

STUDENTS' GENDER, PHOBIA FOR MATHEMATICS AND WILLINGNESS TO STUDY SCIENCES A CASE STUDY OF SENIOR SECONDARY SCHOOL STUDENTS IN NNEWI EDUCATION ZONE, ANAMBRA STATE, NIGERIA

Nwankwo, Yvonne Ebere

Department of Science Education, University of Calabar,
nwankwoyvonnemaria@gmail.com
+234-9054628320

Abam, Oyobo Gladys Tom

Department of Curriculum and Teaching University of Calabar,
Cross River State, Nigeria
+234-8169733229

&

Igwebuike, Osedumme

Department of Curriculum and Teaching, University of Calabar
Osedumme83@gmail.com
+234-7062806398



Abstract

The research examined students' gender, phobia for mathematics and willingness to study sciences: A case study of senior secondary schools in Nnewi Education Zone of Anambra State, Nigeria. To guide this study, three research questions and three hypotheses were formulated. A thorough review of relevant literatures was carried out focusing on the study's variables. The research design employed for this study was descriptive survey. In this design, the researcher observed the dependent variable, which is the willingness to study sciences, based on the occurrence of two independent variables: students' gender and their level of Mathematics-related fear. Simple random, purposive and accidental sampling technique was used to select 120 SS1 students from Nnewi Education Zone in Anambra State, Nigeria. Data collection was carried out through a questionnaire titled "Gender, Mathematics Phobia, and Students' Willingness to Study Sciences Questionnaire (GMPSWTSSQ)," which underwent validation and achieved a reliability coefficient of 0.87. To test the formulated hypotheses, the researcher employed independent t-tests and Pearson Product Moment correlation using a significance level of 0.05. The results indicated the following findings: There was no statistically significant difference in Mathematics-related fear between male and female students in senior secondary school. Also, a significant difference existed between male and female students concerning their willingness to study sciences in senior secondary school. A significant relationship was identified between Mathematics-related fear and students' willingness to study sciences in Senior Secondary School. Based on these findings, it was recommended among others that educational policymakers should develop and implement targeted interventions aimed at reducing mathematics phobia, such as interactive learning materials, peer mentoring programs, and teacher training workshops focused on mathematics pedagogy.

Keywords: Gender, Mathematics Phobia, Science, Willingness and Secondary School.



Introduction

Science is the systematic study of the structure and behaviour of the physical, social, and natural worlds through observation and experimentation. It is the key to innovation, global

competitiveness and human advancement. It is not always evident that science shapes our daily lives, but the certainty is that science impacts countless decisions we make each day. From managing our health and well-being, choosing paper over plastic at the grocery store (Beilock & Maloney, 2015). It is important that the world continues to advance in the field of science, whether it is finding new cures for cancer and other diseases or identifying and exploring new galaxies. In the fields of Science, Technology, Engineering, and Mathematics (STEM), adequate numerical and Mathematical skills is a prerequisite to function effectively in daily life and influences academic performance and success in many careers (Beilock & Maloney, 2015).

However, many students become disenchanted with science when they enter senior classes and develop Mathematics phobia. A factor that has been shown to negatively influence performance and acquisition of science skills. Wiedemann (2015) posited that phobia or anxiety is characterized by nervousness and fear, with physical manifestations such as tremors, increased pulse rate and muscle pain. Phobia is a basic human emotion that generates physiological reactions to stressors when a “fight or flight” defense response is activated in order to protect the individual from a threatening object or phenomenon. McAnallen (2010) in Gioia (2022) suggested that Mathematics anxiety is a response associated with avoiding Mathematics that leads to a failure to gain critical skills and, ultimately, to make appropriate decisions on career orientation. Since Mathematics phobia is often more pronounced in women than in men, it is essential to take the effect of gender into consideration. Gioia (2022), Adie, Inah, Ibu, Anditung & Igyo (2022) asserted that gender is a socio-cultural concept while sex is biological differentiation of boy and girl. Gioia (2022) further see gender as the socially/culturally constructed characteristics and roles which are associated to males and females in any society. Males are assigned such attributes as boldness, aggressiveness, logical in reasoning, intelligence, tactfulness, self-confidence etc. whereas females are assigned the opposite attributes such as fearfulness, tactlessness, talkativeness and submissiveness among others.

