 325-340, October 2022
https://doi.org/10.26803/ijlter.21.10.18
Received Aug 15, 2022; Revised Oct 18, 2022; Accepted Oct 21, 2022

Innate Mathematical Characteristics and Number Sense Competencies of Junior High School Students

Raymundo A. Santos
Distance, Open and Transnational University, Central Luzon State University
Science City of Muñoz, Nueva Ecija, Philippines

Leila M. Collantes
College of Education, Central Luzon State University
Science City of Muñoz, Nueva Ecija, Philippines

Edwin D. Ibañez
College of Science, Central Luzon State University
Science City of Muñoz, Nueva Ecija, Philippines

Florante P. Ibarra
College of Education, Central Luzon State University
Science City of Muñoz, Nueva Ecija, Philippines

Jupeth T. Pentang*
College of Education, Western Philippines University
Puerto Princesa City, Philippines

Abstract. The study determined the influence of innate mathematical characteristics on the number sense competencies of junior high school students in a Philippine public school. The descriptive-correlational research design was used to accomplish the study involving a nonrandom sample of sixty 7th-grade students attending synchronous math sessions. Data obtained from the math-specific Learning Style and Self-Efficacy questionnaires and the modified Number Sense Test (NST) were analyzed and interpreted using descriptive statistics, Pearson's Chi-Square, and Simple Linear Regression analysis. The research instruments and statistics were all validated and tested for reliability. The analysis revealed that the students are virtual learners, had no or slight self-efficacy, and their number sense competency level is poor. They encountered difficulty in all the components and domains of the NST. Moreover, the students' mathematical self-efficacy is significantly related

* Corresponding author: *Jupeth T. Pentang, jupeth.pentang@wpu.edu.ph*

and may influence their number sense competency level. Building upon the learners' self-efficacy to further their understanding and skills in number sense is necessary.

Keywords: learning style; mathematics education; number sense; Philippine high school; self-efficacy

1. Introduction

Mathematics proficiency is two-fold: remembering and applying the correct rules and following the established rules. As evident in the mathematics curricula, the ultimate goal is to equip learners with essential knowledge and skills that will enable them to solve real-life situations using mathematics (Pentang, 2021). Hence, learners are taught mathematical concepts and skills presented in a spiral approach. While mathematical proficiency develops over time, it is anchored in the learner's number sense. This pertains to the learner's general understanding of numbers, operations, their relationship, and the ability and confidence to perform calculations correctly. Researchers have reported that the number sense of students was consistently low, though they noted that such levels improved through the years (Maghfirah & Mahmudi, 2018; Whitacre et al., 2020; Wulandari et al., 2021). It was pointed out that some possible causes of students' low performance in number sense could be attributed to the emphasis and use of traditional algorithms (method and content), as taught widely in many traditional schools (Kirkland, 2022; Yang, 2002).

Number sense can be regarded as a group of skills that enable individuals to work with numbers and other tasks, such as understanding quantities and symbols that represent quantities, comparing numbers and their relative values, estimating and manipulating numerical quantities, and judging the reasonableness of their calculations (Whitacre et al., 2020). Individuals who possess good number sense use flexible and appropriate ways to solve numerical problems and are not limited to the use of rote and raw rules learned in classroom instruction (Pentang, 2019). They can routinely estimate their answers before calculating, look for connections and readily recognize patterns in numbers, enabling them to predict outcomes. Their strategies often lead to a more efficient solution to the problem.

Mathematics curricula at the grade school level emphasize understanding numbers and developing number sense. The New Jersey Mathematics Curriculum Framework (n.d.) states that number sense can be viewed as an intuitive feel for numbers and a common-sense approach to using them. It necessitates understanding the relationships between different numbers, including fractions and decimals, and how to use them to illuminate certain situations. The learners' number sense development in the Philippine context is emphasized in their earlier mathematical education (Department of Education, 2016). Understandably, innate characteristics such as learning styles and self-efficacy help promote learners' number sense competency.

Learning style is the preferred way in which an individual gathers, organizes, examines, interprets, and applies information. It is a method by which learners absorb, process, and make sense of the information. Psychologists and researchers

suggest several learning styles. The most common is the Visual, Auditory, and Kinesthetic (VAK) Model, espoused by Barbe et al. (1979). Visual learners process information using charts, maps, graphs, and other forms of visual aid that show patterns, while auditory learners prefer and process information that is heard or spoken. Conversely, kinesthetic learners benefit from tactile experiences and physical activity to practice applying new information. Recognizing and understanding the students' learning styles enables teachers to formulate lessons and design instructional activities that will address learners' varied learning styles.

Self-efficacy is crucial to the students' learning style as an essential factor in their academic performance. Self-efficacy is a person's confidence in their capacity to plan and carry out the steps necessary to achieve specific outputs (Bandura, 1977). For example, students may have a strong self-concept that they are good in math but may have poor self-efficacy in explaining their solutions. Self-efficacy is a personal belief that one can achieve one's desired goal through specific actions. A student with solid self-efficacy is more likely to be intrinsically motivated and challenge himself to overcome complex tasks.

