International Journal of Engineering Sciences &Research Technology

(A Peer Reviewed Online Journal)
Impact Factor: 5.164

IJESRT

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THOMSON REUTERS

[Wirawan, *et al.*, 8(12): December, 2019]
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

CONTRIBUTION OF PEDAGOGICAL KNOWLEDGE, CONTENT KNOWLEDGE, PEDAGOGICAL CONTENT KNOWLEDGE, AND STUDENTS' SELF-AWARENESS TO STUDENTS' MATHEMATICAL ANXIETY

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DOI: 10.5281/zenodo.3577199

ABSTRACT

This study aimed to determine the contribution of pedagogical knowledge, content knowledge, pedagogical content knowledge, and self-awareness of students to students' mathematical anxiety. This type of research was a combination (mixed methods), with a sequential explanatory design. The population of this research was all teachers and students of grade XI senior high school in Denpasar in the academic year 2018/2019. The sample was determined by purposive sampling technique. Purposive Sampling used 10 teachers and 196 students as research samples. Content knowledge data were obtained through content knowledge tests while pedagogical knowledge data, pedagogical content knowledge, self-awareness and mathematics anxiety were obtained through questionnaires, observation sheets, and interview guidelines. Quantitative research applied path analysis and qualitative research took descriptive analysis. Based on the results of qualitative data path analysis, it showed that there was a direct contribution from pedagogical knowledge, content knowledge, pedagogical content knowledge, self-awareness to mathematics anxiety simultaneously by 97.4%. These results were supported by a descriptive analysis, in which the teacher and student interview guidelines indicated that the teacher had prepared a learning plan, carried out and provided an evaluation to the fullest while the students were able to follow the learning process well. The results were also supported from the teacher observation sheet and students show, the teacher had carried out the learning according to the design made and students were motivated when learning took place.

KEYWORDS: Sour Combination and Mathematics, Content, Contribution, Pedagogical.

1. INTRODUCTION

The process of learning mathematics in schools undergoes many obstacles. The prior obstacle certainly comes from teachers and students. The empirical studies show the findings in mathematics learning are very difficult for students to understand the material because it is abstract. Due to students' opinion about the difficulty of math lessons, it results into the inconvenience when taking math lessons. In line with what was revealed by Yusof and Tall (2008), negative attitudes towards mathematics usually arise when students have difficulty in completing exam questions, if this condition occurs repeatedly then the attitude changes into mathematical anxiety.

According to Bessant (1995), the concept of mathematical anxiety has a multidimensional nature from both cognitive and affective roots. The cognitive domain contributes to the approach of learning mathematics by linking mathematics anxiety and evaluating mathematics learning abilities. Affective domain contributes to test the contribution of mathematics, attitudes and concepts regarding anxiety. This is also emphasized by Lazarus (1976) who differs anxiety into two; (1) state anxiety is a temporary emotional reaction arising in certain situations that are felt as a threat, for example taking tests and undergoing surgery, (2) trait anxiety is an individual's condition in the form of anxiety in dealing with various situations.

Anxiety is associated with mathematics, including state anxiety, which is a certain condition and reaction that is felt as a threat, such as taking math lessons. The results of research conducted by Hadfield and McNeil (2011) classify the causative factors of mathematical anxiety, including environmental, mental and individual factors.

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These factors: (1) environmental factors, including experience in mathematics classes and personalities of mathematics teachers, (2) mental factors, related to the ability of abstraction and high-level logic in mathematical content, (3) individual factors, including self-esteem , good physical condition, attitudes towards mathematics, self-confidence, learning styles, and previous experiences related to mathematics. In accordance with the results of Maureen Finlayson's research conducted at Cape Breton University, Canada (2017) states that the highest anxiety level of students according to level and age is during high school. In line with the opinions of Richardson and Woolfolk (1990) mathematical anxiety is a typical form of test anxiety.

The study results conducted by Hopko (2003) which used the Mathematics Anxiety Rating Scale Revision get two factors validated by confirmatory factor analysis. These factors are mathematics learning anxiety and mathematics evaluation anxiety. These results then became two provinces of mathematical anxiety confirmed by Hopko. Alexander, and Martray (1989). They stated that the anxiety scale is divided into three criteria, namely anxiety about mathematics learning, anxiety about mathematics tests / tests, and anxiety about mathematical tasks.