Mathematics is an important subject with broad applicability to everyday life, yet Mathematics is often considered as a difficult subject in schools (Kaur, 2017). As early as the 1st grade, students can start displaying negative attitudes towards learning Mathematics and gradually develop it in the form of Mathematics phobia (Hornigold, 2015). Krogh-Jespersen and Echols (2018) asserted that willingness to learn is an impulse or desire within the individual to continue to search for information and understand various things in the context of self-development. It is an individual's desire to stick to an agreed learning commitment. Willingness to learn is determined by internal and external factors. Internal factors are factors of the individual, namely individual characteristics, attitudes, and personality. External factors are determined by environmental factors, both family and school environment.

Gender differences exist in the proneness to openly admit anxiety, rather than actual differences (Devine; Fawcett; Szucs & Dowker, 2012). From this viewpoint, women and men experience emotions in similar ways, but during the process of socialization, they learn how (and to whom) emotions can be openly expressed, and when it is appropriate to do so. Thus, men may be more reluctant to openly admit anxiety (Hill & Saranson, 1966, as cited in Zeidner, 2018).

Jacob, Arturo, Adusei and Molchanova (2020), Adie, Okri and Anditung (2019) carried out a study on Gender differences in mathematics phobia across cultures: A univariate analysis of variance among samples from twelve countries. The purpose of this paper was to explore the perceived Mathematics Phobia differences among males and females across cultures using the Phobia Towards Math Scale (PTMS). Data were collected between October 2019 and September 2020) from students (N = 4,340) in 12 countries. Using univariate analysis of variance, the results indicate that gender has a significant main effect on Mathematics phobia with females recording higher mean scores than males, (71.816 > 68.118).

Conversely, females reported significantly higher Mathematics anxiety scores than males in the rest of the locations, except Iran (Tehran and Qom) and Pakistan (Faisalabad). Gender-based ranking of the top-three locations with high Mathematics Phobia scores indicates that females, starting from Malaysia, Thailand (Bangkok), and Nigeria (Enugu State) ranked the highest. Similarly, males beginning from Malaysia, Nigeria (Enugu State), and Thailand (Bangkok) ranked the top-three in Mathematics Phobia. The implications are that mathematics teachers need to adopt different culturally-appropriate and gender-focused interventions to support students with Mathematics anxiety challenges (Dogan, 2020).

Boys may have been trained to confront their fears and anxieties in order to satisfy the stereotyped gender role that encourages avoidance of being perceived as vulnerable and weak. Conversely, women may be more willing to disclose feelings of anxiety (Ashcraft & Ridley, 2015). Thus, it would likely be considered more acceptable for them to disclose their negative feelings, where the traditional feminine gender role permits the expression of fear and anxiety without negative social consequences. In both cases, gender role identification would likely lead to reporting bias as a way of presenting oneself in a positive light. If this hypothesis is correct, boys who underreport their high levels of math anxiety may forgo opportunities for guidance or counselling (Ashcraft & Ridley, 2015)

Flessati and Jamieson (2011), Adie, Obi, Okri and Ogbe, (2020) examined the hypothesis of gender response bias in the reporting of Math anxiety by asking undergraduate students whether Math anxiety is perceived as a female experience. They found gender differences in Math anxiety, with females scoring higher than male undergraduates; however, contrary to the gender response bias hypothesis, the students believed that Math anxiety (as well as anxiety about other subjects) affected both genders similarly. This result is inconsistent with the idea that the expression of anxiety in general, and Math anxiety in particular, is more characteristic of female students.

A second gender stereotype that has been proposed to account for gender differences in Math anxiety relates to the ability rather than the emotional domain, and holds that women perform worse at Mathematics than their counterpart men (Ramirez; Shaw & Maloney, 2018). Moreover, the prevailing belief may depend on different factors including the age and gender of the individual.

Research relevant to the willingness to learn proves that willingness to learn is a psychological state that determines how the behaviour is formed. It is a predictor of individual and gender differences in career decisions and labor market outcomes. In general, influencing or motivating students' willingness to learn is difficult for educators in all content areas. In a companion paper Buser, Peter and Wolter, (2017), found striking gender differences in educational choices, in particular in the choice of profession for individuals who opt for vocational education, Boys make up more than 90 percent of apprentices in the most math-heavy professions which lead to higher salaries. According to the authors boys are less likely than girls to choose the academic track but nevertheless make up nearly 70 percent of students who specialize in Mathematics and Physics within the academic track. Girls concentrate in language and social science-oriented specializations in the academic track and in low-math apprenticeships. The result also showed that willingness to compete and study, predict career choices at all parts of the ability distribution.