1.1. Statement of the Problem

A student's ultimate success or difficulty in any math course depends on numerical skills. Hence, it is imperative to equip him with a solid foundation in nature (such as the concept of rational number, unit of measurement), principles (divisibility, factors, and multiples), and operations with numbers, particularly during the early years of schooling. Furthermore, one of the standards in mathematical practice in assessing students' proficiency is their ability to make sense of quantity and their relationships in problem situations. The Philippine Mathematics Standards of the K-12 Basic Education Curriculum (Department of Education, 2016) and the Philippine Basic Education Mathematics Framework (SEI-DOST & MATHTED, 2011) highlight the importance of the Number and Number Sense strand, making this the foundation of all other mathematical contents. A student should have developed such competency when entering middle or junior high school.

Unfortunately, the Program for International Students Assessment (PISA) 2018 report and the Trends in International Mathematics and Science Studies (TIMSS) 2019 reflect Filipino students' dismal mathematics performance in both assessments. The latter also shows that the Philippines' achievement score has declined from the first time they participated in the assessments (in 2003, then again in 2019), though it claimed that every country had a wide variation in achievement. Even the national achievement test (NAT), conducted annually, has indicated the poor performance of Filipino learners in mathematics (Pentang, 2019). As a result, there appears to be a misalignment between the math curriculum and the students' achievement. Consequently, educational leaders, curriculum planners, and mathematics teachers have to periodically assess learners' progress in numeracy and examine possible factors causing a disparity in the outcome. This concern can be credited to students lacking number sense competency.

The observations and considerations above prompted this study of students' number sense competency and determined the predictors of their proficiency in number sense. This aligns with the belief that the mastery of basic arithmetic and mental computation skills is an essential tool for success in high school math courses. Subsequently, this study aimed to determine whether learners' innate mathematical traits impact their number sense competency.

1.2. Objectives of the Study

The general goal of the study was to determine the influence of innate mathematical characteristics on the number sense competency (NSC) of junior high school students in a public school in the Philippines. It aimed to:

1. describe the innate mathematical characteristics of the students in terms of learning style and self-efficacy;
2. determine the levels of NSC among the students;
3. identify a significant relationship between the innate mathematical characteristics of the students and their level of NSC; and
4. ascertain which of the students' innate mathematical characteristics significantly predicts their NSC.

2. Literature Review

2.1. Learning Style

Individuals learn in various learning environments and academic experiences. Some flourish in traditionally prepared settings, while others thrive in an open environment (Mariano-Dolesh et al., 2022). Learning style indicates how the student perceives, interacts, and responds to the learning environment (Alog, 2012; Cabual, 2021). Ergo, the learner as well as the teacher must be aware of and utilize the learning style of the former. Subsequently, psychological and educational research has been undertaken regarding learning style and academic achievement. Adu et al. (2020), Sinaga (2022), and Villajuan (2019) reported that learning style has a statistically significant positive relationship with students' mathematics performance and success. Accommodating the students' learning styles in the instructional method yields better mathematical performance. This study theorized that learning styles influence mathematical number sense competency.

2.2. Self-Efficacy

Self-efficacy refers to a learner's perceptions of the skills needed to perform at an expected standard and meet one's academic objectives. It has been demonstrated that it affects academic achievement, learning, and motivation (Pajares & Schunk, 2001). Several studies have been conducted on self-efficacy and its relationship to the learner's academic performance and achievement in different grade levels. A notable similarity was highlighted when McMillian (2017) found a very modest positive relationship – but not a statistically significant correlation – between self-efficacy and mathematics performance. Furthermore, Ducay and Alave (2021), Görgün and Tican (2020), Hayat et al. (2020), Samavi et al. (2017), and Vuong et al. (2010) reported that self-efficacy is an essential factor in students' academic achievement. This study theorized that self-efficacy influences mathematical number sense competency.

2.3. Number Sense Competency

No two researchers define number sense in the same manner, and discrepancy in the components of number sense exists among researchers (Maghfirah & Mahmudi, 2018). Whitacre et al. (2020), on the other hand, formulated three constructs: approximate number sense (innate set of neurological abilities), early number sense (involving number knowledge), and mature number sense (multi-digit and rational number sense). Number sense is an intuitive feeling about numbers, operations, and their relationship, understanding of the relative and absolute magnitude of numbers, application of knowledge of numbers and operations to the computational situation, and making a reasonable judgment of calculation results (Yang, 2002). Hence, a person with good number sense has both the ability and confidence to decide whether a numerical result is reasonable (Wulandari et al., 2021). Number sense is an analogous numerical cognition that denotes a particular meaning to a group of vital mathematical abilities or the basic mathematical concept (Yang, 2002). Students with mature number sense understand numbers and operations, use reasoning to spot patterns, and choose the most efficient problem-solving strategies (Kirkland, 2022). Theoretically, the respondents are deemed to have number sense competency with the implementation of a spiral math curriculum.

