



# Evaluating the No Zero Grading Technique (NZGT) as a Veritable Tool for Enhancing Students' Interest and Achievement in Mathematics in an Ubuntulised Classroom

Terungwa James Age<sup>1</sup>  & Masilo France Machaba<sup>1</sup> 

<sup>1</sup> Department of Mathematics Education, University of South Africa, Pretoria South Africa.

## ABSTRACT

The persistent challenge of student interest and achievement in mathematics has led educators to explore innovative teaching and assessment approaches. This experimental study investigated the impact of integrating the No Zero Grading Technique (NZGT) within an Ubuntu classroom environment on students' interest and achievement in mathematics. The study employed a quasi-experimental, control group pretest-posttest design involving 165 Upper Basic II students from two public secondary schools in Benue State, Nigeria. The Mathematics Interest Questionnaire (MIQ) and Mathematics Achievement Test (MAT) were used to collect data. The experimental group received the NZGT intervention within an Ubuntu classroom setting for 12 weeks, while the control group maintained traditional grading practices in a similar Ubuntu environment. Analysis of Covariance (ANCOVA) revealed significant differences in both interest levels ( $F = 14.953$ ,  $p < .05$ , partial  $\eta^2 = .085$ ) and achievement scores ( $F = 16.162$ ,  $p < .05$ , partial  $\eta^2 = .091$ ) favoring the experimental group. These findings suggest that the integration of NZGT within an Ubuntu classroom can significantly enhance both student interest and achievement in mathematics. The study contributes to the growing body of literature on alternative assessment practices and culturally responsive pedagogies in mathematics education, offering promising strategies for improving mathematics instruction and addressing longstanding challenges in the field.

**Correspondence**  
Terungwa James Age  
Email:  
[agetj@unisa.ac.za](mailto:agetj@unisa.ac.za)

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## INTRODUCTION

Mathematics education has long been a subject of intense scrutiny and research, given its fundamental role in scientific and technological advancement, as well as its importance in developing critical thinking skills. Despite its significance, many students continue to struggle with mathematics, often developing negative attitudes towards the subject that persist throughout their academic careers and beyond.<sup>1</sup> This persistent challenge has led educators and researchers to explore innovative teaching methodologies and assessment techniques that can enhance both student interest and achievement in mathematics. The need for such innovations is particularly acute in light of the global emphasis on STEM education and the

<sup>1</sup> Rosetta Zan and Pietro Di Martino, "Attitude toward Mathematics: Overcoming the Positive/Negative Dichotomy," *The Montana Mathematics Enthusiast* 3, no. 1 (2007): 157–68; John Mighton, *The Myth of Ability: Nurturing Mathematical Talent in Every Child* (House of Anansi, 2003).

increasing demand for mathematically literate workers in various sectors of the economy.<sup>2</sup> In response to these challenges, this experimental study aims to investigate the efficacy of the No Zero Grading Technique (NZGT) within the context of an Ubuntu classroom as a means to enhance students' interest and achievement in mathematics.

One of the primary objectives of this experimental study is to determine the interest rating of students in mathematics exposed to NZGT in an Ubuntu classroom. Interest plays a crucial role in academic achievement, particularly in subjects perceived as challenging.<sup>3</sup> NZGT and Ubuntu principles may help foster greater interest in mathematics by creating a more supportive and less punitive learning environment. Research on interest development in mathematics provides some insights into how NZGT and Ubuntu approaches might be beneficial. For instance, the reduction of anxiety facilitated by NZGT's approach of providing multiple opportunities and reducing the stakes of individual assessments may help alleviate mathematics anxiety, which has been shown to start as early as first grade and is negatively related to mathematics achievement.<sup>4</sup> Additionally, NZGT aligns with a mastery goal orientation rather than a performance goal orientation, which research by Murayama et al. has shown to predict long-term growth in mathematics achievement.<sup>5</sup> The Ubuntu philosophy's emphasis on building strong, supportive relationships also aligns with research by Sakiz et al., which found that perceived teacher affective support was positively related to students' sense of belonging, academic enjoyment, and self-efficacy in mathematics.<sup>6</sup> Furthermore, the collaborative learning encouraged in an Ubuntu classroom has been shown to enhance interest in mathematics, with a meta-analysis by Slavin et al. finding that cooperative learning methods had positive effects on mathematics achievement and attitudes towards mathematics.<sup>7</sup>