Moreover, Diekman et al. (2011) in Fuesting, Diekman, and Murphy (2017) found that communal goal-endorsement still negatively affected students' interest in science careers, even after students' past experience and self-efficacy in science had been controlled. Furthermore, gender differences in science interest were significantly mediated by communal goals. The study indicates that this misconception about science careers is problematic, since communal opportunities are highly valued when women make vocational decisions. Interestingly, according to the recent review study by Boucher, Fuesting, Diekman, and Murphy (2017), not

only women but also communally-oriented men could be deterred by the stereotypic misperceptions of science that are perceived as being uncommon. Additionally, Brown, Thoman, Smith, and Diekman (2015) reported that regardless of college students' major, enrolment, and gender, when they had the chance to perceive science careers as supporting communal values, their interest in science careers had been increased

Mathematics phobia among students, is called arithmophobia or numerophobia. The words arithmophobia and numerophobia both have Greek origins where the root word stands for 'numbers', and 'phobos' meaning 'deep dislike or fear'. This type of phobia affects student's attitude towards Mathematics and often creates ridiculous fear of numbers. Mathematics is a universal, utilitarian subject that is needed for everyone in their life (Ihechukwu & Ugwuegbulam, 2016). It is an integral part of the curriculum throughout the countries in the world. It is an interdisciplinary language and tool that is considered as one of the fundamentals in the formal educational system (Roy, 2016). The author further stated that Mathematics is the study of quantity, structure, space and change. It is as a human endeavor encompasses the mathematics of measurement time, distance and different system of distance measurement that developed throughout the world. Mathematics is a science about well-defined objects and notions which can be analyzed and transformed in different ways using 'mathematical reasoning' to obtain conclusions about which we are certain (OECD, 2018).

Even teachers and parents have negative attitudes towards Mathematics; it is expressed as a hard subject that is inaccessible, uninteresting, and it is not for cool and engaging people, and not for girls and this usually deter students in science courses especially among ladies (Boaler & Dweck, 2016). Of all the most important cause of poor performance in Mathematics at school level may be the phobia in Mathematics. Thus, the study can help the concerned teachers and the educational administrators to run and support the students who are suffering due to the lack of support and other resources, and the perceived barriers that impact on classroom instruction and supports (Graves, 2018). It is an essential requirement in every field of intellectual endeavor and human development to cope with the challenges of life (Ihechukwu & Ugwuegbulam, 2016).

Theoretical framework

This paper was grounded in two theories viz:

- i. Constructivist theory of learning by Jerome Bruner (1966).
- ii. Emotional processing theory by Foa and Kozak (1986)

Constructivist Theory of Learning by Jerome Bruner (1966)

Constructivist theory of learning which was propounded by Jerome Bruner (1966) is rooted on observation and the study of how individual learn irrespective of gender. Constructivism holds that learners bring their personal experiences into the classroom and these experiences have a tremendous impact on students' views of how the world works. Students come to learning situations with a variety of knowledge, feelings, and skills, and this is where learning should begin. This knowledge exists within the student and is developed as individuals interact with their peers, teachers, and the environment.

The underlying logic of the learning cycle is that individual lessons only make sense in the light of how they build on previous knowledge/lessons and how they create the cognitive need and scaffolding for subsequent lessons. Both the individual and the collective human understanding of science are built on the foundation of prior conceptions, including resistant-to change misconceptions. Students should be given opportunity to find relationship between already known concepts and new ones.

Emotional processing theory by Foa and Kozak (1986)

The Emotional processing theory was propounded by Foa and Kozak (1986). This theory builds on Lang's concept of fear structure to explain the psycho-pathology and treatment of anxiety and its disorders. According to this theory, pathological fear structure contains associations among the stimulus, response, and meaning representations that distort reality and includes excessive response elements. The authors consider fear in Mathematics as a feeling of tension that affects students' accomplishment of Mathematical tasks especially in solving Mathematical problems.