2.4. Literature Gaps

Core to achieving a successful number sense performance is one's learning style preference. Research on learning styles in various countries and covering various grade levels has ascertained that one's learning style is significantly related to and impacts academic performance and achievement in general. Concomitant to learning style is self-efficacy, which pertains to one's beliefs in one's capability to execute specific tasks to achieve academic goals. Studies involving students from different levels support the positive relation of self-efficacy to one's academic performance and its predictive effectiveness in gauging the latter. However, no studies have explored the relationship between learning style and self-efficacy with number sense competency. Also, the number sense competency of Filipino students has not been explicitly studied. Furthermore, no studies have been conducted to determine the factors influencing their number sense competency. These gaps in the literature are addressed in the current study. The study is a pioneering work describing the learning style, self-efficacy, and number sense competency amid online learning in Philippine public high schools.

3. Methodology

3.1. Theoretical and Conceptual Framework

The study was anchored on the following: Learning Style Theory, Self-Efficacy Theory, and Innate Sense of Numbers. Learning style is the preferential way in which an individual acquires, processes, retains, and applies information. Over the years, several models and theories related to learning styles have been developed. As applied in this study, the researchers aimed to describe the learning style of the respondents using the VAK model (Barbe et al., 1979) and to find out whether the learners' learning style is related to their number sense competency.

Aside from learning styles, the study also employed the concept of self-efficacy as defined by Bandura (1977), which pertains to a person's beliefs regarding how well one can execute a plan of action in prospective situations. Self-efficacy is a personal judgment on how well or poorly one can perform a specific task or cope with a situation based on one's skills and circumstances. Bandura (1977) posited that self-efficacy determines how an individual feels, thinks, motivates, and behaves when he meets stress and challenges and determines how much effort will be expended to reach his goals and how long those goals will be pursued. People with high self-efficacy approach complex tasks as a challenge to be mastered.

Even if number sense is natural for us, it is understandable that some number concepts are challenging to understand. This can be attributed to the fact that it is easier to learn a concept in numbers that correspond most closely to innate numerical concepts, the idea of the collection, and its numerosity. Furthermore, it can be attributed to several innate characteristics. The study determined the number sense competency of the respondents, in the belief that learners possess a number sense that further develops as they mature and experience meaningful learning activities. This innate ability enables them to perform calculations, formulate mathematical conclusions, and check the accuracy and reasonableness of their answer.

The research paradigm (Figure 1) was conceptualized using the theories discussed above to describe the independent variables (innate mathematical characteristics) and determine their influence on the dependent variable (number sense competency). It is hypothesized that one's learning style and self-efficacy greatly influence one's number sense performance.

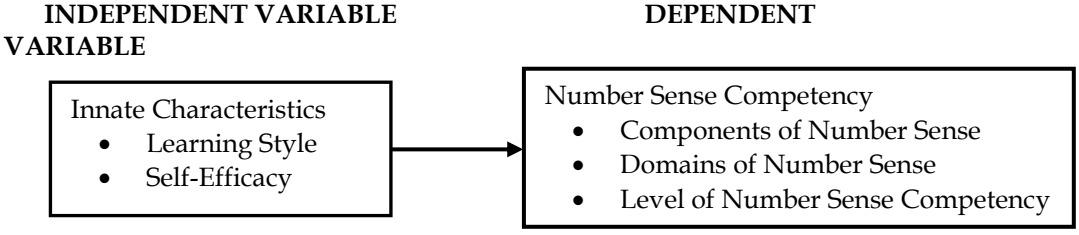

Figure 1: Research Paradigm

3.2. Research Design

The study is quantitative, specifically descriptive-correlational. The descriptive research design described the respondents' innate characteristics (learning style and self-efficacy) and their number sense competency (NSC). The correlational research design measured the degree of the relationship between the respondents' innate characteristics and their NSC, including the influence of the former on the latter.

3.3. Respondents of the Study

The study respondents were junior high school (7th grade) students at a public school in the Philippines based on the minimum competency requirement

supposedly covered in elementary math courses. Due to the nature of the remote instructional modality at the survey site, only students attending the synchronous session were purposively chosen as prospective respondents, based on their ability to provide the necessary information and connectivity when the study was conducted. The 60 respondents who completed the survey instruments were included in the sample. Ethical measures were taken by obtaining clearances and consent forms from authorities, parents, and students.

3.4. Research Instruments

The researchers administered the Learning Style Preference and the Mathematics Self-Efficacy Scale. The first instrument, adapted from Arem (2009), focuses on the three learning styles, which are math-specific and follow the VAK model learning style (Barbe et al., 1979). The thirty-item inventory includes ten descriptors for each learning style. The category with the highest total determines the preferred learning style of the respondent. On the other hand, the second instrument has 24 items, which respondents use to rate their self-efficacy from 1 (no self-efficacy) to 5 (extreme self-efficacy) to succeed in accomplishing exercises related to math topics without using calculators. The average scale score obtained indicates their self-efficacy.