The second objective of this experimental study is to ascertain the achievement scores of students in Mathematics exposed to NZGT in an Ubuntu classroom. While fostering interest is crucial, the ultimate goal is to improve student achievement in mathematics. The combination of NZGT and Ubuntu principles may contribute to enhanced achievement through several mechanisms supported by educational research. Firstly, by eliminating zeros and providing multiple opportunities for success, NZGT may encourage students to persist in the face of challenges. Persistence has been shown to be a key factor in mathematics achievement, with studies by Middleton and Spanias and Hannula demonstrating the importance of motivation and perseverance in mathematics learning.<sup>8</sup> Secondly, the supportive environment of an Ubuntu classroom, combined with the multiple chances provided by NZGT, may boost students' self-efficacy in mathematics. Self-efficacy has been consistently linked to mathematics performance, as evidenced by research from Pajares and Graham and more recent work by Schunk and Di Benedetto.<sup>9</sup> Thirdly, by allowing students to revise and improve their work, NZGT may promote a deeper understanding of mathematical concepts. This aligns with research showing that

<sup>2</sup> Lyn D. English, "STEM Education K-12: Perspectives on Integration," *International Journal of STEM Education* 3, no. 1 (December 1, 2016): 3, <https://doi.org/10.1186/s40594-016-0036-1>; Koeno Gravemeijer et al., "What Mathematics Education May Prepare Students for the Society of the Future?," *International Journal of Science and Mathematics Education* 15, no. S1 (May 8, 2017): 105–23, <https://doi.org/10.1007/s10763-017-9814-6>.

<sup>3</sup> Suzanne Hidi and K. Ann Renninger, "The Four-Phase Model of Interest Development," *Educational Psychologist* 41, no. 2 (June 2006): 111–27, [https://doi.org/10.1207/s15326985ep4102\\_4](https://doi.org/10.1207/s15326985ep4102_4); Allan Wigfield and Jenna Cambria, "Students' Achievement Values, Goal Orientations, and Interest: Definitions, Development, and Relations to Achievement Outcomes," *Developmental Review* 30, no. 1 (March 2010): 1–35, <https://doi.org/10.1016/j.dr.2009.12.001>.

<sup>4</sup> Gerardo Ramirez et al., "Math Anxiety, Working Memory, and Math Achievement in Early Elementary School," *Journal of Cognition and Development* 14, no. 2 (April 2013): 187–202, <https://doi.org/10.1080/15248372.2012.664593>; Rose K. Vukovic et al., "Mathematics Anxiety in Young Children: Concurrent and Longitudinal Associations with Mathematical Performance," *Contemporary Educational Psychology* 38, no. 1 (January 2013): 1–10, <https://doi.org/10.1016/j.cedpsych.2012.09.001>.

<sup>5</sup> Kou Murayama et al., "Predicting Long-Term Growth in Students' Mathematics Achievement: The Unique Contributions of Motivation and Cognitive Strategies," *Child Development* 84, no. 4 (July 20, 2013): 1475–90, <https://doi.org/10.1111/cdev.12036>.

<sup>6</sup> Gonul Sakiz, Stephen J. Pape, and Anita Woolfolk Hoy, "Does Perceived Teacher Affective Support Matter for Middle School Students in Mathematics Classrooms?," *Journal of School Psychology* 50, no. 2 (April 2012): 235–55, <https://doi.org/10.1016/j.jsp.2011.10.005>.

<sup>7</sup> Robert E. Slavin, Cynthia Lake, and Cynthia Groff, "Effective Programs in Middle and High School Mathematics: A Best-Evidence Synthesis," *Review of Educational Research* 79, no. 2 (June 10, 2009): 839–911, <https://doi.org/10.3102/0034654308330968>.