By implication to the present study, the development of fear in Mathematics is affected by intellectual capacity, personality, and environmental factors. Personality variables include gender, as a result of self-esteem, self-concept, attitude, confidence and learning behaviour. Meanwhile, intellectual variables comprise of concepts related to students' academic performance. On the other hand, environmental variables include experiences of the students outside of the school like in the house with their family members, environment with their friends and relatives, and extrinsic expectations.

Statement of the problem

The poor performance of secondary school students in Nigeria, particularly in science subjects, both in internal and external examinations, has become a matter of concern to Nigerians. Fear or aversion towards a specific subject can affect students' willingness to study those subjects

Lack of students' willingness to study sciences remains a pressing concern for education stakeholders. This situation raises the alarm that the country may fail to meet its future manpower needs, despite its large population. Therefore, it is crucial to examine the influence of gender and Mathematics phobia on students' willingness to study sciences in senior secondary schools within the Nnewi Education Zone of Anambra State, Nigeria. This inquiry aims to address the question: Can students' gender and fear of Mathematics impact their motivation to pursue science subjects at the senior secondary school level?

Purpose of the Study

The purpose of this study was to investigate gender, phobia towards Mathematics and willingness to study sciences in senior secondary school in Nnewi Education Zone of Anambra State, Nigeria. Specifically, the study sought to.

1. examine the difference in Mathematics phobia between male and female students in senior secondary school in Nnewi Education Zone of Anambra State, Nigeria
2. ascertain the difference between male and female students in willingness to study sciences in senior secondary school in Nnewi Education Zone of Anambra State, Nigeria.
3. determine the relationship between phobia for mathematics and students' willingness to study sciences in Senior Secondary School Nnewi Education Zone of Anambra State, Nigeria.

Research Questions

1. To what extent do male and female students differ in Mathematics phobia among students in senior secondary school in Nnewi Education Zone of Anambra State, Nigeria?
2. To what extent do male and female students differ in their willingness to study sciences in senior secondary school in Nnewi Education Zone of Anambra State, Nigeria?
3. What is the relationship between phobia for mathematics and students' willingness to study sciences in Senior Secondary School Nnewi Education Zone of Anambra State, Nigeria?

Research Hypotheses

1. Phobia towards Mathematics does not significantly differ between male and female students in senior secondary school in Nnewi Education Zone of Anambra State, Nigeria.
2. There is no significant difference between male and female students towards willingness to study sciences in senior secondary school in Nnewi Education Zone of Anambra State, Nigeria.
3. There is no significant relationship between phobia for mathematics and students' willingness to study sciences in Senior Secondary School Nnewi Education Zone of Anambra State, Nigeria.

Methodology

Descriptive survey was used in this study. By using this design, the researcher used the independent variables: students' gender and Mathematics phobia that has already occurred to observe the dependent variable: willingness to study sciences as they manifest. Isangedighi, Joshua, Asim and Ekuri (2004) asserted that "ex-post facto research design involves the collection of data to accurately and objectively describe existing phenomena. Studies that make use of this design are employed to obtain a picture of the present condition of a particular phenomenon

The population of the study comprised of one thousand seven hundred and thirty (1,730) senior secondary school one (SS1) students from the 49 public secondary schools in Nnewi Education Zone. Purposive sampling technique was used to select SS1 class. This is because this is the only senior secondary class where students enroll for all subjects (science and arts). The instrument used for data collection in this study was questionnaire titled "Gender, Mathematics Phobia and Students' Willingness to Study Sciences Questionnaire (GMPSWTSSQ

In analyzing the data, independent t-test and Pearson's Product Moment Correlation Coefficient were used. The hypotheses were analyzed at .05 level of significance.

Results

Hypothesis 1

Phobia towards Mathematics does not significantly differ between male and female students in senior secondary school in Nnewi Education Zone of Anambra State, Nigeria.