The forty-item Number Sense Test (NST), developed by Yang (2002), was adapted for this study and modified to suit the respondents' culture. The test covers concepts and operations on whole numbers, decimals, and fractions, mostly involving estimation and mental computations. Additionally, the instrument covers six components of number sense: understanding of the meaning and size of numbers, understanding and use of equivalent representations of numbers, understanding the meaning and effect of operations, understanding and use of equivalent expressions, flexible computing and counting strategies for mental and written computations/calculations, and the use of measurement benchmark.

All instruments (Learning Style, Self-Efficacy, and Number Sense Competency) were pilot-tested and garnered an internal consistency greater than .90, indicating reliability. Three external parties reviewed and validated the use of data-gathering tools.

3.5. Method of Data Gathering

Protocol was observed in selecting the survey site and respondents by formally requesting permission from the respective school administrator to survey the chosen school. Google forms were prepared, and the links were shared with the respondents through their respective Google Classrooms. The confidentiality of the respondents was observed and protected by assigning them respondent numbers. The respondents signed their consent before the study began. Respondents were allowed to answer the first questionnaire asynchronously while the second instrument was administered synchronously. To ensure that respondents adhered to the usual pacing in answering the Number Sense Test, they were instructed to allow themselves 60 seconds per item and to move on to the next item if they encountered difficulty with the item.

3.6. Methods of Data Analysis

Descriptive and inferential analysis was used. Frequency count and percentage were utilized for the respondents' innate mathematical characteristics regarding learning styles and self-efficacy. Similarly, frequency count, percentage, mean, and standard deviation were employed for the respondents' number sense competency (NSC). Meanwhile, Pearson's Chi-Square (x^2) was computed to determine the significant relationship between innate mathematical characteristics with NSC. Furthermore, a simple linear regression analysis was carried out to determine the significant predictors of the respondents' NSC.

4. Results and Discussion

4.1. Innate Mathematical Characteristics of the Respondents

4.1.1. Learning Style

The predominant learning style of the respondents (Table 1) is visual (46.70%), followed by kinesthetic (26.70%), with the least being auditory (10%). There are minimal cases of respondents having dual learning styles (visual and auditory, 3.30%; visual and kinesthetic, 10%; and auditory and kinesthetic, 1.7%). Additionally, a single case of trimodal learning style was reported. The data implies that almost half of the respondents prefer visual learning and that some learn using a combination of at least two learning styles. As visual learners, printed and electronic visual aids may support advancing their number sense competencies.

The same result was obtained by Adu et al. (2020), who reported that visual learning is predominant among South African students, and Cabual (2021), who found that visual is reportedly the 'new normal' learning style. In contrast, Alog (2012) discovered that the predominant learning styles among the 5th and 6th-grade students in her study of intermediate public schools are auditory and visual, respectively. The data shows that learners have several learning preferences and that diversity among schoolchildren still emerges. Given these differences, math teachers must ensure that each learner is given careful attention, especially with their number sense development, as it is the very foundation of mathematical understanding.

Table 1: Learning Style of the Respondents

Learning Style	Frequency (n = 60)	Percentage
Visual	28	46.70
Auditory	6	10.00
Kinesthetic	16	26.70
Visual/Auditory	2	3.30
Visual/Kinesthetic	6	10.00
Auditory/Kinesthetic	1	1.70
Visual/Auditory/Kinesthetic	1	1.70

4.1.2. Self-Efficacy

One-half of the respondents have fair self-efficacy (50%), indicating an average or medium level of self-efficacy. When combined, approximately 42 percent have no to slight self-efficacy, while only five respondents have complete to extreme self-efficacy. These observations are similar to those found by Görgün and Tican

(2020), who reported that middle school students have an average level of math self-efficacy perception. This result is alarming but not new in the Philippine context. Students tend to report no or low confidence and even dislike mathematics (Pentang, 2019). This may be a result of their limited background and negative experiences. The number of learners with no to fair math self-efficacy may be attributed to the poor preparation they experienced during their primary years or may be due to other personal factors such as negative math dispositions. The results of the study, however, contrast with the findings of Ducay and Alave (2021), which showed a high self-efficacy for junior high school students. With regard to the learners with fair self-efficacy, personality development activities may also be integrated during math classes which increase self-efficacy and, eventually, their number sense competency.

