

Analysing of causal factors affecting the academic achievement of mathematics major students in the Faculty of Education at Suan Sunandha Rajabhat University

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Abstract

The purpose of this research is to 1. Examine the consistency and harmony of causal factors on the academic achievement of students in the Mathematics program, Faculty of Education, Suan Sunandha Rajabhat University. 2. To study the causal factors affecting the academic achievement of students in the Mathematics program, Faculty of Education. The target group is students in the Mathematics program, Faculty of Education, Suan Sunandha Rajabhat University, who are enrolled in the second semester of the 2024 academic year, totaling 190 students. The researcher collected data from questionnaires consisting of 3 parts: Part 1, general information about the respondents, closed-ended with a checklist; Part 2, information about the causal factors affecting the academic achievement of students in the Mathematics program, closed-ended using a Likert scale; and Part 3, other open-ended suggestions, which were distributed to students in the Mathematics program.

The research findings show that

1. General information about the students: the majority are female students, numbering 94, which is 77.70% of the target group. 51 students are over 20 years old, representing 42.15%. The highest number of respondents are second-year students, totaling 37, or 30.58%. The respondents' average GPA is between 3.01 and 4.00, with 114 students representing 94.21%. The most common type of accommodation is dormitories, with 113 students representing 93.39%.

2. The main factors contributing to students' learning challenges in the dimensions of learners include students reading the topic ahead of time before class, with an average of 3.13 (standard deviation 1.02), indicating a moderate level. This suggests that pupils do not spend much time studying the topic in preparation. In terms of the learning management process, this is because the teacher is always checking students' homework. In terms of curriculum and material, this is due to students only partially studying the curriculum and topic before class, resulting in learned content that does not meet their expectations.

3. Other problems stem from the environment, classroom arrangement, and personal issues. It was found that students residing on campus had difficulty traveling, leaving them with no time to review course material. Classroom arrangements with the center area too far from the instructor made it difficult to see the screen clearly. Additionally, there were other support issues such as slow internet and soundproof classrooms, which allowed noise from adjacent rooms and outside to interfere.

Keywords: Analysing of causal factors, academic achievement, mathematics major students

1. Introduction

In 2562, the Ministry of Education announced the Bachelor's Degree Qualifications Standards in Education and Educational Studies (Four-Year Curriculum). The fields of education and educational studies were described as sciences that deal with the preparation and development of teachers and educational personnel prior to their first day of service and that support the development of in-service and out-of-service teachers to possess professional teacher competence, professional knowledge, and a teacher's spirit. The government devised a 20-year national strategy concentrating on innovative goals and outlined six desirable graduation traits, including:

1) Has shared values. 2) Is a good individual who values morality and ethics and is dedicated to the teaching profession. 3) Is a lifelong student with intelligence and wisdom. 4) Is a co-creator of the invention. 5) Is extremely proficient in learning management, and 6) Be a strong citizen (Ministry of Education, 2019, p. 2-3) and learning outcomes in mathematics have been defined, with learners having knowledge of mathematical principles, concepts, theories, content, and abstract structures established through groups of axioms, as well as precise reasoning using symbolic logic and mathematical notation, forms, and structures of change and space. There is universal knowledge equivalent to international standards that can connect mathematical knowledge with science and technology, as well as link knowledge and learning processes by allowing learning through practice that encourages students to develop their thinking, design and manage mathematics learning, produce and use modern technological media, organize learning environments, conduct research to solve problems and develop students, and evaluate mathematics learning. They can do research and develop innovations to improve mathematics learning, as well as train students to be co-creators of mathematical innovations. (Ministry of Education, 2019, p. 20)

In teaching mathematics at the secondary or undergraduate level in other fields, the role of mathematics is emphasized on calculation, and mathematics is often used as a tool for studying those disciplines. This differs from teaching mathematics at the undergraduate level in mathematics, where, in addition to calculation, proof is also emphasized, such as mathematical principles, number systems, basic geometry, number theory, abstract algebra, etc. These courses fall under the category of major-specific subjects (Sompon Puangsun, Khawn Piasai, Sukanya Hajisalah and Anek Janjaroon, 2024, p. 87).