In order to help students be able to control anxiety in mathematics, the role of teacher and student is truly needed to build cooperative activity among others in the learning process. Improving and developing pedagogical knowledge, content knowledge and pedagogical content knowledge of a mathematics teacher are possible to conduct in supporting the learning process thus, it is carried out to the maximum. While in terms of students, students' self-awareness in the learning process must be increased.

The results of previous study conducted by Siraj-Blatchford, et.al (2002) show pedagogical knowledge is a teaching practice, but in the early years, it includes the provision of learning environments for playing, exploration, and instructive learning. As argued by Hill, et.al (2005), pedagogical knowledge is an understanding for teaching that involves the way how to teach content as a condition for teacher effectiveness. This condition is also noted by Mulyasa (2009: 75) that pedagogical knowledge includes some aspects, namely: (a) insight understanding and educational foundation, (b) understanding toward students, (c) curriculum / syllabus development, (d) learning design, (e) the implementation of learning that educates and dialogues, (f) the use of learning technology, (g) evaluation of learning outcomes, and (h) the development of students to actualize the various potentials they have. Based on that teacher's pedagogical knowledge understanding will certainly have an impact on students' mathematical anxiety.

Content Knowledge is the teacher's understanding of mathematical material. According to Shulman (1995), content knowledge as a subject, for example knowledge of concepts, theories, ideas, and frameworks, knowledge of proof, practices and approaches to develop such knowledge. In line with Ball, et.al (2008) there are three things to measure the material knowledge of a mathematics teacher, namely: (1) common content knowledge, general teaching material knowledge, (2) specialized content knowledge, specific teaching material knowledge and (3) horizon content knowledge, knowledge in a wider scope. In accordance with the results of research Olfos, et.al. (2014) indicators of teacher knowledge content, namely: (1) conceptual knowledge, general and specific mathematical knowledge, (2) representational knowledge, representing mathematical knowledge. The results of the development of content knowledge have a significant impact on students' mathematical anxiety in the learning process.

According to Ilyas (2015) pedagogical content knowledge is a special form of knowledge that integrates mathematical knowledge with student knowledge, learning, and pedagogy. In accordance with the results of research obtained by Shulman (1986) pedagogical content knowledge consists of: (1) knowledge about ways to present and explain a material to make the material understandable, (2) knowledge about students' thinking, especially knowledge about conception, and preconceptions of students of different ages and backgrounds they bring into learning and (3) include an understanding of what makes learning about a particular topic easy or difficult. Research results from Olfos, et.al. (2014) pedagogical indicators of teacher knowledge content, namely: (a) knowledge of teaching of content, teacher knowledge about organizing school mathematics curricula, constructivist learning concepts in guiding decision making, learning planning, and teacher actions in class (b) knowledge of students 'knowledge, teacher knowledge related to the knowledge gained by students, awareness of the understanding of concepts and knowledge that students have had to complete the tasks given,

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including knowledge of the difficulties and mistakes that students often make in learning. This understanding certainly has a positive impact on students' mathematical anxiety.

In line with the research results of Anwar et al (2016), an important component that can develop professionalism for better educators is pedagogical content knowledge. Not much different from the results of research by Williams & Lockley (2012) states that educators must have strong pedagogical content knowledge in order to become the best educators. Previous research from Patricia F. Campbell et al (2014) findings provides evidence of the relevance of teacher knowledge and perceptions for professional development preparation and programs. This is based on M. Gilar Jatisunda (2018) research on "Development of Mathematical Teacher Knowledge pedagogical content knowledge" which gives pedagogical content knowledge of mathematics teachers is very important for learning success with development steps through lesson study that is integrating pedagogical content knowledge components in each phase of lesson study, namely: (1) planning, (2) implementing, (3) reflection.

Controlling mathematics anxiety of students by increasing pedagogical knowledge, content knowledge and pedagogical content knowledge of a teacher with a maximum must also be balanced with an increase in self-awareness of a student in the learning process. Self-Awareness according to Solso ddk (2007: 240) explains, "Awareness is the readiness (awareness) of events in the surrounding environment and cognitive events consisting of memory, thoughts, feelings and physical sensations". In line with the results of research to enhance self-awareness Martin (2000) states there are three indicators, namely: (a) self-awareness perception of mathematical ability, (b) awareness of the importance of mathematics perspective, and (c) awareness of motivation to appear in a mathematical context.