<sup>8</sup> James A. Middleton and Photini A. Spanias, "Motivation for Achievement in Mathematics: Findings, Generalizations, and Criticisms of the Research," *Journal for Research in Mathematics Education* 30, no. 1 (1999): 65–88; Markku S. Hannula, "Motivation in Mathematics: Goals Reflected in Emotions," *Educational Studies in Mathematics* 63, no. 2 (October 24, 2006): 165–78, <https://doi.org/10.1007/s10649-005-9019-8>.

<sup>9</sup> Frank Pajares and Laura Graham, "Self-Efficacy, Motivation Constructs, and Mathematics Performance of Entering Middle School Students," *Contemporary Educational Psychology* 24, no. 2 (April 1999): 124–39, <https://doi.org/10.1006/ceps.1998.0991>; Dale H. Schunk and Maria K. DiBenedetto, "Self-Efficacy Theory in Education," in *Handbook of Motivation at School* (Routledge, 2016), 34–54.

opportunities for revision and reflection can enhance learning outcomes.<sup>10</sup> Finally, the collaborative nature of an Ubuntu classroom may help mitigate the effects of socioeconomic disparities on mathematics achievement, an important consideration given the persistent achievement gaps in mathematics education.<sup>11</sup> Research has shown that collaborative learning can be particularly beneficial for disadvantaged students, suggesting that the Ubuntu approach could have equity-enhancing effects in mathematics education.<sup>12</sup>

While the combination of NZGT and Ubuntu principles in mathematics education shows promise, the researcher wishes to acknowledge that it was not without challenges, which this study considered. As noted by scholars, ensuring consistent implementation of both NZGT and Ubuntu principles across different classrooms and schools can be challenging, requiring careful attention to implementation fidelity.<sup>13</sup> Hence, ongoing support for teachers was crucial to the success of this approach. This experimental study investigated the potential of integrating the No Zero Grading Technique (NZGT) within an Ubuntu classroom to enhance both student interest and achievement in mathematics.

## Objectives

The study sought to achieve the following objectives:

1. Ascertain the level of interest in mathematics among students exposed to the No Zero Grading Technique (NZGT) in an Ubuntulised classroom.
2. Examine the achievement scores of students in mathematics after being exposed to the NZGT in an Ubuntulised classroom environment.

## Hypotheses

1. There is no significant difference in the level of interest in mathematics among students after being exposed to the No Zero Grading Technique (NZGT) in an Ubuntu classroom.
2. There is no significant difference in the achievement scores of students in mathematics after being exposed to the No Zero Grading Technique (NZGT) in an Ubuntu classroom.

## LITERATURE REVIEW

### The No Zero Grading Technique

The No Zero Grading Technique represents a paradigm shift in assessment practices, challenging traditional notions of grading and student evaluation. This approach, which has roots in mastery learning theories, posits that assigning zeros for incomplete or unsatisfactory work can be detrimental to student motivation and learning outcomes.<sup>14</sup> Instead, NZGT advocates for a more refined and supportive grading system that encourages students to persist in their learning efforts. The core principle of NZGT is that students should always have the opportunity to demonstrate their understanding and improve their performance. Rather than receiving a zero for incomplete or unsatisfactory work, students are given additional chances to complete assignments or retake assessments. This approach is based on the understanding that learning is a process, and that progress, rather than perfection, should be the goal.<sup>15</sup>

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<sup>10</sup> John Hattie and Helen Timperley, "The Power of Feedback," *Review of Educational Research* 77, no. 1 (March 1, 2007): 81–112, <https://doi.org/10.3102/003465430298487>; Paul Black and Dylan Wiliam, "Developing the Theory of Formative Assessment,"

*Educational Assessment, Evaluation and Accountability* 21, no. 1 (February 23, 2009): 5–31, <https://doi.org/10.1007/s11092-008-9068-5>.