The Department of Mathematics, Faculty of Education, Suan Sunandha Rajabhat University, aims to elevate the quality of teacher production to a high-level profession, creating teachers who are qualified, possess professional knowledge and competencies, and are committed to values and ideals with a teacher's spirit. This leads to the development of quality human resources that meet national strategies. This is achieved through teaching and learning processes that emphasize active learning, tailored to the characteristics and objectives of each course, to help students achieve learning outcomes aligned with the desired graduate attributes.

The purpose of this study is to investigate the aspects that contribute to and impact mathematics learning in order to offer recommendations for enhancing these elements, enhancing the educational process, and establishing an atmosphere that is more favorable to successful mathematics learning. Because there are so many variables involved and they all have varied effects on math learning, studying these elements is difficult. Numerous scholars have examined and endeavored to elucidate the causal connections among these variables.

However, based on the problems encountered from the past to the present, it has been found that students in the mathematics major have relatively low academic achievement. Additionally, it has been found that a number of students are unable to continue their studies, resulting in their dismissal from the university, dropping out to study in other majors, transferring majors, or not completing their degrees. The researcher is aware of the problem and the importance of identifying the factors that cause students to be unable to study or to

have low academic achievement in mathematics at the Faculty of Education, Suan Sunandha Rajabhat University. Therefore, this research was conducted.

2. Objective

1. To investigate the consistency and harmony of the structural equation model of causal factors influencing academic achievement among students majoring in mathematics at Suan Sunandha Rajabhat University.

2. Investigate the elements that influence students' academic progress in the mathematics program at Suan Sunandha Rajabhat University's Faculty of Education.

3. Methodology

This research used a research methodology to study the causes of causal factors on the academic achievement of students majoring in mathematics, Faculty of Education, Suan Sunandha Rajabhat University, between external latent variables and internal latent variables.

1. Population and Sample

The population used in this research is 327 students from the Mathematics major, Faculty of Education, Suan Sunandha Rajabhat University.

The target group consisted of undergraduate mathematics education students selected through purposive sampling. These were mathematics education students from the Faculty of Education at Suan Sunandha Rajabhat University, in their first to third years, who were currently studying in the second semester of the 2024 academic year, totaling 190 students.

2. Research Instrument

In this study, the researchers used a questionnaire as a tool to collect data on the causal factors affecting the academic achievement of students majoring in mathematics, Faculty of Education, Suan Sunandha Rajabhat University. The details are as follows:

Part 1: Respondents' General Information. This section includes both open-ended questionnaires for respondents to complete and closed-ended multiple-choice questionnaires. The questions take the form of a checklist.

Part 2: A closed-ended questionnaire with a Likert scale is used to collect information on the causal factors influencing students' academic progress in the mathematics program at Suan Sunandha Rajabhat University's Faculty of Education. It comprises the following: 1. Learner Dimension. 2. Dimensions of the Learning Management Process 3. Curriculum and Content Dimension.

For the second part of the questionnaire, the questions are structured using a Likert scale. The scoring criteria for measuring opinions are set at 5 levels, namely:

5 points means most closely aligned with the opinion or practice.

4 points means it strongly aligns with the opinion or practice.

3 points means it aligns with the opinion or practice to a moderate degree.

2 points means it aligns little with the opinion or practice.

1 point means it least aligns with the opinion or practice.

Defining the criteria for consumer opinion levels to interpret the average value into 5 levels, based on

the calculation of the average value (Boonjai Srisathitnarakul, 2012, p. 283), as follows:

An average of 4.21–5.00 means it most closely aligns with the opinion or practice.

An average of 3.41–4.20 means it aligns well with opinions or practices.

An average of 2.61–3.40 means it corresponds to moderate opinions or practices.

An average of 1.81–2.60 means it corresponds to little agreement or practice.

An average of 1.00–1.80 means it corresponds to the least amount of agreement or practice.

