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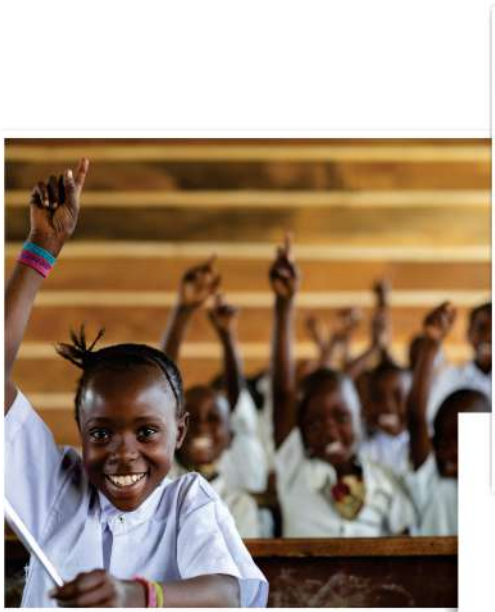
INNOVATIVE STRATEGIES FOR TEACHING VOCATIONAL, SCIENCE, TECHNOLOGY AND MATHEMATICS EDUCATION: CLASSROOM PRACTICES



PROF. JOSEPHINE N. OKOLI

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EDITOR
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PREFACE

The electronic book (e-book) acknowledges that traditional methods in Vocational, Science, Technology and Mathematics Education: Classroom Practices may not be sufficient to equip students with the necessary skills for a rapidly evolving technological landscape.

Therefore, it advocates for the adoption of Innovative teaching approaches that promote a more dynamic and effective learning experience.

Prof. Josephine N. Okoli
Faculty of Education,
Science Education Department,
Nnamdi Azikiwe University Awka, Anambra State, Nigeria.

TABLE OF CONTENT

SECTION ONE
EMPIRICAL RESEARCH WORKS

Chapter 1
Effects of constructivism based instructional method on students' achievement in financial accounting in senior secondary schools in Anambra State
Chika M. Okonkwo **1**

Chapter 2
Innovative tools for effective teaching of physical and health education in colleges of education in Anambra State.
Anaekwe Grace U., Obiefuna Grace C. **8**

Chapter 3
Effect of framing instructional strategy on students' motivation and academic achievement in mathematics in Oron Local government Area of Akwa Ibom State, Nigeria
Ekpenyong Effiong Ibok, **Idaka Etta Idaka, Iwuala Patricia Ebere Chilebe** **13**

Chapter 4
Influence of demographic variables as a determinant principal administrative practices in Enugu State Nigeria
Nweke Phina Amaka, Emmanuel Chukwunwike Onyekwe, Iwenzu Ngozi Caroline Uloaku Victoria Egbuchiwe **22**

SECTION TWO
THEORETICAL FRAMWORKS

Chapter 5
Role of smart green schools in the development of environmental education for sustainable development
Regina Ijeamasi Enebechi **31**

Chapter 6
Budgeting, Savings and Investment Pedagogy: An Imperative for Graduate Survival and Sustainability
Ehumadu Rophina Ifeyinwa Chima **41**

Chapter 7
Inquiry-Based Learning in Mathematics Classroom: A Guide for Teachers
Ogoke Chinemeze James, Tina Uchenna Otumegwu, Achugamonu Pius C **49**

Chapter 8
Enhancing Acquisition of Science, Technology, Engineering and Mathematics (STEM) Skills in Early Childhood Education
Obiefuna Grace C, Nwankwo Glory U. **57**

Chapter 9
Innovative Teaching Strategies in Basic Science in the 21st Century Classroom Settings
Suleiman Dambai Mohammed, Perekeme Peresuodes **67**

Chapter 10
Brainstorming: An Innovative Tool for Enhancing Teaching and Learning of Biology in Schools
Ifeoma B. Okafor, Chukwuma C. Ekechukwu, Caroline I. Okorie **74**

Chapter 11
Innovative Strategies for Teaching Mathematics Education in Nigeria: Classroom Practices
Tukur Madu Yemi **80**

Chapter 12
Innovative Strategies for Enhancing Mathematical Thinking and Problem-Solving Skills in Nigerian Classrooms
Emmanuel C. Nwigboji, Uzoamaka Chimuanya Okafor-Agbala **85**

Chapter 13
Innovative Instructional Strategies in Science Teaching and Learning
John B. Moses, Tamaraudeinyefa Tobi **98**

Chapter 14
Instructional Approach and Proofs of Pythagora's Theorem for Problem-Solving
Madu Cletus Ifeanyi, Abur Cletus Terhemba **109**

Chapter 15
Building a Strong Foundation in Chemistry for Beginners
Obikezie Maxwell Chukwnazo **117**

Chapter 16
Hands-On, Minds-On: Emerging Practices in Classroom Robotics Education
Fadip Audu Nannim, Moeketsi Mosia **124**

Chapter 17
From Support to Self-Reliance: Instructional Scaffolding Strategies for 21st Century Science Classrooms
Maria Tsakeni, Stephen Chinedu Nwafor **134**

Chapter 18
Think-Pair-Share Comparative Teaching and Learning Strategy
Mohammed Idris, Abel Idoko Onoja **146**

Chapter 19
Multiple Intelligence Strategies: An Innovative Instructional Approach to Teaching and Learning in the 21st Century
JohnBosco O.C. Okekeokosisi, MaryAnn Chigozie Ofordum, Odunayo Abigael Bamisebi **152**

Chapter 20
Fostering Critical Thinking and Creativity through Interdisciplinary Teaching in the 21st Century Classroom
Nkiru N.C. Samuel 157

Chapter 21
Interdisciplinary Approach to Teaching Basic Science: The Challenges and Benefits
Melody Otimize Obili, Nneka R. Nnorom **168**

Chapter 22
Classroom-Based Innovative Teaching Strategies in Agricultural Education
Anyachor Charles N. **177**

Chapter 23
E-Learning Platforms for Continuous Professional Development
Chikendu Rebecca Ebonam, Ekoyo Destiny Onyebuchi **182**

FOREWORD

This book entitled "**Innovative Strategies for Teaching Vocational, Science, Technology and Mathematics Education: Classroom Practices",** is a book of readings on various innovative classroom pedagogies. It is a welcome literature for Education System and a very important resource book for teachers who are functioning in the disciplines of Vocational Education, Science, Mathematics and Technology education and training. It is a compendium of most of the **active learning strategies** aimed at producing graduates who have been prepared for adaptation to the conditions of the 21st century world of fluidity. The 21st century world accommodates soft skills which the individual can edit from time to time as the conditions of socio-cultural, economic and technological environments change constantly and uncontrollably. A century in which cross-border job openings are important means of employment, a century where attitude is more important than subject-based excellence, a century where collaboration, innovation and creativity are irreducible demands by employers of labour, a century where adaptive skills are critical for entrepreneurship, creation of jobs and wealth.

All categories of teachers at all levels of education would find this resource book interesting and professionally helpful for their teaching practice. Because conditions of the modern world are in perpetual flux, teachers have to re-skill in order to produce adaptive graduates and the era of lecture method is literally over. It is these modern innovative instructional strategies that would enable teachers to produce such graduates who would survive and then succeed in the 21st century global economy.