Table 2: Mathematics Self-Efficacy of the Respondents

Self-Efficacy Levels	Frequency (n = 60)	Percentage
No Self-Efficacy	8	13.33
Slight Self-Efficacy	17	28.33
Fair Self-Efficacy	30	50.00
Complete Self-Efficacy	4	6.67
Extreme Self-Efficacy	1	1.67

4.2. Number Sense Competencies

4.2.1. Components of the Number Sense Test (NST)

Table 3 presents the percentages of respondents who answered each item correctly and the mean percentages of the respondents who answered correctly in each component. Namely, 36.33 percent for the understanding of the meaning and size of number; 37.50 percent for understanding and use of equivalent representation of numbers; 53.61 percent for understanding the meaning and effect of operations; 28.8 percent for understanding and use of equivalent expressions; 39.31 percent for flexible computing and counting strategies for mental computation and calculations; and 23.08 percent for the use of measurement benchmark. Thus, it can be deduced that the respondents had difficulty in all the components of number sense, as shown by the mean percentage of respondents who answered correctly. In particular, approximately half of the respondents performed fairly in only one component (understanding the meaning and effect of the operation). The number sense competency among students is undeniably an ongoing concern for the Philippines and some Asian countries since this finding is similar to that of Mohamed and Johnny (2010) and Pentang (2019), who shared the same discovery among Malaysian and Filipino students, respectively. Therefore, the classroom teacher should involve the students in solving non-routine, non-procedural problems. This will promote the learners' algorithm development compared to the formula algorithm. Similarly, students should be trained and encouraged to check the reasonableness of their answers.

Table 3*:* Number Sense Domain and Number Sense Components for the NST

Domain	Components					
	A	B	C	D	E	F
Whole Number	63.33	51.67	90.00	28.89	46.67	17.98
Decimal	18.33	37.50	34.17	29.17	39.17	38.33
Fraction	27.33	23.33	36.67	28.33	32.08	12.92
Mean	**36.33**	**37.50**	**53.61**	**28.80**	**39.31**	**23.08**

Legend:A = understanding of the meaning and size of number
B = understanding and use of equivalent representation of numbers
C = understanding the meaning of operations
D = understanding and use of equivalent expressions
E = flexible computing strategies for mental computation
F = use of measurement benchmark

4.2.2. Domains of Number Sense Test

Generally, about 40 percent of the respondents were able to respond accurately to the Number Sense Test (NST). Table 4 details the mean performance (%) of the respondents who answered the test correctly. The majority (57.4%) could perform calculations involving whole numbers. Only 36.2 and 26.08 percent had an easier time performing calculations involving decimals and fractions, respectively. These suggest that the respondents encountered difficulty in all three domains. Besides, less than 40 percent of the respondents can perform addition (38.47%), multiplication (34.61%), and division (33.52%). Consistent with Pentang et al. (2020), the respondents generally have trouble with the fundamental operations concerning fractions. This is linked to negative dispositions and poor conceptual understanding of fractions (Bacsal et al., 2022; Ibañez & Pentang, 2021). The same observations are shared by math teachers, who feel frustrated that students generally remain inadept in performing arithmetic operations (written or mental calculation) involving fractions and decimals, even in upper-level high school math courses, without the aid of calculators. The data shows why some Filipino learners perform low in national and international assessments such as NAT, PISA, and TIMSS. These learners struggled with the fundamental and foundational concepts of mathematics.

Table 4: Number Sense Domain and Four Basic Operations for the NST

Domain	Arithmetic Operations (%)				Mean
	Addition	Subtraction	Multiplication	Division	
Whole Numbers	69.17	74.17	44.59	41.67	**57.40**
Decimals	28.33	47.50	34.52	34.45	**36.20**
Fractions	17.92	37.22	24.72	24.44	**26.08**
Mean	**38.47**	**52.96**	**34.61**	**33.52**	**39.89**

4.2.3. Level of Number Sense Competency

The level of number sense competency was based on the grading scale and descriptors used in the Philippine public educational system. Among the 60 respondents, only two had outstanding competency. One respondent performed fairly satisfactorily, while the rest did not meet expectations (Table 5). The mean score achieved by the respondents is 12.78, which translates to an equivalent grade of 31.96 percent. Overall, the respondents' level of number sense

competency did not meet expectations. The number sense skills of students were at a low level, and the students were still deficient in all areas of number sense, parallel to the findings of Wulandari et al. (2021).

School administrators may consider offering after-school tutoring to enable learners to catch up with and reinforce the requisite mathematical skills essential to experience success in their learning and create and may further wish to implement workshops for teachers on developing the number sense competencies of their students. This study may serve as a baseline for teachers in conducting action research that may propose effective ways to further the number sense competencies of learners. Moreover, the results imply the need for a careful review of the curriculum, instruction, and assessment implemented.

Table 5: Raw Score Interval, Frequencies, and Equivalent Grade

Raw Score Interval	Frequency	Equivalent grade (%)	Verbal Interpretation
36 and Above	2	90 – 100	Outstanding
34 to 35	0	85 – 89	Very Satisfactory
32 to 33	0	80 – 84	Satisfactory
30 to 31	1	75 – 79	Fairly Satisfactory
Below 30	57	74 below	Did Not Meet Expectations

Note: NST Mean Score = 12.78 NST Equivalent Grade = 31.96%

4.3. Relationship between Innate Characteristics and Number Sense Competencies

4.3.1. Learning Style and Number Sense Competency

The number sense competency levels bearing a specific number of respondents are considered in the cross-tabulation result (Table 6). All respondents (100%) who are auditory learners did not meet expectations. Most (92.9%) respondents who are reportedly visual learners also did not meet expectations, while 7.1 percent have outstanding number sense competency. Among the kinesthetic learners, 93.8 percent did not meet expectations, and only 6.3 percent had a relatively satisfactory number sense competency. All respondents who claim to have at least two learning styles also did not meet expectations.