<sup>11</sup> Sarah Theule Lubienski, "A Closer Look at Black-White Mathematics Gaps: Intersections of Race and SES in NAEP Achievement and Instructional Practices Data," *Journal of Negro Education*, 2002, 269–87; Sean F Reardon, "The Widening Academic Achievement Gap between the Rich and the Poor," in *Social Stratification* (Routledge, 2018), 536–50.

<sup>12</sup> Slavin, Lake, and Groff, "Effective Programs in Middle and High School Mathematics: A Best-Evidence Synthesis"; Aki Murata et al., "Making Connections among Student Learning, Content, and Teaching: Teacher Talk Paths in Elementary Mathematics Lesson Study," *Journal for Research in Mathematics Education* 43, no. 5 (2012): 616–50.

<sup>13</sup> Joseph A. Durlak and Emily P. DuPre, "Implementation Matters: A Review of Research on the Influence of Implementation on Program Outcomes and the Factors Affecting Implementation," *American Journal of Community Psychology* 41, no. 3–4 (June 6, 2008): 327–50, <https://doi.org/10.1007/s10464-008-9165-0>; Carol L. O'Donnell, "Defining, Conceptualizing, and Measuring Fidelity of Implementation and Its Relationship to Outcomes in K–12 Curriculum Intervention Research," *Review of Educational Research* 78, no. 1 (March 1, 2008): 33–84, <https://doi.org/10.3102/0034654307313793>.

<sup>14</sup> Thomas R. Guskey, "Zero Alternatives," *Principal Leadership* 5, no. 2 (2004): 49–53; Ken O'Connor, *How to Grade for Learning, K-12* (Corwin Press, 2009).

<sup>15</sup> M. Dueck, *Grading Smarter, Not Harder: Assessment Strategies That Motivate Kids and Help Them Learn* (Alexandria, Virginia: ASCD, 2014); Rick Wormeli, *Fair Isn't Always Equal: Assessment & Grading in the Differentiated Classroom* (Routledge, 2023).

Several studies have explored the impact of no-zero policies on student outcomes across various subjects. For instance, Balingit and St. George reported on a school district in Virginia that implemented a no-zero policy and observed improvements in student engagement and completion rates.<sup>16</sup> Similarly, in a study by Kpum et al., students exposed to the No Zero Grading technique demonstrated significantly higher achievement, self-efficacy, and more positive attitudes compared to those subjected to the traditional Zero Grading system.<sup>17</sup> Also, a study by Carey and Carifio found that minimum grading practices, which are closely related to NZGT, led to increased student motivation and reduced failure rates in high school courses.<sup>18</sup> While such policies have faced some controversy, proponents argue that they align more closely with the true purpose of education: to promote learning and growth rather than simply to sort and rank students.<sup>19</sup>

### The Ubuntu Philosophy

The Ubuntu philosophy, encapsulated in the Zulu phrase "Umuntu ngumuntu ngabantu" (A person is a person through other persons), emphasizes the interconnectedness of human existence and has gained increasing attention in educational contexts.<sup>20</sup> When applied to education, this philosophy promotes a classroom environment characterized by mutual respect, collaboration, and shared responsibility for learning outcomes. In an Ubuntu classroom, the focus shifts from individual competition to collective progress, aligning well with contemporary constructivist approaches to education, which emphasize the social nature of learning.<sup>21</sup> The Ubuntu approach in education has been shown to foster a sense of belonging and community among students, which can be particularly beneficial in subjects that are often perceived as challenging, such as mathematics.<sup>22</sup> Embedding Ubuntu into the classroom allows educators to create learning environments that are equitable, just, and culturally resonant for African students.<sup>23</sup> This integration is anticipated to foster greater engagement, understanding, and overall achievement in mathematics.<sup>24</sup> Age asserts that the integration of Ubuntu principles into mathematics education represents a significant step towards enhancing mathematics learning.<sup>25</sup> Msila conducted a study on the implementation of Ubuntu principles in South African schools and found that it led to improved discipline, increased learner participation, and enhanced overall school performance.<sup>26</sup> While this study was not specific to mathematics education, its findings suggest that the Ubuntu approach can create a more conducive learning environment across various subjects. Furthermore, research by Nafukho and

<sup>16</sup> Moriah Balingit and D St George, "Is It Becoming Too Hard to Fail? Schools Are Shifting toward No-Zero Grading Policies," *The Washington Post*, 2016.