Table 1: Independent t-test analysis of difference between male and female students towards Mathematics phobia

Grouping variables	N	$\bar{x}$	S.D	Df	t-cal	p-val
Male	65	23.40	3.44	118	-.212	.563
Female	55	23.54	3.44			

*Significant at .05 level, t-crit. = 1.96, t-cal. = -.212

To test hypothesis independent t-test was used. As shown in table 1, the calculated t-ratio of -.212 (t-cal = -.212, $p < .05$), is less than critical t-ratio of 1.96 tested at .05 level of significance and 118 degree of freedom. Since $p(.563)$ is greater than $p(.05)$, it implies that, there is no significant difference between male and female students' Phobia for mathematics in senior secondary school in Nnewi Education Zone of Anambra State, Nigeria.

Hypothesis 2: There is no significant difference between male and female students' willingness to study sciences in senior secondary school in Nnewi Education Zone of Anambra State, Nigeria

Table 2: Independent t-test analysis of difference between male and female students' willingness to study sciences in senior secondary school

Grouping variable	N	$\bar{x}$	SD	df	t-cal	p-val
Male	65	30.07	8.06	118	3.72	.049
Female	55	31.09	7.22			

*Significant at .05 level, t-crit. =1.96, t-cal. =-3.72

To test the hypothesis, independent t-test was used. The t-test analysis as found in table 2 shows that the calculated t-ratio of 3.72 (t-cal= -3.72, $p < .05$), is greater than critical t-ratio of 1.96 tested at .05 level of significance and 118 degree of freedom, and since $p(.049)$ is less than $p(.05)$, it implies that , the null hypothesis which states that, there is no significant difference between male and female students towards willingness to study sciences in senior secondary school in Nnewi Education Zone of Anambra State, Nigeria, was rejected. Meaning that there is a significant difference between male and female students willingness to study sciences in senior secondary school in Nnewi Education Zone of Anambra State, Nigeria.

Hypothesis 3: There is no significant relationship between Mathematics phobias on students' willingness to study sciences in Senior Secondary School Nnewi Education Zone of Anambra State, Nigeria.

Table 3: Pearson Product Moment Correlation (PPMC) of relationship between Mathematics phobia and students' willingness to study sciences in Senior Secondary School

Variable	$\sum X^2$	$\sum Y^2$	$\sum XY$	r-cal	Sig.
Mathematics phobia	666.96	443835.76	642270.01	.398	.001
Students' willingness to study science	786.44	618487.87			

*Significant @ $p < .05$; df = 118; critical r-value = 0.088

Data in table 3 ascertained the relationship between Mathematics phobia and students' willingness to study sciences in senior secondary schools. There was a positive correlation between the two variables, $r(118) = .398$, $p = .001$. With reference to this result, the null hypothesis which states that, there is no significant relationship between Phobia for mathematics and students' willingness to study sciences in Senior Secondary School in Nnewi Education Zone of Anambra State, Nigeria was rejected. Therefore, there is a significant relationship between Phobia for mathematics and students' willingness to study sciences in Senior Secondary School Nnewi Education Zone of Anambra State, Nigeria.

Discussion of findings

The result of analysis of hypothesis one showed that there is no significant difference between male and female students Phobia for mathematics among senior secondary schools in Nnewi Education Zone of Anambra State. The finding is in line with that of Ashcraft and Ridley (2015) who stated that traditional feminine gender role permits the expression of fear and anxiety without negative social consequences on education. According to the authors both cases, gender role identification would likely lead to reporting bias as a way of presenting oneself in a positive light. If this hypothesis is correct, boys who underreport their high levels of math anxiety may forgo opportunities for guidance or counselling (Ashcraft & Ridley, 2015). On other hand, the study of Ramirez, Shaw and Maloney, (2018) contradict the finding of the hypothesis when they stated in their study on gender stereotype that has been proposed to account for gender

differences in math anxiety relates to the ability rather than the emotional domain, and holds that women perform worse at Mathematics than their counterpart men.

The result of analysis of hypothesis two showed that there is significant difference between male and female students towards willingness to study sciences in senior secondary school in Nnewi Education Zone of Anambra State, Nigeria. The finding is in line with the study of Buser, Peter, and Wolter, (2017) who found striking gender differences in educational choices, in particular in the choice of profession for individuals who opt for vocational education. According to the authors Boys make up more than 90 percent of apprentices in the most math-heavy professions which lead to higher salaries. Also, boys are less likely than girls to choose the academic track but nevertheless make up nearly 70 percent of students who specialize in Mathematics and Physics within the academic track. Girls concentrate in language and social science-oriented specializations in the academic track and in low-math apprenticeships. The result also showed that willingness to compete and study predicts career choices at all parts of the ability distribution

Data in table 3 indicated that there is significant relationship between phobia for mathematics and students' willingness to study sciences in Senior Secondary School Nnewi Education Zone of Anambra State, Nigeria. The result finding is in line with the study of Boaler and Dweck (2016) which showed that even teachers and parents have negative attitudes towards mathematics; it is expressed as a hard subject that is inaccessible, uninteresting, and it is not for cool and engaging people, and not for girls and this usually deter students in science courses especially among ladies.