Part 3: Additional ideas for respondents to use open-ended questionnaires to express their perspectives on the causal elements influencing academic achievement of mathematics students at Suan Sunandha Rajabhat University's Faculty of Education.

3. Data Collection

This study investigates the causal factors influencing the academic achievement of mathematics students in the Faculty of Education at Rajabhat Suan Sunandha University. The data sources for this research are divided into two parts:

Part 1: Primary Data, collected using a questionnaire to gather opinions on variables, namely causal factors affecting the academic achievement of students majoring in Mathematics, Faculty of Education, Suan Sunandha Rajabhat University, from a target group of 190 sets. The operational steps are as follows:

1. Distribute questionnaires to the target group enrolled in the second semester of the 2024 academic year, totaling 190 people, and explain the self-completion method.

2. Initially verify the completeness and accuracy of the questionnaires and separate out incomplete ones.

Part 2: Secondary Data, obtained by reviewing all literature from books, academic documents, studies, articles, and information published online.

4. Data Analysis

Data collected from the questionnaire was analyzed and then analyzed using the following statistics:

1. General data analysis of students using descriptive statistics, which includes frequency distribution and percentage.

2. Data analysis of causal factors affecting the academic achievement of mathematics students using descriptive statistics, including the mean and standard deviation.

3. Summarize or analyze other feedback from Part 3 of the questionnaire in a descriptive narrative format.

3. Results

This research article aims to study the causal factors influencing the academic achievement of students majoring in mathematics, Faculty of Education, Suan Sunandha Rajabhat University. The researcher presents the results of the data analysis, divided into sections according to the data in the following order:

Part 1. General Information for Students in the Mathematics Major at the Faculty of Education

Table 1
Gender information of students in the math major

Gender	N	Percentage
Male	27	22.31
Female	94	77.69
Total	121	100.00

From Table 1, it was found that the majority of mathematics students who responded to the questionnaire were female, totaling 94 students, or 77.70 percent.

Table 2
Table 2: Age Data for Mathematics Students

Age	N	Percentage
18 years	4	3.31
19 years	23	19.01
20 years	43	35.54
More than 20 years	51	42.15
Total	121	100.00

From Table 2, the majority of students who responded to the questionnaire were over 20 years old, totaling 51 people, or 42.15%. The next largest group was 20 years old, with 43 people, or 35.54%.

Table 3
Year of Study Data for Mathematics Students

Year of Study	N	Percentage
Freshman	30	24.79
Second-years student	37	30.58
Third-years student	29	23.97
Fourth-years student	25	20.66
Total	121	100.00

From Table 3, it was found that second-year students responded to the questionnaire the most, with 37 people, accounting for 30.58%. Second to that were first-year students, with 30 people, accounting for 24.79%.

Table 4
Average GPA data for students in the mathematics major

Average GPA	N	Percentage
1.01-2.00	2	1.65
2.01-3.00	5	4.13
3.01-4.00	114	94.21
Total	121	100

From Table 4, the average GPA of mathematics students who responded to the questionnaire was mostly between 3.01 and 4.00, with 114 students representing 94.21%.

Table 5
Residential Information for Mathematics Students

Residence	N	Percentage
Dormitory	113	93.39
Private	6	4.96
Other	2	1.65
Total	121	100.00

From Table 5, the majority of mathematics students reside in dormitories, totaling 113 students, or 93.39%. The next most common living arrangement is private residences, with 6 students, or 4.96%.

Part 2. Causal Factors Affecting Academic Achievement of Mathematics Students in the Faculty of Education, Suan Sunandha Rajabhat University