<sup>17</sup> Kpum Moses Mhide et al., "Effect of No-Zero Grading Policy on Achievement, Self-Efficacy and Attitude towards Physics in Secondary Schools in Benue North-East Senatorial District, Benue State," *International Journal of Research and Innovation in Social Science* VII, no. X (2023): 1306–18, <https://doi.org/10.47772/IJRIS.2023.701101>.

<sup>18</sup> Theodore Carey and James Carifio, "The Minimum Grading Controversy," *Educational Researcher* 41, no. 6 (August 1, 2012): 201–8, <https://doi.org/10.3102/0013189X12453309>.

<sup>19</sup> Douglas B. Reeves, "The Case against the Zero," *Phi Delta Kappan* 86, no. 4 (December 1, 2004): 324–25, <https://doi.org/10.1177/003172170408600418>; Melissa Roderick and Eric Camburn, "Risk and Recovery from Course Failure in the Early Years of High School," *American Educational Research Journal* 36, no. 2 (1999): 303–43.

<sup>20</sup> D. Tutu, *No Future without Forgiveness* (New York: Doubleday, 2009); Moeketsi Letseka, "In Defence of Ubuntu," *Studies in Philosophy and Education* 31, no. 1 (January 6, 2012): 47–60, <https://doi.org/10.1007/s11217-011-9267-2>.

<sup>21</sup> L. S. Vygotsky, *Mind in Society: The Development of Higher Psychological Processes* (Harvard University Press, 1978); Jean Lave and Etienne Wenger, *Situated Learning* (Cambridge University Press, 1991), <https://doi.org/10.1017/CBO9780511815355>.

<sup>22</sup> Letseka, "In Defence of Ubuntu"; Yusef Waghid and Paul Smeyers, "Reconsidering Ubuntu: On the Educational Potential of a Particular Ethic of Care," *Educational Philosophy and Theory* 44 (2012): 6–20.

<sup>23</sup> Catherine A. Buell and Bonnie Shulman, "An Introduction to Mathematics for Social Justice," *PRIMUS* 29, no. 3–4 (April 21, 2019): 205–9, <https://doi.org/10.1080/10511970.2018.1530707>; Özkan Ergene, Caylan Büşra Ergene, and Esin Yazıcı, "Ethnomathematics Activities: Reflections from the Design and Implementation Process," *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, August 27, 2020, <https://doi.org/10.16949/turkbilmat.688780>; Medlyn Claudyasuka Patari et al., "Etnomathematics Exploration In The Culture System Of Malay Culture In Naga Mahap Village," *Daya Matematis: Jurnal Inovasi Pendidikan Matematika* 10, no. 2 (June 14, 2022): 83, <https://doi.org/10.26858/jdm.v10i2.34218>.

<sup>24</sup> Irfan Fauzi, Rohma Mauhibah, and Al Jupri, "Learning Designs for the Addition and Subtraction of Two-Digit Numbers Based on Realistic Mathematics Education Principles Using Snakes and Ladders Game," *Al Ibtida: Jurnal Pendidikan Guru MI* 8, no. 1 (June 27, 2021): 32, <https://doi.org/10.24235/al.ibtida.snj.v8i1.7741>; Yetti Widiarti, Hanifah Hanifah, and Saleh Haji, "The Effect of Blended Learning Model with Realistic Mathematics Education (RME) Approach on Concept Understanding and Mathematics Problem Solving Ability of Students of Junior High School 11 Bengkulu City," 2023, 381–93, [https://doi.org/10.2991/978-2-38476-012-1\\_49](https://doi.org/10.2991/978-2-38476-012-1_49).