Conclusion

In conclusion, this study reveals that while there is no significant gender difference in mathematics phobia among senior secondary school students in Nnewi Education Zone of Anambra State, Nigeria, there exists a significant gender disparity in willingness to study science courses, and a strong correlation between mathematics phobia and decreased interest in science education. A weak foundation in mathematics at the secondary level can culminate in difficulties learning higher-order mathematics at the college level, fostering fear, anxiety, and ultimately, mathematics phobia. Therefore, targeted interventions addressing mathematics phobia are crucial to promote a positive learning environment and enhance students' academic achievement and career aspirations in science-related fields.

Recommendations

The researcher made the following recommendations

1. Educational policymakers should develop and implement targeted interventions aimed at reducing mathematics phobia, such as interactive learning materials, peer mentoring programs, and teacher training workshops focused on mathematics pedagogy.
2. Schools should incorporate gender-sensitive teaching strategies to address the significant gender disparity in willingness to study science courses, ensuring equal opportunities for male and female students to develop interest and confidence in science, technology, engineering, and mathematics (STEM) fields.
3. Curriculum developers should prioritize building strong foundational mathematics skills at the secondary level, incorporating real-world applications and problem-solving exercises to foster students' critical thinking and analytical abilities, thereby reducing the likelihood of mathematics phobia and related anxiety in higher education

References

- Adie, E. B., Inah, L. I., Ibu, P. N., Anditung, P. A. & Igbo, C. O. (2022). Effect of Concept Mapping Strategy on the Academic Achievement of Post Basic Students' in Mathematics in Obudu Education Area of Cross River State, Nigeria, *Interdisciplinary Journal of Science Education (IJ-SED)*, 4(1), 151-158.
- Adie, E. B., Obi, J. J., Okri, J. A. & Ogbe, A. O. (2020). Effect of Constructivist Method of Teaching Basic Science and Mathematics on the Academic Performance of Junior Secondary School students' in Calabar Municipality, Cross River State, *Interdisciplinary Journal of Science Education (IJ-SED)*, 2(1), 1-9.
- Adie, E. B., Okri, J. A. & Anditung, P. A. (2019). Influence of School Science Facilities on Students' Learning Outcome in Senior Secondary Mathematics in Central Education Zone, Cross River State. *Multi-disciplinary Journal of Research and Development Perspectives*, 8(2), 30-38.
- Ashcraft, M. H., & Ridley, K. S. (2015). Maths anxiety and its cognitive consequences. In J.I.D Compbell (Ed.) *Handbook of mathematical cognition. Psychology Press*pp.315–327
- Beilock, S.L & Maloney, E.A (2015). Math anxiety: A factor in math achievement not to be ignored. *Policy insights from the Behavioural and Brain Science* 2(1): 4 - 21
- Besley, J. C., Dudo, A., Yuan, S., & Lawrence, F. (2018). Understanding scientists' willingness to engage. *Science Communication*, 40(5), 559–590
- Boaler, J., & Dweck, C. S. (2016). *Mathematical mindsets: unleashing students' potential through creative math, inspiring messages and innovative teaching. Research in Mathematics Education*.18(3):1-4
- Boucher, K. L., Fuesting, M. A., Diekman, A. B., & Murphy, M. C. (2017). Can I work with and help others in this field? How communal goals influence interest and participation in STEM fields. *Frontiers in Psychology*, 8, 901-921
- Brown, E. R., Thoman, D. B., Smith, J. L., & Diekman, A. B. (2015). Closing the communal gap: The importance of communal affordances in science career motivation. *Journal of Applied Social Psychology*, 45, 662–673.
- Bruner, J. S. (1966). *Toward a theory of instruction*, Cambridge, Mass.: Belkapp Press.
- Buser, T., Noemi, P. & Stefan, W. (2017). "Gender, competitiveness, and study choices in high school: Evidence from Switzerland." *American Economic Review: Papers & Proceedings* 107 (5):125–130
- Córdova-Rangel, A., Escalera-Chave, M. E. & Gasca, S. B. (2017). Mathematics really generates anxiety? Empirical Study in middle school students, *International Electronic Journal of Mathematics Education*. 12 (1), 88-97
- Devine, A., Fawcett, K., Szucs, D., & Dowker, A. (2012). Gender differences in mathematics anxiety and the relation to mathematics performance while controlling for test anxiety. *Behavioral and Brain Functions*, 8(1), 33 – 39
- Diekman, A. B., Brown, E. R., Johnston, A. M., & Clark, E. K. (2010). Seeking congruity between goals and roles: A new look at why women opt out of science, technology, engineering, and mathematics careers. *Psychological Science*, 21(8), 1051–1057.
- Dogan, U. (2020). Mathematics anxiety and phobia among males and females across various locations. *Journal of Educational Research*, 113(4), 537-548
- Flessati, S. L., & Jamieson, J. (2011). Gender differences in mathematics anxiety: An artifact of response bias? *Anxiety Research*, 3(4), 303–312.
- Gioia, F. (2022). *Concepts and Calculations: Gender differences in willingness to guess. Management Science*. 60(2),434-448
- Graves, T. (2018). Teacher knowledge and perception of mathematics disabilities and SMTC Plan B Papers. Master's Thesis. The University of Wyoming 71 http://repository.uwyo.edu/smtc_plan_b/71