This book would also be very useful to researchers and innovators in the envisioned pedagogic paradigm shift of this era. I therefore, proudly recommend this book, a compendium on innovative pedagogies to all classes of teachers and researchers on pedagogies and curriculum reforms in the modern era.

Prof. Zephrinus C. Njoku
Faculty of Education,
Science Education Department,
University of Nigeria, Nsukka, Nigeria.

BIODATA OF CONTRIBUTORS

Chika M. Okonkwo is a staff of Chukwuemeka Odumegwu Ojukwu University, Igbariam, Anambra State, Nigeria. She obtained her M.ed in measurement and evaluation from Imo state university, Nigeria. Currently she is a PhD student in measurement and evaluation from Michael Okpara University of Agriculture Umuahia, Abia State, Nigeria. She is a researcher who have contributed in some Journals. Chika M. Okonkwo has attended conferences and workshop. She is a member of learned societies such as Teachers Registration Council of Nigeria (TRCN) and Association of behavioural Research Analysis and Psychometricians (AB-ReAP).

Mrs Anaekwe Grace U. (MSTAN) is a lecturer at Federal College of Education (Technical) Umunze, Anambra State. She attended Girls High School Uga (1983). She later proceeded to Federal College of Education (Technical) Umunze, Anambra State where she obtained her National Certificate in Education (NCE) in Home Economics in 1995. Mrs Anaekwe continued with her academic pursuit at Nnamdi Azikiwe University, Awka, Anambra State, where she got her Bachelor's Degree in Education (B.ed) in Adult / Health Education in 2003. At University of Nigeria Nsukka, she bagged her Masters in Education (M.ed) in Public Health in 2017. She had attended many conferences with paper presentations. She belongs to many professional bodies including Teachers Registration Council of Nigeria (TRCN), Science Teachers Association of Nigeria (STAN). Mrs Anaekwe Grace is married and the marriage is blessed with many children.

Obiefuna, Grace Chigozie is a Biochemistry graduate. She holds a Post Graduate Diploma in Education with Master's degree in Biochemistry and a lecturer at Federal College of Education (Technical) Umunze, Anambra State. She is a successful academician with an ample wealth of knowledge and skills in teacher training techniques, writing and explaining innovative ideas on education related issues in order to motivate others. Grace has written and published many Journal articles in education and health niches. She finds it fulfilling attending conferences, seminars, and workshop; so as to become more relevant in her field of study and career. She is a member of professional bodies such as Science Teachers Association of Nigeria (STAN), Teachers Registration Council of Nigeria (TRCN) and was recently certified by La Plage Mata Verse, an international institute, as an educator with skills in the use of artificial intelligence for curriculum development.

Ekpenyong Effiong Ibok is a lecturer in Department of Mathematics and Computer Science Education, Faculty of Science Education, University of Calabar, Calabar. He obtained Ph.D in Mathematics Education from University of Calabar. He is a qualified Licensed Teacher with publications in International and National Journals, a registered member of Teachers Registration Council of Nigeria (TRCN), Mathematical Society of Nigeria (MSN) and Mathematical Association of Nigeria (MAN). Dr. Ibok is a Mathematics pedagogy, Research consultant and Data analytics.

Idaka Etta Idaka is a lecturer in the Department of Curriculum and teaching University of Calabar, Calabar. She obtained PhD in Curriculum Studies, Elementary Education from University of Calabar. She is a qualified Licensed Teacher with publications in International and National Journals, a registered member of Teachers Registration Council of Nigeria (TRCN), Curriculum Organization of Nigeria (CON). World Council for Curriculum and instruction (WCCI).

Iwuala Patricia Ebere Chilebe is a lecturer in the Department of Curriculum & Teaching University of Calabar, Calabar. She had her PhD from Abia State University Uturu. She has many publications in International and National Journals published to her credits. As a trained teacher, she's registered with Teachers Registration Council of Nigeria (TRCN), a member of Curriculum Organization of Nigeria (CON).

Nweke Phina Amaka is a lecturer in the Department of Educational Foundations. School of Education, Federal College of Education (Tech) Asaba, Delta State. She obtained her M.ED in Educational supervision and planning from the National Open University of Nigeria in the year 2017. She is a member of Teachers Registration Council of Nigeria (TRCN), Nigerian Association for Educational Administration and Planning (NAEAP). She has made contributions in many chapters in a book and journals. She has attended conferences where she has presented papers.

Emmanuel C. Onyekwe is a lecturer in the Department of Educational Foundations, School of Education, Federal College of Education (Technical), Asaba, Delta State, Nigeria. He obtained his M.Ed in Educational Administration from Delta State University Abraka, Delta State Nigeria, in the year 2010. He has contributed in book chapters and Journals. He is a member of some learned societies such as Philosophical Association of Nigeria (PEAN) and Teacher's Registration Council of Nigeria (TRCN).

Iwenzu Ngozi Caroline is a lecturer in the department of educational foundation in school of Education, Federal College of Education (Tech) Asaba, Delta state. Mrs Ngozi has contributed in some books chapters, journals and also attended conferences where she has presented papers. She is a member of learned societies such as Teachers registration council of Nigeria (TRCN), Nigerian Association for Educational Administration and planning (NAEAP), and Association of Educational management and policy practioners (AMEAPP).

Uloaku. V. Egbuchiwe is a lecturer in the Department of Educational Foundations, school of Education, Federal College of Education (Technical) Asaba, Delta State, Nigeria. She obtained her M.Ed in Education Management and planning from Imo state university, Owerri in the year 2023. She is a seasoned scholar who has contributed in many book chapters and journals. She has attended conferences where she has presented papers. She is a member of Teachers Registration Council of Nigeria (TRCN), Nigerian Association for Educational Administration and planning (NAEAP).

Regina Ijeamasi Enebechi is a lecturer in the Department of Science Education, Nnamdi Azikiwe University, Awka. She holds a Ph. D in Science Education/ Biology from the University of Nigeria Nsukka, she has a multidimensional experience in research. She is a seasoned scholar and a prolific writer who has authored many articles in reputable local and international journals, published many textbooks and contributed in many book chapters. She is a member of editorial board of many local and international journals. She has been actively involved in both conducting and reviewing academic work. She has produced many science teachers and educators with various degrees (NCE, B.Sc(Ed) and M.Sc(Ed) who are currently teaching at primary, secondary and tertiary levels of education. She is a member of science teachers association of Nigeria (MSTAN), Member Teachers' Registration Council of Nigeria, Fellow Corporate Administrative Institute (FCAI). Dr. Enebechi has received so many awards.

Ehumadu Rophina Ifeyinwa Chima is a lecturer in the department of Home Economics Education, Federal College of Education (Technical), Umunze. She obtained her Ph.D in Home Science Education from the department of Agricultural/ Vocational Education, Micheal Okpara University of Agriculture, Umudike in the year 2021. She has to her credit published articles in reputable journal sites. Dr. Ehumadu Rophina Ifeyinwa Chima has attended conferences where she has presented papers. She is a licensed teacher with teacher registration council of Nigeria (TRCN) and a member of Home Economics professional association of Nigeria (HPAN).