Based on this study, it is interesting and important to conduct research on pedagogical knowledge, content knowledge, pedagogical content knowledge, self-awareness towards mathematics learning, which is closely related to mathematics anxiety. So from the description above, researchers are interested in studying the title of the study, "Contribution of Pedagogical Knowledge, Content Knowledge, Pedagogical Content Knowledge, and Student Self-Awareness to Student Mathematics Anxiety".

2. METHOD

This research is a combination of research (mixed methods), with sequential explanatory design. The first stage of quantitative research is categorized in ex-post facto research with path analysis. Then the results of the first stage are supported by the second stage, namely qualitative research using descriptive analysis to find out the factors that affect students' mathematical anxiety. The population of this research is all students and high school mathematics teachers in Denpasar City in 2018/2019 school year.

Determining the sample, researchers used a purposive sampling technique. Purposive Sampling is a non-random sampling technique, the intended purposive sample is the mathematics teacher and class XI students. Based on many high school in Denpasar City in the academic year 2018/2019, the sample of high school in Denpasar City is as follows:

Table 1 Sample of Grade XI Students and Mathematics Teachers

NO	SCHOOL NAME	MANY TEACHERS	LOTS OF STUDENTS
1	SMA DHARMA PRAJA	2	41
2	SMAN 3 DENPASAR	2	42
3	SMA DWIJENDRA PUSAT DENPASAR	2	50
4	SMAN 8 DENPASAR	2	43
5	SMA SARASAWATI 1 DENPASAR	2	20
JUMLAH		10	196

(Source: Wakasek Curriculum for each school)

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Measuring pedagogical knowledge teachers use closed questionnaire sheets with a Likert scale of 5 choices. Pedagogical knowledge questionnaire uses 18 statements so the maximum score for pedagogical knowledge is 80. The pedagogical content knowledge questionnaire uses 12 statements so that the maximum pedagogical content knowledge score is 60. The self-awareness questionnaire uses 10 statements so the maximum score of pedagogical knowledge is 50. The mathematics anxiety questionnaire using 18 statements so that the maximum score for mathematics anxiety is 80. Whereas to measure content knowledge using content knowledge tests with 20 questions. Each question has a score of 1 so the maximum score for content knowledge is 20.

Interview guidelines for pedagogical knowledge researchers designed 5 questions that were prepared. Interview guidelines for pedagogical content knowledge researchers designed 4 questions that were prepared. Interview guidelines for self-awareness researchers designed 3 questions that were prepared. Interview guidelines for mathematics anxiety researchers designed 3 questions that were prepared. Interview guidelines that have been designed by researchers do not rule out the possibility of guidelines that have been made can be developed according to the situation on the ground. The observation sheet, the researcher designed each of the 4 statements for pedagogical knowledge and pedagogical content knowledge and each of the 3 statements for mathematical self-awareness and anxiety.

Qualitative data analysis techniques were carried out by expert validity, empirical validity testing and reliability testing. After that, the path analysis is continued with the normality test, linearity test, heterokedasticity test, multicollinearity test, autocorrelation test, determinant coefficient. Qualitative data is triangulated, namely: (1) internal and external validity test, (2) reliability test, and objectivity test data that has been obtained. After completing the triangulation step then the researcher analyzes the data with reduction, display, and conclusion drawing / verification.

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3. HASIL DAN PEMBAHASAN

The null hypothesis of this study is "the contribution of pedagogical knowledge, content knowledge, pedagogical content knowledge, self-awareness to mathematics learning related to mathematical conversation". Test the null hypothesis, using a 5% significance level. This means that if the significance value in the table is less than or equal to 0.05, then the null hypothesis is rejected. Meanwhile, if the significance value in the table is more than 0.05, then the null hypothesis is accepted. The results of the path analysis evaluation in the following table.

Table 1: Analysis Summary Model

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.454[a]	.206	-.021	4.04988
a. Predictors: (Constant), X2, X1				

In accordance with Table 1, the value of R Square is, that shows the contribution of pedagogical knowledge and content knowledge to pedagogical content knowledge simultaneously by 20.6% and 79.4.6% (100% -20.6%) influenced by other variables not researched.