- Hornigold, J. (2015). *Dyscalculia pocketbook*. Management Pocketbooks. Retrieved <http://dyscalculationmathphobia.com>.
- Ihechukwu, N. B. & Ugwuegbulam, O. C. (2016). Causes and solutions of mathematics phobia among secondary school students. *Research on Humanities and Social Sciences*. 20(6), 2225 - 2484
- Interventions, and a new interpretation framework. *Educational Psychologist*, 53(3), 145–164.
- Isangedighi, A.J, Joshua, M. T , Asim A.E & Ekuri E.E (2004). *Fundamentals of research and statistics in education and social science*. Calabar: University of Calabar Press.
- Jacob, O. S.; Arturo, G.; Adusei, H. & Molchanova, V. S. (2020). Gender differences in mathematics phobia across cultures: A univariate analysis of variance among samples from twelve countries, *European Journal of Contemporary Education*, 9(4): 878-885
- Krogh-Jespersen S. & Echols C.H (2018). Children's explicit assessment of reliability influence their willingness to learn novel labels. *Journal of Experimental Child Psychology*. 171, 31-45
- McAnallen, R.R. (2010). An investigation of mathematics anxiety and academic coping Strategies among high school Students in Vietnam: A cross-sectional study. *Sec. Educational Psychology* 13(1), 6547 –6558.
- Nosek B.A, Smyth, F.L., Sriram, N., Lindner, N.M., Devos, T., Ayala A. & Greenwald, A.G. (2010) National differences in gender–science stereotypes predict national sex differences in science and math achievement *PNAS Proceedings of the National Academy of Sciences of the United States of America*, 106 (26), 10593 – 10597
- OECD (2018). PISA 2021 Mathematics framework. OECD Publishing. Pisa 2021- maths. oecd.org
- Ramirez G., Shaw S. T., Maloney E. A. (2018). Math anxiety: Past research, promising
- Roy, A. (2016). *The enigma of creation and destruction*. Bloomington, IN: Author House.
- OECD (2018). PISA 2021 Mathematics framework. OECD Publishing. Pisa 2021- mathsoecd. Org
- Saez F.M, Bustos, C.E; Perez, M.V, Mella, J.A, Lobos, K.A & Diaz, A.E (2018). Willingness to study, self-efficiency and causal Attributions in Chilean University. *Students Proposition Representations* 6(1) 199-245.
- Wiedemann, K (2015). Anxiety and Anxiety Disorders. *Int. Encyclopedia Soc. Behavioural Science* 1, 560-567.
- Zeidner, M. (2018). *Test anxiety: The state of the art*. New York: Plenum Press.