James C. Ogoke is a lecturer in the Department of mathematics, School of Sciences, Alvan Ikoku University of Education Owerri, Imo State, Nigeria. He obtained his PhD in Mathematics Education from Nnamdi Azikiwe University, Awka, Anambra State in Nigeria in the year, 2022.

He is a seasoned scholar who has contributed in many book chapters and journals. Dr. Ogoke to his credit, has attended conferences where he has presented papers. He is a member of many learned societies such as Teachers Registration Council of Nigeria (TRCN), Science Teachers Association of Nigeria (STAN), Mathematics Association of Nigeria (MAN), Science Educator Association of Nigeria (SEAN).

Tina Uchenna Otumegwu is a lecturer in the Department of Educational Psychology, Guidance and Counseling, Federal College of Education (Technical), Omoku, Rivers State, Nigeria. She holds a Ph.D. and M.Ed. in Measurement and Evaluation from Imo State University, Owerri, and a B.Sc. (Ed.) in Mathematics from the University of Nigeria, Nsukka. She has several years of teaching experience at the secondary school level in Imo State and worked as an examiner for the West African Examinations Council (WAEC) and the National Examinations Council (NECO) for seven years. Dr. Otumegwu has published widely in both local and international journals and has contributed chapters to academic books. She has also presented papers at various academic conferences. She is a member of several professional bodies, including TRCN, ASSEREN, and IAIIEA.

Achugamonu Pius Chukwuma is a lecturer in the Department of Mathematics Education in Faculty of Science Alvan Ikoku Federal University of Education Owerri, Imo State. He obtained his PhD in statistics from Imo State University Owerri, Imo State. He is a seasoned lecturer who collaborated with others in production of different textbooks in his area and courses in mathematics education too. He has presented papers in different conferences, Journal publications and in chapter contributions too. Currently he is a member of World Bank Analytics fellowship committee in community development in Nigeria. Achugamonu Pius C**.** had run so many programs with the world Bank Analytics fellowship.

Nwankwo Glory U is a lecturer in the Department of Integrated Science Education, School of sciences, Federal College of Education (Technical) Umunze, Anambra State, Nigeria. She is a graduate of Science Education (Integrated science option), holds a Master's degree and PhD in same option. She is a certified educator with skills in leading health, safety and environment and an experienced scholar who has co-authored numerous textbooks, contributed in many book chapters and journals. To her values, Dr. Nwankwo has attended a lot of conferences, seminars, and workshops so as to boost her career. She is a member of many professional associations such as Teachers Registration Council of Nigeria, Science Teachers Association of Nigeria (FSTAN – membership).

Suleiman Dambai Mohammed is a Reader in Science Education Department of Science Education Faculty of Education Federal University of Lafia, Nasarawa State. I obtained my Ph.D in University of Abuja-Nigeria in 2016. I'm a registered member with STAN; TRCN; and National Research Institute (NRI).I have over 30(thirty) publications in National and International Journals; Text books and Chapter contributions in both Local and International. I'm married with children.

Perekeme Peresuode is a lecturer in the Department of Mathematics, School of Science, College of Education, Warri, Delta State, Nigeria. He obtained his PhD in Mathematics Education from Nnamdi Azikiwe University, Awka, Anambra State, Nigeria, in 2024. He is a seasoned scholar who has contributed to many book chapters, proceedings, and journals. Dr. Perekeme has also attended conferences where he presented papers. He is a member of several learned societies, including the Mathematical Association of Nigeria (MAN), Teachers' Registration Council of Nigeria (TRCN), Science Teachers Association of Nigeria (STAN), Nigerian Mathematical Society (NMS), Computer Science Association of Nigeria (COAN), Association for the Promotion of Academic Researchers and Reviewers (APARR), Nigeria Statistical Association (NSA), Forum for Academic and Educational Advancement, and the Association of Science Educators Anambra (ASEA).

Ifeoma B. Okafor is a lecturer in the department of Biology Education, School of Sciences, Federal College of Education (Technical), Umunze Anambra State, Nigeria. She obtained her Ph.D. in Science Education (Biology) from Nnamdi Azikiwe University, Awka, Anambra State, Nigeria. She is a seasoned scholar who has co-authored numerous textbooks, contributed in many book chapters and journals. She is a member of the editorial board of Anambra State STAN Journal. Dr. Ifeoma Blessing Okafor to her credit has attended seminars, workshops and conferences where she has presented papers. She is a member of many learned societies such as Teachers Registration Council of Nigeria (TRCN), Organisation of Women in Science for the Developing World (OWSD), Women in Colleges of Education (WICE) and Fellow, Science Teachers Association of Nigeria (FSTAN). She is the National Secretary STAN Basic Science Panel Junior. She is also the treasurer of STAN Anambra State Chapter.

Chukwuma C. Ekechukwu a lecturer in Biology Department, School of Secondary Education (Science), Federal College of Education (Technical), Asaba, Delta State, Nigeria. He is currently a post graduate student at Chukwuemeka Odumegwu Ojukwu University, Igbariam, Anambra State, Nigeria.

Caroline I. Okorie is a lecturer in the Department of Computer Science Education. Faculty of Education and Arts Madonna University Nigeria Okija, Anambra State. She obtained her Ph.D in Education Measurement and Evaluation from Imo State University (IMSU) in Nigeria in the year 2017. She is a seasoned scholar who has contributed in many Book chapters and Journals. Dr. Okorie to her credit, has attended conferences where she has presented papers. She is a member of many learned societies such as: Association for Academic Review and Development (AARD) African Journal of Science Technology and Mathematics Education (AJSTME) Association of Education al Researchers and Evaluators of Nigeria (ASSEREN) Primary and Tertiary Teacher Education Association of Nigeria (PATTEAN).

Tukur Madu Yemi is a distinguished academic in Mathematics Education at the Federal University of Kashere, Gombe State, Nigeria. With over two decades of experience in teaching, research, and academic leadership, he has made significant contributions to the advancement of mathematics education and educational policy in Nigeria. He earned his Ph.D in Mathematics Education from Universiti Utara Malaysia (UUM), a globally recognized institution renowned for its academic innovation and excellence. His research interests include mathematics pedagogy, curriculum development, educational research methodology, and higher education reform. Dr. Yemi has served in various academic and administrative capacities, including Deputy Dean, Head of Department, and Chair of several university committees. He actively mentors both undergraduate and postgraduate students and has published widely in reputable national and international Journals. Beyond academia, he is a committed public intellectual who contributes regularly to national discourse through opinion pieces in leading Nigerian newspapers. Notable among his recent writings are:

“Delayed Salary Payment for Nigerian University Staff: A Matter of Urgency and Dignity”

“The Almajiri Crisis: Rethinking Education for Northern Nigeria”

“Time Management in Academic Research: A Guide for Postgraduate Students”

Dr. Yemi is a frequent participant in national and international conferences, where he shares research-based insights on improving educational access, quality, and governance.