Pearson's Chi-Square calculation results do not show a significant relationship in the number sense competency among the different groups of learning styles, $x^2_{(12)} = 5.094$, $p > 0.05$. This implies that one learning style is not comparatively better than the other regarding the student's attainment of number sense competency level. The result resembles the findings of Alog (2012), who claimed that pupils' learning style was unrelated to their academic achievement in Mathematics. However, this opposes the findings of Adu et al. (2020), Sinaga (2022), and Villajuan (2019). The result suggests that students may still have poor number sense competency regardless of learning style.

Table 6: Learning Style and Number Sense Competencies of the Respondents

Learning Style	Number Sense Competency		
	Did Not Meet Expectations	Fairly Satisfactory	Outstanding
Auditory	6(100.0%)	0(0.0%)	0(0.0%)
Visual	26(92.9%)	0(0.0%)	2(7.1%)
Kinesthetic	15(93.8%)	1(6.3%)	0(0.0%)
Auditory/Kinesthetic	1(100.0%)	0(0.0%)	0(0.0%)
Visual/Auditory	2(100.0%)	0(0.0%)	0(0.0%)
Visual/ Kinesthetic	6(100.0%)	0(0.0%)	0(0.0%)
Auditory/Visual/ Kinesthetic	1(100.0%)	0(0.0%)	0(0.0%)
Total	**57**	**1**	**2**

4.3.2. Self-Efficacy and Number Sense Competency

Respondents who had no to slight self-efficacy did not meet the expectations. Among those with fair self-efficacy, 95.5 percent also did not meet expectations, and only 4.5 percent reached a reasonably satisfactory level. While 50 percent of those with complete self-efficacy did not meet the expectation, 25 percent attained fairly satisfactory and outstanding levels, respectively. The sole student who has extreme self-efficacy achieved an outstanding level. It can be inferred that neither learning style nor self-efficacy has anything to do with number sense ability.

Correlational analysis using Pearson's Chi-Square shows a statistically significant relationship in the number sense competency among the different groups of self-efficacies, $x^2_{(10)} = 45.077$, $p < 0.01$. This suggests that students with no or slight self-efficacy are less likely to meet the expectation in number sense competency. On the other hand, students with extreme self-efficacy tend to perform outstandingly in number sense competency. The result shows that the student's self-efficacy holds their number sense competency. The result supports the findings of Ducay and Alave (2021), Görgün and Tican (2020), and McMillian (2017), who state that middle school learners' self-efficacy impacts their mathematics performance. Teachers should develop a favorable climate for students to grow in understanding and application of numbers by designing instructional materials and activities that promote the development of number sense.

Table 7: Self-Efficacy and Number Sense Competencies of the Respondents

Self-Efficacy	Number Sense Competency		
	Did Not Meet Expectations	Fairly Satisfactory	Outstanding
No Self-Efficacy	12(100.0%)	0(0.0%)	0(0.0%)
Slight Self-Efficacy	21(100.0%)	0(0.0%)	0(0.0%)
Fair Self-Efficacy	21(95.5%)	1(4.5%)	0(0.0%)
Complete Self-Efficacy	2(50.0%)	1(25.0%)	1(25.0%)
Extreme Self-Efficacy	0(0.0%)	0(0.0%)	1(100.0%)
Total	**56**	**2**	**2**

4.4. Predictor of Number Sense Competency

The Chi-square calculations showed that only self-efficacy is significantly related to the respondents' number sense competency. Thus, a simple linear regression analysis was performed to determine whether self-efficacy predicts the number sense competency of the respondents (Table 8). The determination coefficient (R^2) is equal to .631 (*Adjusted* R^2 = .625), indicating that their self-efficacy accounts for approximately 63 percent of the variance in respondents' NSC grades. This supports the inference that the respondents' self-efficacy level impacts their number sense competency. Besides, the model is highly significant [$F_{(1,58)}$ = 99.201, p < .001], implying that self-efficacy significantly predicts the learner's number sense competency, t = 9.960, p = .000. This aligns with the findings of Hayat et al. (2020), Samavi et al. (2017), and Vuong et al. (2010).

Innate characteristics are indeed helpful in boosting mathematical learning. Self-efficacy, in particular, must be developed among learners to promote a deep understanding of number sense. Classroom teachers should train and encourage their students to explain their answers or to give brief reasons or examples for their answers. Even if obtaining the correct answer is desired in most cases, helping the students in metacognition contributes to developing their number sense. This can be achieved using open-ended questions requiring brief explanations, enabling students to communicate their thought processes mathematically. Providing an avenue for the learners to grow in self-efficacy will promote excellence in their mathematical competencies, particularly in number sense.