Table 2: Analysis Coefficients

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	84.152	46.029		1.828	.110
	X1	.309	.489	.214	.631	.548
	X2	-.289	.231	-.424	-1.251	.251
a. Dependent Variable: X3						

Based on the analysis in Table 2 above, the significance value for X1 is 0.548 greater than 0.05 and the significance value of X2 is 0.802 greater than 0.05. This means that at the 5% significance level, X1 and X2 do not have a contribution to X3. The results also showed that the efficiency of beta X1 and X2 were 0.214 and -0.424, respectively. Therefore, a re-calculation of the regression model is performed. The results of summary analysis are presented in table 3 and table 4 as follows.

Table 3*: Analysis Summary Model*

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.314[a]	.099	-.352	2.61534
a. Predictors: (Constant), X3, X1, X2				

Based on the analysis of Table 3, the value of R Square, that is, shows the contribution of pedagogical knowledge, content knowledge and pedagogical content knowledge to self-awareness simultaneously at 9.9% and at 90.1.6% (100% - 9,9%) influenced by other variables not examined.

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Table 4: ***Analysis Coefficients***

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	87.379	36.131		2.418	.052
	X1	.056	.325	.069	.172	.869
	X2	-.133	.165	-.347	-.806	.451
	X3	-.105	.244	-.187	-.430	.682
a. Dependent Variable: X4						

In accordance with the analysis in Table 4 above, the significance value for X1 is 0.869 greater than 0.05, the significance value of X2 is 0.451 greater than 0.05 and the significance value of X3 is 0.682 greater than 0.05. This means that at the 5% significance level, X1, X2 and X3 have no contribution to X4. The results also showed that the efficiency of beta X1, X2 and X3 were 0.069, -0.3347 and -0.187, respectively. Therefore, a re-calculation of the regression model is performed. The results of the summary analysis are presented in table 5 and table 6 as follows.

Table 5*: Analysis Summary Model*

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.987[a]	.974	.953	.70241
a. Predictors: (Constant), X1, X2, X3, X4				

In accordance with the results of the analysis in Table 5, the value of R Square that is, shows the contribution of pedagogical knowledge, content knowledge, pedagogical content knowledge, self-awareness to mathematics anxiety simultaneously at 97.4% and at 2.6% (100% - 97.4%) influenced by other variables not examined.

Table 6: ***Analysis Coefficients***

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	89.310	13.636		6.549	.001
	X1	-.667	.087	-.574	-7.627	.001
	X2	.419	.047	.763	8.976	.000
	X3	.355	.067	.441	5.327	.003
	X4	-.551	.110	-.384	-5.021	.004
a. Dependent Variable: Y						

In accordance with the analysis in Table 4 above, the significance value for X1 is 0.01 less than 0.05, the significance value of X2 is 0,000 less than 0.05, the significance value of X3 is 0.003 less than 0.05 and the significance value for X4 is 0.004 less than 0.05. This means that at the 5% significance level, X1, X2, X3 and X4 have a contribution to X4. The results also show beta coefficient of X1 is -0.574, beta coefficient of X2 is 0.763, beta coefficient X3 is 0.441 and beta coefficient X4 is -0.384. The results of the analysis in the table can

be calculated the coefficient for errors $e_3 = \sqrt{1-R^2} = \sqrt{1-(0.974)} = 0.161$. Based on the final conclusions of the path analysis, it is known that the path diagram in accordance with this study is as follows.

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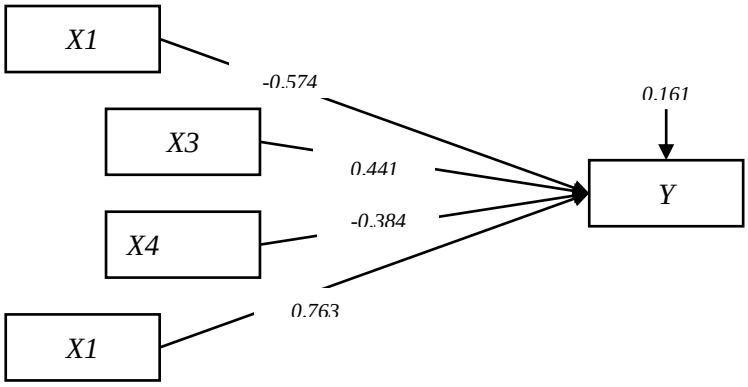