Emmanuel C. Nwigboji is a lecturer in the Department of Science Education, Alex Ekwueme Federal University, Ndufu-Alike, Ebonyi State, Nigeria. He holds a Master’s degree in

Mathematics Education from Nnamdi Azikiwe University, Awka, Anambra State, which he obtained in 2017. He is currently pursuing his Ph.D. in Mathematics Education at the same institution. A dedicated scholar and researcher, Mr. Nwigboji has made significant contributions to academia through his authorship of numerous book chapters and scholarly journal articles. He has actively participated in academic conferences, where he has presented insightful papers on contemporary issues in science and mathematics education. Mr. Nwigboji is a registered and active member of several professional and academic bodies, including the Teachers Registration Council of Nigeria (TRCN), the Science Teachers Association of Nigeria (STAN), the Mathematical Association of Nigeria (MAN), and the Science Educators Association of Nigeria (SEAN). His commitment to advancing science and mathematics education in Nigeria underscores his professional engagements and academic endeavors.

Uzoamaka Chimuanya Okafor-Agbala is a lecturer in the Department of Science Education, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria. She obtained her PhD in Mathematics Education from Nnamdi Azikiwe University, Awka, Anambra State in Nigeria in the year 2023. She has to her credit published articles in reputable Journal sites. Dr. Okafor-Agbala have attended conferences where she has presented papers. She is a licenced teacher with Teachers Registration Council of Nigeria (TRCN) and a member of Science Teachers Association of Nigeria (STAN).

John B. Moses is a lecturer in the Department of Science Education, Faculty of Education, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria. He obtained his PhD in Science Education from Nnamdi Azikiwe University, Awka, Anambra State, Nigeria. He is a seasoned scholar who has contributed in many book chapters and journals. Dr. Moses to his credit has attended many conferences where he has presented papers. He is a member of many learned societies such as Teachers Registration Council of Nigeria (TRCN), Science Teachers Association of Nigeria (STAN).

Tamaraudeiyefa Tobi is a Post Graduate student in the Department of Science Education, Faculty of Education, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria.

Madu Cletus Ifeanyi is a lecturer in Department of Mathematics FCE(T), Bichi. Obtained PhD in Pure Mathematics from ABU Zaria. He is a qualified Licensed Teacher with publications in International and National Journals, a registered member of Teachers Registration Council of Nigeria (TRCN), Mathematical Society of Nigeria (MSN) and Mathematical Association of Nigeria (MAN).

Abur Cletus Terhemba is a lecturer in the Department of Mathematics, Federal College of Education (Technical) Bichi Kano State Nigeria. He obtained his Masters Degree in Mathematics Education from Benue State University Makurdi, Nigeria in the year 2018. He has to his credit published articles in reputable journal sites. Mr. Abur Cletus Terhemba has attended conferences where he has presented papers. He is a licensed teacher with Teachers Registration Council of Nigeria (TRCN) and a member of Mathematical Association of Nigeria (MAN).

Maxwell Chukwunazo Obikezie is a distinguished academic who lectures at the Department of Science Education, Nnamdi Azikiwe University, Awka. He is an active member of the Science Teachers' Association of Nigeria (STAN) and holds a valid registration with the Teachers' Registration Council of Nigeria (TRCN), reflecting his commitment to professional excellence and ethical standards in teaching. A prolific scholar, Dr. Obikezie has authored numerous articles and book chapters in the fields of chemistry, chemistry education, science education, and general education. His research work is widely recognized in both domestic and international academic circles, and he has attended many conferences globally, where he has presented and published papers on various educational and scientific topics. In addition to his research and teaching

pursuits, Dr. Obikezie is a reputable reviewer and editor for several scholarly journals, contributing significantly to the advancement of scientific and educational scholarship. He is known for his expertise as a sound chemistry teacher and a dedicated researcher, with a focus on improving science education and fostering innovative teaching methodologies. His dedication to academia, research, and teacher development makes him a highly respected figure in the fields of chemistry and science education.

Fadip Audu Nannim is a Postdoctoral Research Fellow at the University of the Free State, Bloemfontein, South Africa, and a Lecturer in the Department of Computer and Robotics Education at the University of Nigeria, Nsukka. He earned his Ph.D. in Computer and Robotics Education from the University of Nigeria, Nsukka. Dr. Nannim is a dedicated scholar with a strong publication records, having co-authored textbooks and numerous peer-reviewed journal articles. He serves as a reviewer and editor for various local and international academic journals. Dr. Nannim is an active member of several professional bodies, including the Teachers Registration Council of Nigeria (TRCN), the Computer Educators Association of Nigeria (CEAN), the South African Education Research Association (SAERA), and the Nigerian Institute of Management (NIM) Chartered.

Moeketsi Mosia is Associate Professor and ETDP-SETA Research Chair in Mathematics Education at the University of the Free State, where he also serves as Vice-Dean: Teaching & Learning. A leading scholar of mathematics education and higher-education policy, he sits on the ministerial task team drafting a national "teaching mathematics for understanding" framework, the Umalusi Assessment Standards Committee, and the CHE Accreditation Committee. Formerly Director of the UFS Centre for Teaching and Learning and Head of Natural Science Teaching at Sol Plaatje University, Prof Mosia pairs rigorous research with strategic leadership to advance mathematics teaching, curriculum quality, and student success across South Africa.

Maria Tsakeni is an Associate Professor and Head of the Mathematics, Natural Sciences and Technology Education Department in the Faculty of Education at the University of the Free State in South Africa. She is an NRF (South Africa) C2 rated researcher. Her area of research is in instructional and curriculum innovations in STEM classrooms. She is a member of the SAARMSTE and SAERA conferences, and she was the Chairperson of the Local Organising Committee for SAARMSTE 2023. She was also a member of the SAERA 2024 Local Organising Committee. She attends international conferences such as the ESERA, IOSTE, ECE, AERA and WERA.

Stephen Chinedu Nwafor is currently a postdoctoral Research Fellow in the Department of Mathematics, Natural Sciences, and Technology Education at the University of the Free State's Faculty of Education in South Africa. He teaches at Nnamdi Azikiwe University in Awka, Anambra State, Nigeria, in the Department of Science Education. He is a member of the Teacher Registration Council of Nigeria (TRCN), the Science Teachers Association of Nigeria (STAN), and the International Forum of Researchers and Lecturers (IFRL). He has participated in both national and international conferences. His research interests include understanding the psychological aspects of learning among science students, Gender issues in STEM, Pedagogical and technological innovations in STEM, and entrepreneurship in STEM.

Mohammed Idris is a lecturer in the Department of Biology Education, Alvan Ikoku Federal University of Education Owerri, Imo State, Nigeria. He obtained his master's in Science Education from University of Ilorin, Nigeria. He is a seasoned scholar who has contributed in many journals. Mr Mohammed to his credit, has attended a deluge of conferences where he has presented papers. He is a member of many learned societies such as Teachers Registration Council of Nigeria, (TRCN) and Science Teacher Association of Nigeria (STAN).