Table 8: Predictor of the Number Sense Competency of Respondents

Predictor	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Constant	-7.222	4.185		-1.725	.090
Self-Efficacy	14.078	1.413	.794	9.960	.000

Note: R^2 = .631 (Adjusted R^2 = .625); $F_{(1,58)}$ = 99.201 (p = .000)

5. Conclusion

The respondents are primarily visual learners. A few cases exist where the respondents indicated dual or tripartite learning styles. A small number claimed to be not at all or slightly confident regarding their mathematical self-efficacy. Besides, they had difficulty in all the components of the Number Sense Test, as indicated by the average percentage where fewer than half answered correctly. Moreover, most had an easier time answering questions involving whole numbers, while more than half experienced difficulty in dealing with decimals and fractions.

The respondents' level of number sense competency did not meet the expectations. A few reached a reasonably satisfactory or outstanding level of number sense competency. This is possibly aggravated by the pandemic slide phenomenon resulting from remote/distant learning. The respondent's self-efficacy is strongly related to number sense competency. However, their learning

style is unrelated to their level of number sense competency. Self-efficacy appears to influence the respondent's number sense competency. The study is distinct from other studies since it analyzed the relationship between students' innate mathematical characteristics and number sense competency.

6. Recommendations

Curriculum planners and supervisors should consider revisiting the syllabus and introducing changes to focus on the most critical learning competencies while ensuring the quality of content delivery. Furthermore, classroom teachers must clearly understand the concept and nature of number sense and recognize the importance of developing number sense competency among their students. They may consider administering an aptitude test on number sense at the start of the math course to gauge their student's readiness for the content and skills to be covered in the lessons. Knowing and understanding the entry level of the students will minimize stress and frustration for both the learners and the teacher as they proceed with the instructional and learning activities.

Self-efficacy has been found to predict students' NSC. Thus, the teacher can enhance learners' self-efficacy by ensuring they experience success in their math class, providing verbal or non-verbal prompts, acknowledgment and recognition of skills or effort demonstrated by the learner, and peer coaching or teaching. On the other hand, learners can further develop their self-efficacy through peer observation, soliciting feedback from family and peers, and developing personal standards to assess their progress.

With the limitations posed by the current study, further inquiry may increase the sample size and use other instruments or methods (e.g. written computation, interview, and observation) to further investigate the actual effect of innate mathematical characteristics on learners' number sense competency. Other researchers may consider replicating the study to investigate further the influence of innate mathematical characteristics on learners' number sense competency and consider other factors/variables in their study.

7. References

Adu, K., Plyman, N., & Adu, E. (2020). Learning styles as correlates of grade 6 learners' mathematics performance in Buffalo City Municipality in South Africa. *e-Bangi: Journal of Social Sciences and Humanities, 17*(5), 119-131. https://ejournal.ukm.my/ebangi/article/view/40211

Alog, R. (2012). *Learning style and its relationship to academic performance of Central Philippine University Elementary School intermediate pupils* [Master's thesis, Central Philippine University]. BAHÁNDÌAN. https://hdl.handle.net/20.500.12852/1035

Arem, C. (2009). *Conquering math anxiety (3rd ed)*. Nelson Education. https://books.google.com.ph/books/about/Conquering_Math_Anxiety.html?id=7WYNCsMf7CsC&redir_esc=y

Bacsal, E., Ibañez, E., & Pentang, J. (2022). Jigsaw strategy: Strengthening achievement and interest in mathematics among elementary pre-service teachers. *Palawan Scientist, 14*(1), 35-42. https://www.palawanscientist.org/tps/jigsaw-strategy-strengthening-achievement-and-interest-in-mathematics-among-elementary-pre-service-teachers/

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*(2), 191-215. https://doi.org/10.1037/0033-295X.84.2.191

Barbe, W., Swassing, R., & Milone, M. (1979). *Teaching through modality strengths: Concepts and practices*. Zaner-Bloser.

Cabual, R. (2021). Learning style and preferred learning modalities in the new normal. *Open Access Library Journal, 8*, e7305. https://doi.org/10.4236/oalib.1107305

Department of Education (2016). K-12 Curriculum Guide - Mathematics. https://www.deped.gov.ph/wp-content/uploads/2019/01/Math-CG_with-tagged-math-equipment.pdf

Ducay, J., & Alava, A. (2021). Self-efficacy, anxiety, and academic performance in mathematics of junior high school students. *Globus Journal of Progressive Education, 11*, (1), 41-46. https://www.globusedujournal.in/self-efficacy-anxiety-and-academic-performance-in-mathematics/

Görgün, S., & Tican, G. (2020). Investigation of middle school students' math self-efficacy perceptions and math problem posing attitudes. *International Education Studies, 13*(11), 86-98. https://doi.org/10.5539/ies.v13n11p86