<sup>25</sup> Terungwa James Age, "Ubuntulisation of Mathematics Classroom for the Enhancement of Learner's Interest and Achievement," *Journal of Advanced Sciences and Mathematics Education* 4, no. 1 (June 4, 2024), <https://doi.org/10.58524/jasme.v4i1.367>.

<sup>26</sup> Vuyisile Msila, "Ubuntu and School Leadership," *Journal of Education* 44, no. 1 (2008): 67–84.

Broodryk has highlighted the potential of Ubuntu philosophy to promote inclusive education and foster a sense of communal responsibility for learning outcomes, which could be particularly beneficial in addressing the challenges faced in mathematics education.<sup>27</sup>

### The No Zero Grading Technique and the Ubuntu Philosophy

The combination of NZGT and Ubuntu philosophy in mathematics education presents a promising approach to addressing the challenges of student interest and achievement, forming the theoretical foundation for this experimental study. This synergy is based on several key principles that align with contemporary research in educational psychology and mathematics education. Firstly, both NZGT and Ubuntu philosophies prioritize the learning process over final outcomes, emphasizing growth and progress.<sup>28</sup> NZGT provides multiple opportunities for improvement, while Ubuntu emphasizes collective growth and support, potentially creating a more resilient and perseverant approach to mathematics learning. Secondly, by eliminating the threat of zeros and fostering a supportive community, this combined approach can help reduce math anxiety and create a more positive learning environment.<sup>29</sup> Research has shown that math anxiety can begin as early as first and second grade, potentially setting the stage for a lifelong aversion to the subject.<sup>30</sup> The supportive nature of both NZGT and Ubuntu principles may help mitigate these early negative experiences. Thirdly, Ubuntu's emphasis on interconnectedness aligns with NZGT's focus on providing support and multiple chances for success, encouraging peer tutoring and collaborative problem-solving in mathematics.<sup>31</sup> This collaborative aspect is particularly relevant in light of research showing the benefits of cooperative learning in mathematics education.<sup>32</sup> Finally, rather than relying solely on test scores, this approach considers a student's overall growth and effort, which is more in line with the Ubuntu view of the whole person and aligns with research on the importance of non-cognitive factors in academic success.<sup>33</sup>

While research specifically on NZGT in mathematics education is still emerging, several studies on related approaches provide insight into its potential effectiveness and inform the hypotheses of this experimental study. Standards-based grading, which shares similarities with NZGT in its focus on mastery of specific learning objectives rather than accumulation of points, has shown promising results in mathematics education. A study by Pollio and Hochbein found that implementing standards-based grading in mathematics classes led to improved student achievement, particularly for low-performing students.<sup>34</sup> Similarly, the principles of NZGT align closely with mastery learning approaches, which have been extensively studied in educational research. A meta-analysis by Kulik, Kulik, and Bangert-Drowns found that mastery learning programs have positive effects on student achievement across various

<sup>27</sup> Fredrick Muyia Nafukho, "Ubuntu Worldview: A Traditional African View of Adult Learning in the Workplace," *Advances in Developing Human Resources* 8, no. 3 (August 1, 2006): 408–15, <https://doi.org/10.1177/1523422306288434>; J. Broodryk, *Ubuntu: Life-Coping Skills from Africa* ( Knowres Publishing, 2006).

<sup>28</sup> C. S. Dweck, *Mindset: The New Psychology of Success* (Random House, 2006); David Scott Yeager and Carol S. Dweck, "Mindsets That Promote Resilience: When Students Believe That Personal Characteristics Can Be Developed," *Educational Psychologist* 47, no. 4 (October 2012): 302–14, <https://doi.org/10.1080/00461520.2012.722805>.

<sup>29</sup> Mark H. Ashcraft and Jeremy A. Krause, "Working Memory, Math Performance, and Math Anxiety," *Psychonomic Bulletin & Review* 14, no. 2 (April 2007): 243–48, <https://doi.org/10.3758/BF03194059>; Erin A. Maloney and Sian L. Beilock, "Math Anxiety: Who Has It, Why It Develops, and How to Guard against It," *Trends in Cognitive Sciences* 16, no. 8 (August 2012): 404–6, <https://doi.org/10.1016/j.tics.2012.06.008>.