Abel Idoko Onoja is the current Head of Department of Basic Science, Alvan Ikoku Federal University of Education Owerri, Imo State, Nigeria. He is a Lion and obtained his higher degrees, Ph.D and Master's in Science Education Biology from Benue State University, Makurdi, Nigeria. He is a renowned scholar who has contributed over 40 journal articles to different academic body. Abel Idoko Onoja to his credit, has attended several conferences and workshops where he presented scholarly articles in science education and general science. He has authored many books and contributed many book chapters in edited books and book of readings. He is a licenced teacher and member of many learned societies such as Teachers Registration Council of Nigeria (TRCN), Science Teachers Association of Nigeria (STAN), Curriculum Organization of Nigeria (CON), World Council for Curriculum and Instruction (WCCI), Gender Studies Association of Nigeria (GSAN) and Educational Assessment and Research Network in Africa (EARNIA). As a staunch member of Alvana Volunteer Services, he has facilitated in many community service outreach to enhance the usage of 21st Century Instructional Strategies by Primary and secondary school teachers. Dr Abel Idoko Onoja is a research consultant and member of various Editorial Board such as Alvana Journal of General Studies (AJOGS) and Wukari Journal of Educational studies. The author has a keen interest in the development of science process skills in learner to facilitate the acquisition of knowledge which guarantees academic freedom.

JohnBosco Onyekachukwu Okekeokosisi (MSTAN) is a lecturer in the Department of Computer Science Education, School of Secondary Education (Science), Federal College of Education (Technical) Asaba, Delta State, Nigeria. He obtained his PhD in Computer Science Education from Nnamdi Azikiwe University, Awka, Anambra State, Nigeria. He is a seasoned scholar who has co-authored numerous textbooks, contributed in many book chapters and journals. He is a member of editorial board of many local and international Journals. Dr Okekeokosisi, to his credit, has attended a deluge of conferences where he has presented papers. He is a member of many learned societies such as Teachers Registration Council of Nigeria, Science Teachers Association of Nigeria (STAN) and Association of Science Educators Anambra (ASEA). He is the Vice-Chairman, Science Teachers Association of Nigeria (STAN), Anambra State Chapter.

MaryAnn Chigozie Ofordum is a lecturer in the department of Physical and Health Education in Federal College of Education (Technical), Umunze. Dr. M.C. Ofordum obtained her Ph.D. in Public Health Education from Enugu State University of Science and Technology, Enugu (ESUT) in the year 2021. She has attended many conferences and presented many papers. She has twenty -three journal publications with reputable bodies and has one published textbook. Dr. M.C. Ofordum is a member of many professional bodies such as Teachers Registration Council of Nigeria (TRCN), Science Teachers Association of Nigeria (MSTAN), Nigeria Association for Health Educators (NAHE), Science Educators of Nigeria (MSEAN), Women in Colleges of Education (MWICE) among others.

Odunayo Abigael Bamisebi is a chemistry educator at Sharpstown High School, Houston Independent School District, Houston , Texas, United States. She obtained her Bachelor's degree in Chemistry Education in 2014 and her Master’s degree in Chemistry Education in 2018, both from the University of Lagos, Akoka, Yaba, Nigeria. She is a seasoned teacher and educational leader with years of experience across both Nigeria and the United States. She has taught Chemistry, Biology, mathematics, and Integrated Science at the secondary and college levels, and served as a part-time lecturer in Science Education at Awori District College of Education, Ota Campus. Odunayo has made significant contributions to science education. She also served as the STAN COVID-19 Education Project Coordinator, leading a groundbreaking remote learning initiative that impacted over 5,000 students during the pandemic. She has presented papers at conferences and served as a keynote speaker at educational forums. Her interests include inquiry-based learning, blended learning, STEM education, and teacher training. She is a member of several professional bodies, including the Science Teachers Association of Nigeria (STAN), and

has been nominated for the prestigious STAN Fellowship, Teachers Registration Council of Nigeria (TRCN), ROYAL FELLOW member of the International Organization for Academic and Scientific Development (IOASD), member of National Science Teaching Association (NSTA), member National Education Association Texas, member Texas State Teacher Association (TSTA). She is also a passionate advocate for teen empowerment, career development, and spiritual growth among youths.

Nkiru Naomi C. Samuel, a Fellow of Science Teachers Association of Nigeria (Fstan) and a distinguished educator in Chemistry Education, in the Department of Science Education at Nnamdi Azikiwe University, Awka. She has dedicated her life to the pursuit of knowledge and the advancement of science education. She is renowned for her dedication and contribution to education and the broader educational community. Dr. Nkiru Naomi C. Samuel's contributions extend beyond the classroom; she has published numerous journal articles, contributed in several book chapters and delivered many commissioned papers in workshops, seminars cum in-service trainings for secondary school teachers and has attended several professional conferences, shared her insights and expanded her influence in science education both within Nigeria and internationally. Known for her warm personality and commitment to academic excellence, she remains an inspiration to her students and colleagues alike. She is a member of many learned societies such as Teachers Registration Council of Nigeria (TRCN), Science Teachers Association of Nigeria (STAN), Royal Society of Chemistry (RSC), Women in Chemistry (WIC). She is the current Secretary of Science Teachers Association of Nigeria (STAN), Anambra State Chapter.

Melody Otimize Obili is a multifaceted individual currently pursuing a PhD in Science Education with a research focus in Integrated Science at Chukwuemeka Odumegwu Ojukwu University, Igbariam, Anambra State, Nigeria. Beyond her academic pursuit, Melody has a diverse range of skills. She has attended several conferences and contributed to journals. Melody, is currently the secretary of Police Officers' Wives' Association, a member of Teachers Registration Council of Nigeria (TRCN), Science Teachers Association of Nigeria (STAN) and Association of Science Educators Anambra (ASEA).

Prof. Nneka Rita Nnorom is a professor of science education at Chukwuemeka Odumegu Ojukwu University, Igbarim, Anambra State. She was one time Head of department and dean of faculty. She has over 50 publications and members of various educational bodies.

Anyachor Charles N. is a lecturer in the Department of Agricultural Education, School of Agricultural and Home economics Education, Federal College of Education (Technical), Umunze, Anambra State, Nigeria. He obtained his master's degree (M.Sc) in Agricultural Economics from Imo State University (IMSU) Owerri and presently running his doctoral degree (P.h.D) Programme from the same University. He is a seasoned scholar who has co-authored numerous textbooks, contributed in many book chapters and journals. He has also attended and presented papers in a deluge of local and international conferences. Anyachor, C.N is a member of so many professional bodies such as Teachers Registration Council of Nigeria (TRCN) and Science Teachers Association of Nigeria (STAN) Anambra State chapter.