Table 6
Factors affecting student dimensions

	Factors Affecting Learning Problems	Opinion level					$\bar{x}$	S.D
		5	4	3	2	1		
1. Factors affecting student dimensions								
1.1	Students read the material in advance before class.	9 (7.5%)	35 (28.9%)	49 (40.5%)	19 (15.7%)	9 (7.4%)	3.13	1.02
1.2	Students arrive on time for class.	92 (76.0%)	23 (19.0%)	3 (2.5%)	1 (0.8%)	2 (1.7%)	4.67	0.72
1.3	Students attend classes regularly without missing any.	95 (78.5%)	21 (17.4%)	3 (2.5%)	1 (0.8%)	1 (0.8%)	4.72	0.64
1.4	The students are focused and attentive in their studies.	37 (30.6%)	66 (54.5%)	18 (14.9%)	-	-	4.16	0.66
1.5	Students are brave enough to ask questions when they don't understand during class.	32 (26.4%)	46 (38.0%)	37 (30.6%)	6 (5.0%)	-	3.86	0.87
1.6	The students are diligently working on their assigned tasks during their studies.	83 (68.6%)	35 (28.9%)	2 (1.7%)	1 (0.8%)	-	4.65	0.56
1.7	Students review the learning material each time.	29 (24.0%)	46 (38.0%)	36 (29.8%)	9 (7.4%)	1 (0.8%)	3.77	0.93
1.8	Students consult friends or professors every time they don't understand something they're learning.	78 (64.5%)	33 (27.3%)	9 (7.4%)	1 (0.8%)	-	4.55	0.67
1.9	Students consistently study and research to gain additional knowledge.	28 (23.1%)	48 (39.7%)	38 (31.4%)	5 (4.1%)	2 (1.7%)	3.79	0.91
1.10	Students can organize their studies with their personal lives.	68 (56.2%)	44 (36.4%)	8 (6.6%)	1 (0.8%)	-	4.48	0.66
1.11	Students use technology to search for information.	90 (74.4%)	27 (22.3%)	3 (2.5%)	-	1 (0.8%)	4.69	0.60
1.12	Students are aware of a variety of online learning resources.	76 (62.8%)	36 (29.8%)	6 (5.0%)	1 (0.8%)	2 (1.7%)	4.51	0.78
1.13	Students can evaluate good information.	60 (49.6%)	47 (38.8%)	13 (10.7%)	-	1 (0.8%)	4.36	0.74
1.14	Students practice exercises regularly.	37 (30.6%)	38 (31.4%)	38 (31.4%)	8 (6.6%)	-	3.86	0.93
1.15	Students always assess their own academic knowledge.	38 (31.4%)	41 (33.9%)	35 (28.9%)	5 (4.1%)	2 (1.7%)	3.89	0.96
1.16	Students submitted their assignments on time.	95 (78.5%)	25 (20.7%)	-	1 (0.8%)	-	4.77	0.48
1.17	Students intentionally chose to study mathematics on their own.	98 (81.0%)	19 (15.7%)	3 (2.5%)	1 (0.8%)	-	4.77	0.53
1.18	Students are always improving, correcting, and developing themselves.	69 (57.0%)	38 (31.4%)	13 (10.7%)	1 (0.8%)	-	4.45	0.72
1.19	Students can learn on their own.	56 (46.3%)	45 (37.2%)	18 (14.9%)	2 (1.7%)	-	4.28	0.78
1.20	Students can adapt to diverse learning management styles.	74 (61.2%)	41 (33.9%)	5 (4.1%)	1 (0.8%)	-	4.55	0.62

From Table 6, it was found that among the factors contributing to learning in the student dimension, the cause related to students read the material in advance before class had an

average of 3.13 (standard deviation 1.02), which is at a moderate level. This indicates that students do not study the content in advance very much. The second most common cause was students reviewing the learning material each time, with an average of 3.77 (standard deviation 0.93). This indicates that students do not review the learning content much after each class. However, most students intentionally chose to study mathematics on their own, with an average of 4.77 (standard deviation 0.53). This indicates that students were highly motivated to choose to study mathematics on their own.