Figure 1 Contribution Diagram X1, X2, X3 and X4 to Y

These results are supported from the results of teacher and students' interview. The excerpt from the result of teachers and students' interfiew as follows:
Teacher Code: G01
P : What are your steps in prepareing the lesson plan?
G : Understanding the applicable syllabus, determine KI and KD then compile the lesson plan.
P : What are your procedures in carrying out the learning process?
G : Excuting the learning process based on the lesson plan, mastering the material that want to be given, making small groups to discuss the material.
P : What is your opinion about utilizing technology for learning mathematics?
G : Nowadays, there are many technologies that can be used to support mathematics learning so that the material is easily to be accessed.
P : What is your procedure in providing an evaluation of student learning output?
G : Before the learning process, the teacher and students make a learning contract which is valid during the mathematics learning process. Then excute the learning process and learning output test.
P : What are your steps in conveying ideas / concepts from the material which is presented?
G : Linking these ideas / concepts with contextual or real problems.

Pedagogical content knowledge is very high. In citation of the second line interview, the teacher explains the steps of preparing a lesson plan by determining KI and KD based on the syllabus and then compile the lesson plan. When the learning process is in the fifth line citation, the teacher conducts learning according to the lesson plan. Besides that the teacher also prepares himself by understanding the material before the learning process takes place. When the learning process takes place, the teacher also make small groups to carry out discussions be more effective. Regarding technology in the learning process in the ninth line interview citation, the teacher knew that there are many technologies that can be utilized in the process of learning mathematics, one of them is accessing material. Related to the learning process taking place in the citation of the fifteenth line interview, the teacher conveyed ideas / concepts by linking conceptual or real problems with students' life.

The results of interviews related to self-awareness and mathematics anxiety of XI high school students in Denpasar as follows:
Students Code: S03
P : What is your perception (interpretation), of mathematics?
PD : Mathematics is very helpful in daily life. The initial interpretation of mathematics seems scary but in reality it is not.
P : How do you motivate yourself to solve math problems?
P : What activities do you do when participating in mathematics learning?
PD : Doing some math exercises, asking and discussing with friends if there is something that

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is not understood.
P : How do you solve the math test?
PD : Learning regularly and doing lots of exercises in solving math problems.
P : How do you feel about the learning ouput provided by the teacher?
PD : If that was good, I'll be happy but if that was bad, I'll be disappointed.

In the citation of interview above, student with code S03 have high self-awareness and KMS. Seen in the second line interview citation, student knows the perception of mathematics lessons where math lessons help in our daily life even though at beginning, math looks scary but apparently not. In improving learning motivation in the fifth line interview, student makes an initial learning plan so that learning motivation grows. When the learning process takes place in the seventh line interview citation, students carried out discussion activity, did some math exercises and of course asked the teacher if there is not understood. In solving math test on the ninth line interview citation, student prepares himself by studying regularly completing the exercises. Learning output obtains by student in the citation of eleventh line interview, student is proud of the results of his own hard work, he looks happy when got the maximum results.

The results of the analysis from the teacher and student observation sheets show:

1. The results of teacher's observation sheet
   a. The teacher prepares annual program (prota) and semester program (promes) based on the syllabus at the beginning of the learning year to support the mathematics learning process.
   b. The teacher prepares lesson plans and worksheets by applying the learning model with a scientific approach.
   c. The teacher gives apperception and motivation to learn such as: you can, keep practice, try again, you can do more than your frineds.
   d. The teacher conveys mathematics subject matter clearly so that students easily to understand the material that has been explained.
   e. Teacher often gives inducement questions such as "who is still remember the previous material?" Does anyone want to solve the questions on the board?
   f. The teacher gives math exercises to be discussed in groups for 15-25 minutes and after students finish the work, it will be discussed together.
   g. The teacher provides flexibility in completing the exercises through the way or method which is possible.
   h. The teacher uses models / strategies / approaches in the learning process of mathematics but is not maximized in its application in class.
   i. The teacher utilizes technology by downloading videos from the internet.
   j. The teacher associates learning ideas / concepts with concepts hich is related with students' life.
   k. The teacher gives exercises, then he goes around to see and check students' work then asks the students related to problems in doing the exercises.
   l. The teacher gives the opportunity for students to try solving the exercises in front of the class and then asks other students to pay attention to the way the solutions are made.
   m. The teacher gives an appreciation in the form of applause to someone who succeeds in completing the exercises correctly and provides motivation for those who are still wrong in making the way or answer which the answer is almost close to correct.
   n. The teacher gives an evaluation of learning output by providing test that students must do in school.
2. The result of students' observation sheet
   a. Student are challenged in working on math problems which are provided by the teacher and focus on paying attention to the material presented.
   b. Students look happy during learning process because the teacher teaching method is interesting, which makes students easier to understand the concepts that has been conveyed.
   c. Students are able to see the benefits of learning mathematics obtained at school.
   d. Students improve motivation to learn mathematics by working the exercises discussing with friends and asking the teacher if the questions are too difficult to solve.
   e. Students take notes in the learning process takes place and ask if there is anything that is not understood.
   f. Students feel proud of the results of the test / exam that they obtained because it is the result of their own work.