DEDICATION

This book is dedicated to educators in the world

CHAPTER 3

EFFECT OF FRAMING INSTRUCTIONAL STRATEGY ON STUDENTS' MOTIVATION AND ACADEMIC ACHIEVEMENT IN MATHEMATICS IN ORON LOCAL GOVERNMENT AREA OF AKWA IBOM STATE, NIGERIA

Ekpenyong Effiong Ibok
Idaka Etta Idaka
Iwuala Patricia Ebere Chilebe

Abstract
This study adopted pretest –post-test control quasi experimental design to examine the effect of framing instructional method on SS2 students' motivation and academic achievement in Mathematics in Oron Local Government Area of Akwa Ibom State, Nigeria. Two research questions was posed which was converted into two null hypotheses. Simple random sampling technique was used to select a sample of 121 students for the study. The instruments used for data collection were Mathematics Motivation Scale (MMS) and Mathematics Achievement Test (MAT).. These were developed by the researcher and validated by experts and was used for data collection. The reliability coefficient obtained for MAT using Kuder-Richardson formula 20 (KR–20) was .87 while that of MMA was established using Chrobach Alpha gives reliability index of .89. The research questions were answer using mean and the hypotheses were tested using One Way Analysis of Covariance were used to test the two hypotheses at .05 level of significance. The findings of the study revealed that there is a significant difference between the mean Mathematics motivation and achievement score of SS2 students who were taught using framing instructional strategy and those taught with lecture method. It therefore concluded that the motivation and achievement students in Mathematics depend on effective use of framing instructional strategy in teaching. It was therefore recommended amongst other that framing instructional method should be adopted in teaching students in secondary schools in order to enhance their motivation and academic achievement in Mathematics.

Keywords: Framing **i**nstructional strategy, Students motivation, Academic achievement

Introduction

Mathematics is a crucial discipline that influences various aspects of life, education, and career opportunities. Its importance extends beyond academic contexts, impacting critical thinking, technological advancement, and informed decision-making in both personal and societal realms. Mathematics is a systematic field of study that deals with numbers, quantities, shapes, structures, and patterns. It encompasses various branches, including arithmetic, algebra, geometry, calculus, and statistics, among others. It is not only a tool for solving problems but also a language that describes relationships and changes in the physical and abstract worlds (Ibok, Unoh & Asuquo, 2024). It provides the tools for modeling scientific phenomena and analyzing data. In the age of technology, mathematics is fundamental in computer science, data analysis, artificial intelligence, and cryptography. It underpins algorithms and computational methods that drive innovation (Smith & Johnson, 2018). Despite the high position offered to Mathematics in Nigerian education system, it is disheartening that approaches and strategies for teaching and learning of this subject at secondary are not probably being put to use effectively to promote learners' activity and provide learners' guided practice enabling them to retain concepts taught and solve problems. The lecture methods have been a longstanding approach in mathematics education, several challenges hinder their effectiveness in promoting deep learning, motivation and retention. The traditional lectures often result in passive learning, where students are merely recipients of information rather than

active participants. This passivity can lead to lower engagement, motivation and retention rates which resulted to poor achievement in schools (Patel, & Roberts, 2021).

The persistent poor performance and motivation of students in learning Mathematics is a major source of concern for educators and parents. In Nigeria The National Examination Council (NECO) reported that only about 35% of students passed mathematics in the Senior Secondary School Certificate Examination (SSCE) in recent years (NECO, 2022).This poor Mathematics achievement and motivation in learning Mathematics concepts may seriously jeopardize the aim and objectives of the government on the education for secondary students provided for the interest of the nation's economic and technological development. This might been the reason for shortages of manpower in Mathematics, science- and technology-related disciplines since the knowledge of Mathematics is at the heart of all these **(**Ogar, Ibok & Williams, 2024).

The need for improved achievement in Mathematics and motivation in learning has driven teachers and researchers to seek appropriate teaching strategies. Framing instructional teaching strategy is ones the approach that will allow students to control their learning process as well as developthe required interest, motivation and improve their achievement in Mathematics (Ekpenyong, Ogar, Obogo, & Unoh, 2024). Framing instructional strategy refers to the structured approach educators or teachers use to present and organize learning experiences, guiding students in how to interpret and engage with mathematical content. This strategy encompasses various techniques, including setting clear learning goals, providing context for mathematical concepts, and utilizing specific pedagogical methods to enhance student understanding (Garcia & Chen, 2020). By framing instruction effectively, educators can create a supportive learning environment that fosters deeper engagement, motivation and comprehension of mathematical principles. A well-framed instruction can enhance students' understanding of mathematical concepts, leading to improved performance and motivation to learn(Lee, Thomas, & Chen, 2021).

Mathematics achievement refers to students' performance and proficiency in mathematical concepts and skills. Studies have shown that various instructional strategies can positively impact student outcomes. Smith and Johnson (2018) investigated the effects of problem-based learning (PBL) on high school students' mathematics achievement and found that students engaged in framing instructional strategy scored significantly higher on standardized tests compared to those in traditional instruction settings, suggesting that framing instructional strategy fosters deeper understanding and retention of mathematical concepts. Lee, Thomas, and Chen, (2020) found that students who participated in structured collaborative activities framing instructional strategy showed improved problem-solving skills and higher overall achievement in mathematics compared to those who learned individually. Garcia, and Chen (2021) examined the effects of differentiated instruction on student achievement in mathematics. The findings indicated that students receiving differentiated instruction in framing instructional strategy demonstrated higher levels of engagement and improved test scores compared to their peers in non-differentiated classrooms. Patel and Roberts, (2022) assessed the effectiveness of integrating technology into mathematics instruction. Results showed that the use of framing instructional strategy led to significant improvements in student achievement, highlighting the importance of technology in modern mathematics education. Thompson, (2023) research focused on the impact of growth mindset interventions on mathematics achievement. The study found that students who participated in mindset training using framing instructional strategy showed increased resilience and improved performance in mathematics assessments, indicating that fostering a growth mindset can positively affect achievement. These empirical studies underscore the significance of framing effective instructional strategies to enhance mathematics achievement among secondary school students.

Motivation plays a critical role in students' willingness to engage with mathematics. Intrinsic motivation, which stems from a genuine interest in the subject, and extrinsic motivation, driven by external rewards, both influence how students approach learning. Research highlights that instructional strategies that promote a positive learning environment and encourage student autonomy can enhance motivation levels. Freeman, Eddy, McDonough, Smith, Okoroafor, Wenderoth & Dirks (2017) conducted a meta-analysis examined the effectiveness of active learning strategies on student motivation in STEM fields, including mathematics. The results indicated that active learning or framing instructional strategy significantly increased student motivation and engagement compared to traditional lecture-based approaches. Johnson and Johnson (2019) study explored the effects of cooperative learning on student motivation in mathematics. The findings showed that students who participated in cooperative learning environments using framing instructional strategy reported higher levels of motivation and satisfaction with their learning experiences. Tomlinson and Imbeau (2017) investigated the impact of differentiated instruction on student motivation in mathematics. The study found that framing instructional strategy was tailored to meet individual student needs, motivation levels increased significantly, leading to better engagement and achievement. Paunesku, Walton, Romero, Smith, & Dweck (2019) conducted a study to assessed the effects of growth mindset interventions on student motivation in mathematics. Results indicated that students who received mindset training through framing instructional strategy exhibited higher motivation levels and a greater willingness to tackle challenging mathematical problems. Hwang, and Chang (2020) research explored the impact of technology-enhanced learning environments on student motivation in mathematics. Findings revealed that the use of digital tools and interactive platforms with framing instructional strategy significantly boosted student motivation and engagement compared to traditional methods. These empirical studies highlight the importance of framing instructional strategies that effectively enhance mathematics motivation among secondary school students. Motivation is a critical factor influencing students' performance in mathematics. Motivated of students are more likely to engage in learning activities, persist in the face of challenges, and achieve higher academic outcomes.