Table 7
Dimensions of the Learning Management Process

	Factors Affecting Learning Problems	Opinion level					$\bar{x}$	S.D
		5	4	3	2	1		
2. Dimensions of the Learning Management Process								
2.21	The professor explained the teaching plan to the students.	96 (79.3%)	22 (18.2%)	1 (0.8%)	1 (0.8%)	1 (0.8%)	4.74	0.59
2.22	The teacher explained the measurement and evaluation methods before the lesson.	102 (84.3%)	16 (13.2%)	2 (1.7%)	-	1 (0.8%)	4.80	0.54
2.23	The professor has knowledge and expertise in the subject matter being taught.	105 (86.8%)	14 (11.6%)	-	1 (0.8%)	1 (0.8%)	4.83	0.54
2.24	The teacher has good knowledge transfer skills and good teaching materials.	99 (81.8%)	20 (16.5%)	-	1 (0.8%)	1 (0.8%)	4.78	0.57
2.25	The professor allowed students to ask questions during class.	106 (87.6%)	14 (11.6%)	-	-	1 (0.8%)	4.86	0.48
2.26	The professor organizes a variety of activities for student participation.	93 (76.9%)	23 (19.0%)	3 (2.5%)	1 (0.8%)	1 (0.8%)	4.70	0.64
2.27	The professor is kind and friendly to the students.	106 (87.6%)	13 (10.7%)	1 (0.8%)	-	1 (0.8%)	4.84	0.50
2.28	The professor provides guidance and helps students solve problems.	96 (79.3%)	21 (17.4%)	2 (1.7%)	-	2 (1.7%)	4.73	0.66
2.29	The professor provided additional learning resources to the students.	94 (77.7%)	20 (16.5%)	5 (4.1%)	-	2 (1.7%)	4.69	0.71
2.30	The professor has an appropriate distribution of points for assessment.	94 (76.0%)	24 (19.8%)	1 (0.8%)	1 (0.8%)	1 (0.8%)	4.73	0.61
2.31	The professor uses a variety of assessment methods (exams, practical work, etc.).	92 (74.4%)	27 (22.3%)	1 (0.8%)	-	1 (0.8%)	4.73	0.56
2.32	The tests are diverse and aligned with the content.	92 (76.0%)	28 (23.1%)	-	-	1 (0.8%)	4.74	0.54
2.33	The professor provides feedback on the results of each assessment to the students.	88 (72.7%)	26 (21.5%)	6 (5.0%)	-	1 (0.8%)	4.65	0.66
2.34	Students can consult with and seek guidance from their professors regularly.	98 (81.0%)	18 (14.9%)	3 (2.5%)	-	2 (1.7%)	4.74	0.67
2.35	The teacher measures and evaluates performance based on the established criteria.	98 (81.0%)	20 (16.5%)	1 (0.8%)	1 (0.8%)	1 (0.8%)	4.76	0.59
2.36	The professor had the students do group activities/work.	86 (71.1%)	32 (26.4%)	2 (1.7%)	-	1 (0.8%)	4.67	0.59
2.37	The professor clearly explained the scoring doubts.	97 (80.2%)	21 (17.4%)	1 (0.8%)	1 (0.8%)	1 (0.8%)	4.75	0.59
2.38	Students participated in the design of assessment and evaluation.	77 (63.6%)	33 (27.3%)	8 (6.6%)	1 (0.8%)	2 (1.7%)	4.50	0.79

	Factors Affecting Learning Problems	Opinion level					$\bar{x}$	S.D
		5	4	3	2	1		
2.39	The professor corrected the homework for the students to check.	73 (60.3%)	38 (31.4%)	7 (5.8%)	1 (0.8%)	2 (1.7%)	4.48	0.77
2.40	The professor allows students to inquire about their accumulated points at any time.	84 (69.4%)	26 (21.5%)	8 (6.6%)	1 (0.8%)	2 (1.7%)	4.56	0.79

From Table 7, one of the factors contributing to learning in the dimension of the learning management process was the instructor providing homework answers for students to check, with an average of 4.48 (standard deviation 0.77), indicating a high level of practice. However, this issue had the lowest average, indicating that students expected the instructor to offer the solutions to the homework or make the answers available for students to review. The next most important feature was student participation in assessment and evaluation design, with an average score of 4.50 (standard deviation 0.79), showing that students desired to be more involved in assessment and evaluation design. However, the majority of students stated that the instructor gave them the greatest opportunities to ask questions throughout class, with an average of 4.86 (standard deviation 0.48).