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4. CONCLUSION

The factors that affect students' mathematical anxiety are the teacher and the students themselves. Pedagogical knowledge, content knowledge, pedagogical content knowledge, and self-awareness have a close connection with students' mathematical anxiety. Pedagogical knowladge is the ability of a teacher to manage student learning including: (1) teacher understands the students, (2) teacher designs the learning, (3) teacher implements the learning, (4) teacher utilizes technology in learning and (5) teacher evaluates of learning. Aspects of mathematics teacher content knowladge are (1) understanding the concepts of mathematics teachers and (2) understanding teaching concepts related mathematics material. Aspects for pedagogical content knowladge of teachers, namely: (1) teacher's knowledge related to students' knowledge and (2) teacher's knowledge related to teaching mathematics material. Aspects for self-awareness, namely: (1) students' self-understanding of mathematics perceptions, (2) students' perspectives understading on the importance of mathematics and (3) students' motivation to solve mathematics problems. While aspects of mathematics anxiety, namely: (1) the process of students when attending mathematics learning, (2) the process of students working on tests / exam of mathematics and (3) the confidence of students in evaluating mathematics assignments. Based on emperic data and a significance level of 5%, it can be seen that:

- There is no contribution of pedagogical knowledge to pedagogical content knowledge.
- There is no contribution of content knowledge to pedagogical content knowledge.
- There is no pedagogical knowledge contribution to self-awareness.
- There is no contribution of content knowledge to self-awareness.
- There is a direct contribution of pedagogical knowledge to students' mathematics anxiety.
- There is a direct contribution of content knowledge to students' mathematiccs anxiety.
- There is no contribution of pedagogical content knowledge to self-awareness.
- There is a direct contribution of self-awareness to students' mathematics anxiety.
- There is no contribution of pedagogical content knowledge through self-awareness to students' mathematical anxiety.
- There is no contribution of pedagogical knowledge through pedagogical content knowledge to self-awareness.
- There is no contribution of content knowledge through pedagogical content knowledge to self-awareness.
- There is no contribution of pedagogical knowledge through self-awareness to students' mathematics anxiety.
- There is no contribution of content knowledge through self-awareness to students' mathematics anxiety.
- There is no contribution of pedagogical knowledge through pedagogical content knowledge through self-awareness to mathematics anxiety.
- There is no contribution of content knowledge through pedagogical content knowledge through self-awareness to mathematics anxiety.
- There is no contribution of pedagogical knowledge and content knowledge to pedagogical content knowledge.
- There is no contribution of pedagogical knowledge and content knowledge to self-awareness.
- There is no contribution of pedagogical knowledge and content knowledge to students' mathematics anxiety.
- There is no contribution of pedagogical knowledge and content knowledge through pedagogical content knowledge to self-awareness.
- There is no contribution of pedagogical knowledge and content knowledge through self-awareness of students' mathematicsanxiety.
- There is a direct contribution of pedagogical knowledge, content knowledge, pedagogical content knowledge, and self-awareness to mathematics anxiety simultaneously at 97.4%.

Based on the conclusion above, the following recommendations are:

- To other researchers to conduct research using the same variables by examining wider population and sample.

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- Teachers should be able to develop and enhance pedagogical knowledge, content knowledge, and pedagogical content knowledge while students should be able to improve self-awareness because it has a direct or indirect effect on students' mathematics anxiety.
- Although pedagogical knowledge, content knowledge, pedagogical content knowledge of a teacher while self-awareness it does not have an indirect effect on students' mathematics anxiety, it needs to be developed continuous positively because it consciously or unconsciously influences the behavior of teachers and students in classroom learning.

5. ACKNOWLEDGMENTS

Thanks to the Chancellor of Ganesha University of Education for supporting this research.

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