The global and Nigerian contexts reveal a pressing need to address the challenges of mathematics achievement and motivation among secondary school students. By framing effective instructional strategies that engage students and foster a positive attitude towards mathematics, educators can significantly enhance learning outcomes. Framing effective instructional strategies is essential for enhancing mathematics achievement and motivation among secondary school students. Ongoing research continues to shed light on the best practices that educators can implement to foster a positive learning environment, ultimately leading to improved outcomes in mathematics education. Framing Instructional strategies encompass the methods and techniques educators use to facilitate learning. It can help demystify mathematical concepts, making them more accessible and engaging for students. Well-framed instructional strategies can lead to improved mathematical understanding and higher achievement levels.

Statement of the Problem

Mathematics education plays a pivotal role in shaping students' academic trajectories and future career opportunities. However, globally, there is a persistent challenge in improving mathematics achievement and motivation among secondary school students. This issue is particularly pronounced in Nigeria, where educational disparities and socio-economic factors further complicate the learning environment. The effective teaching of mathematics in secondary schools is essential for fostering student achievement and motivation. However, many students report a lack of interest and motivation in mathematics, which can be attributed to traditional teaching methods that fail to connect with students' interests and real-world applications. Many educators lack adequate training in contemporary instructional strategies tailored for mathematics. Insufficient professional development leads to ineffective teaching methods, ultimately impacting student achievement and motivation. Even when effective strategies are identified, their

implementation often varies significantly among teachers. Inconsistent application of collaborative learning techniques resulted in varied student outcomes, indicating a need for more structured frameworks. Traditional instructional methods often fail to engage students effectively. Many secondary school students experience disengagement in mathematics classes, which directly correlates with lower motivation and achievement levels. The traditional lecture method do not allow the students to be fully engage with learning process, limiting their achievement potential.

Purpose of the Study

The main purpose of the study was to examine the effect of framing instructional strategy on SS 2 students' motivation and academic achievement in Mathematics in Oron Local Government Area of Akwa Ibom State, Nigeria. Specifically, the study seek to examine:

1. Whether the exists differences in mean mathematics motivation score of students who were taught using the framing instructional strategy and those taught using lecture method
2. Whether the exists differences in mean mathematics achievement score of students who were taught using the framing instructional strategy and those taught using lecture method

Research Questions

The following questions were posed to guide the study;

1. What difference exists in the mean mathematics motivation score of students who were taught using the framing instructional strategy and those taught using lecture method?
2. What difference exists in the mean mathematics achievement score of students who were taught using the framing instructional strategy and those taught using lecture method?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance;

1. There is no significant difference between the mean Mathematics motivation scores of students who were taught using framing instructional strategy and those taught with lecture method
2. There is no significant difference between the mean Mathematics achievement scores of students who were taught using framing instructional strategy and those taught with lecture method

Methodology

Research Design

The research design adopted was pretest – posttest control group quasi-experimental design. Two intact classes were assigned to the Control group (C) and the Experimental group (E) each.

Sample and Sampling Procedure

The population for the study consisted of all the 879 (478 females and 401 males) SS2 students in 4 approved public secondary schools in Oron Local Government Area of Akwa Ibom State, Nigeria. The researchers using all the four (4) schools in the study areas. From each of the four schools, the researchers adopted the hat and draw method of sampling where all the classes or arm of SS2 in each schools were written on a piece of paper, squeezed and shuffled in a hat. The researcher closed his eyes and picked any one school in each school from the hat without replacement. SS2A was picked for the first schools out five arms of classes, SS2 B was picked for the second school out three arms of classes, SS2 C was picked for third school out three arms of classes, and SS2 B was picked for the third schools out four arms of SS2. Two schools were used for the experimental group while the other two

groups was used for the control group. All the students in intact classes of the four selected schools were used for the study which gives a total sample of 121 students representing 13.8% of the entire population (62 was used for experimental group while 59 used for control group).

Instrumentation

The instruments used for data collection was Mathematics Motivation Scale(MMS) used as Pre-Test (PREMMS), Post-test (POSTMMS) and Mathematics achievement Test (MAT), used as Pre-Test (PREMAT). Post-test (POSTMAT) were developed and used to determine achievement and motivation respectively after treatment.

Mathematics Motivation Scale(MMS) consisted of 15 items developed by the researcher to know the level of motivation of students in learning Mathematics concepts before and after treatment. The MMS was developed based on four points Likert scale and their corresponding score are shown below strongly agreed (4-pionts), agreed (3-poibts), disagreed –(2points) and strongly disagreed (1-piont) while the MAT was drawn based on the table of specification which covers six(6) specific domains including remembering, understanding, Knowledge, comprehension, Applying, analyzing, evaluation and creating. The Mathematics Achievement Test (MAT) was developed by the researcher based on SS2 Mathematics school syllabus for 2023/2024 academic session. The purpose of the Mathematics Achievement Test is to find out the extent to which the students grasp the fundamental concepts in sequence and bearing . A 40 multiple-choice questions with each item had five options A, B, C,D, E with only one correct answer was used. Each students were asked to give the correct answer to the questions with the help of research assistants and the students were expected to answer all the questions . Each correct answers scored 1 mark given a total of 40 marks while each wrong answer scored 0-mark.

Mathematics Motivation scale (MMS) and Mathematics Achievement Test (MAT) were subjected to face and content validity. In order to ensure the reliability of the instrument (MMS) and (MAT), a pilot study was done using 30 SS2 students who were not part of the population for study. The reliability coefficient obtained for MAT using Kuder-Richardson formula 20 (KR–20) was 0.87 while that of MMA was established using Chrobach Alpha which gives reliability index of 0.89.

Administration of the Instrument

The research assistants who were the Mathematics teachers in the sampled schools were trained by the researcher on how the teaching was to be carried out. Both pretest PREMAT and pre test PREMMS. Were administered to subjects in both groups (experiment group and control group) to determine their academic achievement and motivation in Mathematics. The control group was taught Mathematics tasks for four weeks using only the conventional method and the experimental group was taught Mathematics tasks for four weeks with framing instructional strategy. At the end of the four weeks, the POSTMAT and POSTMMA were administered to all the same subjects. The researcher with the help of research assistants administered research instruments (PREMAT, POSTMAT, PREMMA and POSTMMA) to the subjects. The total scores were computed and used for data analysis. The research question was answer using descriptive statistics while research hypotheses were tested using analysis using Analysis of Covariance(ANCOVA) at .0 level of significance.

Results

Research Question 1: What difference exists in the mean mathematics motivation score of students who were taught using the framing instructional strategy and those taught using lecture method?

Table 1: : Mean of pre-test and post-test of Mathematics motivation scores of students who were taught using the framing method and those taught using lecture method (N=121)

Teaching method	N	Pre-test mean score	Post-test mean score	Mean gain score
Framing strategy	62	24.4677	52.3226	27.8549
Lecture method	59	23.1356	31.7119	8.5763

The results presented in Table 1 revealed that the mean gain score of mathematics motivation for SS2 students who are taught Mathematics tasks using framing instructional method (27.8549) was higher than the mean gain score of those who are taught with lecture method (8.5763). This implies that SS 2 students who were taught mathematics tasks using the framing instructional method were highly motivated than those taught using lecture teaching method.