Table 8
Curriculum and Content Dimension

	Factors Affecting Learning Problems	Opinion level					$\bar{x}$	S.D
		5	4	3	2	1		
3. Curriculum and Content Dimension								
3.41	Students studied the curriculum and content before the course began.	42 (34.7%)	41 (33.9%)	33 (27.3%)	4 (3.3%)	1 (0.8%)	3.98	0.92
3.42	The curriculum and content in the field of study are as the students think.	61 (50.4%)	43 (35.5%)	14 (11.6%)	1 (0.8%)	2 (1.7%)	4.32	0.84
3.43	The curriculum has standard theoretical content.	77 (63.6%)	36 (29.8%)	7 (5.8%)	1 (0.8%)	-	4.56	0.64
3.44	The curriculum emphasizes hands-on practical training for students.	77 (63.6%)	36 (29.8%)	7 (5.8%)	-	1 (0.8%)	4.55	0.69
3.45	The content sequence in the curriculum is appropriate for the students' grade level.	77 (63.6%)	35 (28.9%)	8 (6.6%)	-	1 (0.8%)	4.55	0.69
3.46	The course content is up-to-date.	79 (65.3%)	33 (27.3%)	8 (6.6%)	-	1 (0.8%)	4.56	0.69

From 8, revealed that the causal factors in learning connected to curriculum and content dimensions were students studying the curriculum and material before class, with an average of 3.98 (standard deviation 0.92), indicating a high level of practical thought. However, this topic got the lowest average, showing that pupils barely covered a portion of the curriculum and content before class. The next most significant factor was that the curriculum and content in the major were as students expected, with an average of 4.32 (standard deviation 0.84), indicating that some students did not study the curriculum and content before class, causing the content learned not to be as expected. However, most students responded that the curriculum had standard theoretical content, with the highest average of 4.56 (standard deviation 0.64), indicating that the curriculum had very high standard theoretical content.

Part 3. Additional ideas

1. Students are disturbed by noise from outside the classroom.
2. Some students have to work outside of class hours, which leaves them with no time to review the course material.
3. Students living far from the educational institution spend a long time traveling.
4. The students are having trouble adjusting to their classmates.
5. The condition of the desks is damaged, and they are not suitable for placing notebooks or iPads for taking notes.
6. The desk arrangement is not suitable for learning in the middle of the room, as it is too far from the front of the classroom, making it difficult to see.
7. The student has health problems and gets sick frequently, leading to frequent absences.
8. The university's internet speed is slow and often problematic.

4. Conclusion And Future Work

From the research findings, it was found that among the causal factors affecting the academic performance of mathematics students in the Faculty of Education at Suan Sunandha Rajabhat University, in terms of the student dimension, the main causal factor was that students rarely read the material in advance before class. Most students only study or learn in class. Seeking knowledge before class is quite limited. Additionally, during class, students are hesitant to ask the instructor when they have doubts, possibly because they are afraid of wasting their classmates' time and that the instructor will not be able to cover the planned content. This leads to doubts or misunderstandings not being addressed immediately during class. Furthermore, at the end of each week, most students do not summarize or review the lesson content each time, and there is little effort to seek additional knowledge. Students only work on or complete exercises for assigned tasks. Additional study or exercises are rarely done. In mathematics, students should study the material before class, review the content, and do exercises, as these are essential for learning the subject. The nature of mathematics is a subject that requires consistent practice and training for clear understanding. If students consistently engage in these processes, they will be able to assess their academic knowledge and abilities (Nattadon Niamthong, 2018, Online).