<sup>30</sup> Ramirez et al., "Math Anxiety, Working Memory, and Math Achievement in Early Elementary School."

<sup>31</sup> David W. Johnson and Roger T. Johnson, "An Educational Psychology Success Story: Social Interdependence Theory and Cooperative Learning," *Educational Researcher* 38, no. 5 (June 1, 2009): 365–79, <https://doi.org/10.3102/0013189X09339057>; Slavin, Lake, and Groff, "Effective Programs in Middle and High School Mathematics: A Best-Evidence Synthesis."

<sup>32</sup> E. Zakaria, L. C. Chin, and M. Y. Daud, "The Effects of Cooperative Learning on Students' Mathematics Achievement and Attitude towards Mathematics," *Journal of Social Sciences* 6, no. 2 (February 1, 2010): 272–75, <https://doi.org/10.3844/jssp.2010.272.275>; Van Dat Tran, "The Effects of Cooperative Learning on the Academic Achievement and Knowledge Retention," *International Journal of Higher Education* 3, no. 2 (May 6, 2014), <https://doi.org/10.5430/ijhe.v3n2p131>.

<sup>33</sup> Angela L. Duckworth and Martin E.P. Seligman, "Self-Discipline Outdoes IQ in Predicting Academic Performance of Adolescents," *Psychological Science* 16, no. 12 (December 1, 2005): 939–44, <https://doi.org/10.1111/j.1467-9280.2005.01641.x>; Camille A Farrington et al., *Teaching Adolescents to Become Learners: The Role of Noncognitive Factors in Shaping School Performance--A Critical Literature Review*. (ERIC, 2012).

<sup>34</sup> Marty Pollio and Craig Hochbein, "The Association between Standards-Based Grading and Standardized Test Scores as an Element of a High School Reform Model," *Teachers College Record: The Voice of Scholarship in Education* 117, no. 11 (November 1, 2015): 1–28, <https://doi.org/10.1177/016146811511701106>.

subjects, including mathematics, with an average effect size of 0.52.<sup>35</sup> Research by Guskey and Pigott and Zimmerman and Dibenedetto has corroborated these findings, suggesting that mastery-oriented approaches can lead to significant improvements in mathematics achievement.<sup>36</sup> Furthermore, the philosophy behind NZGT is consistent with growth mindset theories, which have gained significant attention in educational psychology. A large-scale study by Yeager et al. demonstrated that brief growth mindset interventions can improve academic achievement among lower-achieving students, with particularly strong effects in mathematics.<sup>37</sup> These findings suggest that the mindset promoted by NZGT could have tangible benefits for mathematics learning outcomes.

## METHODOLOGY

### Design, Population and Sampling

This study employed a quasi-experimental, control group pretest-posttest design to examine the impact of the No-Zero Grading Technique (NZGT) within an Ubuntuised classroom on students' interest and achievement in mathematics. The study used two public secondary schools in Benue State, Nigeria with 165 Upper Basic II students. The criteria for the selection of the schools included the presence of functional mathematics laboratories and qualified mathematics teachers, ensuring that the basic infrastructure and human resources necessary for the study were in place. All the upper Basic II students enrolled in mathematics classes in the selected schools were included in the study. The two selected schools were then randomly assigned to either the experimental or control group, minimizing selection bias and enhancing the internal validity of the study.