Research Question 2: What difference exists in the mean mathematics achievement score of students who were taught using the framing instructional strategy and those taught using lecture method?

Table 2: Mean of pre-test and post-test of Mathematics achievement scores of students who were taught using the framing method and those taught using lecture method (N=121)

Teaching Methods	N	Pre-test mean score	Post-test mean score	Mean gain score
Framing strategy	62	17.3871	30.5484	13.1613
Lecture method	59	17.2881	25.0169	7.7288

In Table 2, it revealed that the mean gain score of Mathematics achievement for SS2 students who are taught Mathematics tasks using framing instructional method (13.1613) is higher than the mean gain score of those who are taught with lecture method (7.7288). This implies that SS2 students who were taught mathematics tasks using the framing instructional method performed better than those taught using lecture teaching method.

$H0_1$: There is no significant difference between the mean Mathematics motivation scores of students who were taught using framing instructional strategy and those taught with lecture method.

Table 3: One-way Analysis of Covariance (ANCOVA) on the mean Mathematics motivation scores of SS2 students who were taught using the framing instructional strategy and those taught with lecture method (N=121)

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	12936.066[a]	2	6468.033	430.732	.000	.880
Intercept	703.139	1	703.139	46.825	.000	.284
Pre-test	93.716	1	93.716	6.241	.014	.050
Gender	10711.610	1	10711.610	713.328	.000	.858
Error	1771.934	118	15.016			
Total	230933.000	121				
Corrected Total	14708.000	120				

a. R Squared = .880 (Adjusted R Squared = .877)

The information in Table 3 shows that there is a significant difference between the mean Mathematics motivation scores of SS 2 students who were taught using framing instructional strategy and those taught using lecture method (F=713.328, p=.000). Therefore, the null hypothesis was rejected and the alternative hypothesis was accepted. The result also shows the partial Eta squared estimate which is a measure of effect size as .858. This implies that treatment accounted for 85.8 percent of high variance observed in the post-test scores of the framing instructional strategy influence SS 2 student academic motivation in mathematics**.** The R value of .938 which shows that there is a positive high relationship between the variables of the study which resulted to R squared value of .880 and adjusted R square

of .877. This implied that about 87.7 percent shows the high variation in the dependent variable (students' academic motivation) which can be accounted for by pre-test.

$H0_2$: There is no significant difference between the mean Mathematics achievement scores of students who were taught using framing instructional strategy and those taught with lecture method.

Table 4: One-way Analysis of Covariance (ANCOVA) on the mean Mathematics achievement scores of SS2 students who were taught using the framing instructional strategy and those taught with lecture method(N=121)

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	951.148[a]	2	475.574	152.422	.000	.721
Intercept	440.291	1	440.291	141.113	.000	.545
Pre-test	26.163	1	26.163	8.385	.005	.066
Treatment	913.635	1	913.635	292.820	.000	.713
Error	368.174	118	3.120			
Total	95178.000	121				
Corrected Total	1319.322	120				

a. R Squared = .721 (Adjusted R Squared = .716)

Table 4 points that there is a significant difference between the mean Mathematics achievement scores of SS 2 students who were taught using framing instructional strategy and those taught using lecture method (F=292.820, p=.000). Therefore, the null hypothesis was rejected and the alternative hypothesis was accepted. The result also shows the partial Eta squared estimate which is a measure **of** effect size as .713. This implies that treatment accounted for 71.3 percent of high variance observed in the post-test scores of the framing instructional strategy influence SS 2 student academic achievement in mathematics**.** The R value of .849 which shows that there is a positive high relationship between the variables of the study which resulted to R squared value of .721 and adjusted R square of .716. This implied that about 71.6 percent shows the high variation in the dependent variable (students' academic achievement) which can be accounted for by pre-test.

Discussion

The result of the first hypothesis shows that there is a significant difference between the mean Mathematics motivation scores of students who were taught using framing instructional strategy and those taught with lecture method The finding agreed with Freeman, Eddy, McDonough, Smith, Okoroafor, Wenderoth and Dirks (2017) who found that framing instructional strategy significantly increased student motivation and engagement compared to traditional lecture-based approaches. The finding aligned with the finding of Johnson, and Johnson (2019) who that students who participated in cooperative learning environments using framing instructional strategy reported higher levels of motivation and satisfaction with their learning experiences. In agreement to this finding, Tomlinson and Imbeau (2017) found that framing instructional strategy was tailored to meet individual student needs, motivation levels increased significantly, leading to better engagement and achievement. The finding agreed with Paunesku, et al. (2019) who that students who received mindset training through framing instructional strategy exhibited higher motivation levels and a greater willingness to tackle challenging mathematical problems. In agreement to this finding, Hwang, and Chang (2020) found the use of digital tools and interactive platforms with framing instructional strategy significantly boosted student motivation and engagement compared to traditional methods.

The result of hypothesis two revealed that there is a significant difference between the mean Mathematics achievement scores of students who were taught using framing instructional strategy and those taught with lecture method**.** The findings agreed with Smith and Johnson (2018) who found that students engaged in framing instructional strategy scored significantly higher on standardized tests compared to those in traditional instruction settings, suggesting that

framing instructional strategy fosters deeper understanding and retention of mathematical concepts. In line with above finding Lee, Thomas, and Chen, (2020) found that students who participated in structured collaborative activities framing instructional strategy showed improved problem-solving skills and higher overall achievement in mathematics compared to those who learned individually. In agreement to this work Garcia, and Chen (2021) found that students receiving differentiated instruction in framing instructional strategy demonstrated higher levels of engagement and improved test scores compared to their peers in non-differentiated classrooms. The finding is in agreement with Patel, and Roberts, (2022) who found that the use of framing instructional strategy led to significant improvements in student achievement. In consonance with this finding Thompson (2023) found that students who participated in mindset training using framing instructional strategy showed increased resilience and improved performance in mathematics assessments, indicating that fostering a growth mindset can positively affect achievement.

Conclusion

The framing of instructional strategies plays a critical role in influencing students' mathematics motivation and achievement. Empirical evidence has consistently shown that well-designed framing instructional approaches in form of active learning, collaborative techniques, differentiated instruction, and the integration of technology can significantly enhance both student motivation and performance in mathematics. As educational environments continue to evolve, it is essential to prioritize framing instructional strategies that not only aim for academic success but also cultivate a positive attitude toward learning mathematics.

Recommendations

Based on the findings of the study, the following recommendation were made;

1. Educators should be encourage to implement framing instructional strategy in order to foster deeper understanding, motivation and engagement in mathematics.
2. Educators should be given opportunities to apply framing instructional strategy to enhance motivation and create a supportive learning community.
3. Teachers should be provide professional development opportunities for teachers to learn about effective instructional strategies and how to implement them in their classrooms. This can empower educators to adopt innovative practices that positively impact student outcomes in terms of maintain high levels of motivation and achievement across diverse student populations.
4. Curriculum planning should incorporate framing instructional strategy into the curriculum to help students develop resilience and a positive attitude toward challenges. Educators should emphasize the value of effort and persistence in achieving mathematical success.

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