In terms of the learning management process dimension, it was found that students wanted instructors to provide solutions to their homework every time because they were unsure whether their homework was correct. However, overall, instructors in the field provided solutions to students' homework in every subject and assignment to the highest degree. The next most important factor was that students wanted to participate in the design of assessment and evaluation. This was because learning in the field of mathematics is quite difficult, leading most students to want to reduce knowledge-based exams and increase practical assignments or other tasks besides exams. Instructors also needed to allow students to inquire about their accumulated scores at any time during the course, as receiving this information would help students plan their studies in the subject. It would also help students identify their own problems for improvement, correction, and self-development. This aligns with the active learning management approach, which emphasizes student participation in planning, from learning to assessment and evaluation (Utitasarn, C, Phuengkuson, N, Jampawai, T & Yensiri, S., 2024; Jampawai, 2024)

In terms of curriculum and content dimensions, the main reason affecting academic achievement the most is that students did not study the curriculum and content they would be studying before entering the undergraduate mathematics program. This resulted in the content and learning not being what students expected before enrolling. This is because students are

familiar with the education system at the basic level, which significantly impacts their academic achievement.

Suggestions

This study shows the factors that are problematic for students' learning in mathematics. Therefore, it will be beneficial for students to use the research results to develop themselves and improve their learning for maximum effectiveness. The researcher offers the following suggestions:

Recommendations for Applying Research Findings

1. Instructors should consistently assign students to review the content to be taught before each class so they understand the scope of the material to be covered in the next session.
2. After classroom learning, students should review the material by reading every time to continuously understand the concepts learned in that class.
3. The instructor should manage the teaching and learning process to ensure student participation in thinking about and carrying out activities, both in group and individual formats.
4. The instructor must reflect on the students' scores every time so that the students are aware of their mistakes and can use this information to correct, improve, and develop their learning behavior.

Suggestions for future research

1. When collecting data, the instructor should have students complete it in class at the end of the period to ensure that the data is complete and meets the target group size set for data collection.
2. A qualitative research study should be conducted to investigate the causes of learning difficulties in mathematics in order to obtain factual data and provide appropriate assistance to students.

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REFERENCES

- Boonjai Srisatidnarakul (2012), Development and validation of research instruments : psychometric properties, Chulabook, Bangkok.
- Jampawai, T. (2024). Conditions of Digit in the places of positive integers divisible by 7, *Mathematical Journal*, 66(705), 52-64.
- Utitasarn, C, Phuengkuson, N, Jampawai, T & Yensiri, S. (2024), The Development of Skills in Organizing and Conducting Mathematics Online by Research Based Learning for Pre-Service Mathematics Teacher in the Faculty of Education of Suan Sunandha Rajabhat University, *Journal of Roi Kaensarn Academi*, Vol.9, No 2 February 2024, p.332-344.
- Ministry of Education (2017), National Education Development Plan B.E. 2560-2579, <https://bic.moe.go.th/images/stories/pdf/EDU2560-2579full.compressed.pdf>
- Nattadon Niamthong (2018), Mathematics and the Self-Learning Process, <https://www.scimath.org/article-mathematics/item/8403-2018-06-01-02-56-04>.
- Nilawan Sawangrat (2018), Structural Equation Model of Causal Factors Affecting the Success of Steel Industry Operators in the Age of Thailand 4.0, *journal of the Association of Researchers*, Vol.23, No.1 January-April 2018, Thailand.

- Puangsun, S., Piasai, K., Hajisalah, S., & Janjaroon, A. (2024), A Study of Problems and Perceptions Concerning Mathematical Proofs among Pre-Service Mathematics Teachers in Rajabhat Rajanagarindra University by Using Self-Assessment. *SSRU Academic Journal of Education*, 8(1), 85–98. retrieved from <https://so04.tci-thaijo.org/index.php/ssru-edu/article/view/265957>.
- Sirirut Jumnaksarn (2020), The Principle of Multilevel Structural Equation Modeling Analysis by Using Optimal Sample Size and Estimation Methods, *Journal of Social Sciences in Measurement Evaluation Statistics and Research*, Vol. 1, No.1 (January-June 2020), Thailand.
- Thai Ministry of Education (2019), Announcement of the Ministry of Education on Higher Education Standards B.E. [in Thai]. Thailand, https://www.ratchakitcha.soc.go.th/DATA/PDF/2562/E/056/T_0012.PDF.