Hayat, A., Shateri, K., Amini, M., & Shokrpour, N. (2020). Relationships between academic self-efficacy, learning-related emotions, and metacognitive learning strategies with academic performance in medical students: A structural equation model. *BMC Medical Education, 20*(1), 76. https://doi.org/10.1186/s12909-020-01995-9

Ibañez, E., & Pentang, J. (2021). Socio-constructivist learning and teacher education students' conceptual understanding and attitude toward fractions. *Indonesian Research Journal in Education, 5*(1), 23-44. https://onlinejournal.unja.ac.id/irje/article/view/12187

Kirkland, P. (2022). *Characterizing mature number sense and its association to other constructs in middle school students* (Publication No. 29061211) [Doctoral dissertation, University of Notre Dame]. ProQuest Dissertations Publishing. https://www.proquest.com/openview/999f7612e040836d1226dbc8e25cb688/1?pq-origsite=gscholar&cbl=18750&diss=y

Maghfirah, M., & Mahmudi, A. (2018, September). Number sense: The result of mathematical experience. *Journal of Physics: Conference Series, 1097*(1), 012141. IOP Publishing. https://doi.org/10.1088/1742-6596/1097/1/012141

Mariano-Dolesh, M., Collantes, L., Ibañez, E., & Pentang, J. (2022). Mindset and levels of conceptual understanding in the problem-solving of preservice mathematics teachers in an online learning environment. *International Journal of Learning, Teaching and Educational Research, 21*(6), 18-33. https://doi.org/10.26803/ijlter.21.6.2

McMillian, K. (2017*). An examination of elementary math anxiety, self-efficacy, and academic achievement* (Publication No. 10270027) [Doctoral dissertation, University of North Carolina at Charlotte]. ProQuest Dissertations Publishing. https://repository.uncc.edu/islandora/object/etd%3A1042

Mohamed, M., & Johnny, J. (2010). Investigating number sense among students. *Procedia-Social and Behavioral Sciences, 8*, 317-324. https://doi.org/10.1016/j.sbspro.2010.12.044

New Jersey Mathematics Curriculum Framework (n.d.). Standards 6 - Number Sense. https://www.state.nj.us/education/archive/frameworks/math/math4.pdf

Pajares, F., & Schunk, D. (2001). Self-beliefs and school success: Self-efficacy, self-concept, and school achievement. https://www.uky.edu/~eushe2/Pajares/PajaresSchunk2001.html

Pentang, J. (2019). *Determining elementary pre-service teachers' problem solving performance and skills through sequential explanatory approach* [Master's thesis, Central Luzon State University]. DOST Union Catalog. https://philpapers.org/rec/PENDEP

Pentang, J., Bautista, R., Pizaña, A., & Egger, S. (2020). Mathematical needs of Laura Vicuña learners. *Western Philippines University Graduate Journal, 5*(1), 78-82. https://ssrn.com/abstract=3980365

Pentang, J. (2021). Impact assessment and clients' feedback towards MATHEMATICS project implementation. *International Journal of Educational Management and Development Studies*, 2(2), 90-103. https://doi.org/10.53378/346107

Samavi, S., Ebrahimi, K., & Javdan, M. (2017). Relationship between academic engagements, self-efficacy and academic motivation with academic achievement among high school students in Bandar Abbas. *Biquarterly Journal of Cognitive Strategies in Learning*, *4*(7), 71-92. https://dx.doi.org/10.22084/j.psychogy.2017.1654

SEI-DOST & MATHTED. (2011). *Mathematics framework for Philippine Basic Education*. Manila: SEI-DOST & MATHTED. https://sei.dost.gov.ph/images/downloads/publ/sei_mathbasic.pdf

Sinaga, S. (2022). The effect of motivation and learning style on students' mathematics learning achievement. *Jurnal Basicedu, 6*(3), 3554-3562. https://doi.org/10.31004/basicedu.v6i3.2669

Villajuan, A. (2019). Relationship between learning styles & academic achievement in mathematics of grade 8 students. *International Journal of English, Literature and Social Science, 4*(4). https://dx.doi.org/10.22161/ijels.4419

Vuong, M., Welty, S., & Tracz, S. (2010). The effects of self-efficacy on academic success of first-generation college sophomore students. *Journal of College Student Development, 51*(1), 50-64. https://doi.org/10.1353/csd.0.0109

Whitacre, I. Henning, B., & Atabas, S. (2020). Disentangling the research literature on number sense: Three constructs, one name. https://doi.org/10.3102/0034654319899706

Wulandari, N., Apsari, R., Tyaningsih, R., Salsabila, N., & Hadiyanto, F. (2021). Number sense ability of junior high school students. In *Journal of Physics: Conference Series* (Vol. 1778, No. 1, p. 012024). IOP Publishing. https://doi.org/10.1088/1742-6596/1778/1/012024

Yang, D. (2002). Teaching and learning number sense: One successful process-oriented activity with sixth-grade students in Taiwan. *School Science and Mathematics, 102*(4), 152-157. https://doi.org/10.1111/j.1949-8594.2002.tb18197.x