### Instruments of the Study

Two standardized instruments were adapted and used for data collection in this study. The first instrument, the Mathematics Interest Questionnaire (MIQ) consists of 20 items and was adapted from Stevens and Olivarez.<sup>38</sup> The items assessed various aspects of students' interest in mathematics, including emotional enjoyment, personal valuation of mathematics, and intrinsic motivation to engage with mathematical content. Responses were recorded on a 4-point modified Likert scale ranging from Strongly Disagree (1) to Strongly Agree (4). Sample items included "I enjoy solving mathematical problems" and "I look forward to my mathematics classes," capturing both affective and cognitive components of interest. The second instrument, the Mathematics Achievement Test (MAT), was a 20-item multiple-choice test covering the JSS II mathematics curriculum topics for the intervention period. Each item had four options with only one correct answer, assessing students' knowledge, comprehension, and application of mathematical concepts. The test was adapted from the Basic Education Certificate Examination (2023) conducted by the Benue State Ministry of Education. Both instruments underwent a rigorous validation process to ensure their reliability and validity in the Nigerian secondary school context. Content and face validity were established through a comprehensive review by a panel of five experts, including two mathematics educators, two educational psychologists, and one psychometrician. A pilot study was then conducted with 40 Upper Basic II students from a school not included in the main study. Construct validity was evaluated using both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The EFA was used to identify the underlying factor structure of the instruments, while the CFA was employed to confirm these structures and assess model fit. This two-step approach provided strong evidence for the construct validity of both the MIQ and MAT. Finally, reliability was established using Cronbach's alpha, with coefficients of 0.86 for the MIQ and 0.83 for the MAT,

<sup>35</sup> Chen-Lin C. Kulik, James A. Kulik, and Robert L. Bangert-Drowns, "Effectiveness of Mastery Learning Programs: A Meta-Analysis," *Review of Educational Research* 60, no. 2 (June 1, 1990): 265–99, <https://doi.org/10.3102/00346543060002265>.

<sup>36</sup> Thomas R. Guskey and Therese D. Pigott, "Research on Group-Based Mastery Learning Programs: A Meta-Analysis," *The Journal of Educational Research* 81, no. 4 (March 20, 1988): 197–216, <https://doi.org/10.1080/00220671.1988.10885824>; Barry J. Zimmerman and Maria K. Dibenedetto, "Mastery Learning and Assessment: Implications for Students and Teachers in an Era of High-stakes Testing," *Psychology in the Schools* 45, no. 3 (March 29, 2008): 206–16, <https://doi.org/10.1002/pits.20291>.

<sup>37</sup> David S. Yeager et al., "A National Experiment Reveals Where a Growth Mindset Improves Achievement," *Nature* 573, no. 7774 (September 7, 2019): 364–69, <https://doi.org/10.1038/s41586-019-1466-y>.

<sup>38</sup> Tara Stevens and Arturo Olivarez, "Development and Evaluation of the Mathematics Interest Inventory," *Measurement and Evaluation in Counseling and Development* 38, no. 3 (October 19, 2005): 141–52, <https://doi.org/10.1080/07481756.2005.11909775>.

indicating high internal consistency for both instruments. These comprehensive validation procedures ensured that the MIQ and MAT were psychometrically sound and appropriate for use in this study.

### **Ubuntu Classroom Implementation**

Prior to the intervention, both the experimental and control schools underwent a comprehensive process to establish an Ubuntu classroom environment. This process was designed to create a learning atmosphere characterized by mutual respect, collaboration, and shared responsibility for learning outcomes, in line with the Ubuntu philosophy of "I am because we are." The implementation began with a three-day intensive workshop (totaling 24 hours) conducted for all mathematics teachers in both schools. This workshop covered several key areas: the Ubuntu philosophy and its application in education, strategies for fostering a supportive and collaborative classroom environment, and techniques for promoting mutual respect and shared responsibility for learning. The workshop included both theoretical discussions and practical exercises, allowing teachers to internalize the Ubuntu principles and develop concrete strategies for their implementation. Following the workshop, classrooms in both schools were physically rearranged to facilitate group work and collaborative learning. This included arranging desks in small groups or circles to encourage face-to-face interaction, creating dedicated spaces for class meetings and discussions, and displaying student work and motivational posters emphasizing community and support. These physical changes were designed to create a visual and spatial reinforcement of the Ubuntu principles.

Teachers in both schools then implemented a series of Ubuntu practices throughout the study period. These practices included daily class meetings to discuss concerns, set goals, and celebrate achievements, fostering a sense of community and shared purpose. Peer tutoring and collaborative problem-solving sessions were regularly scheduled, encouraging students to support each other's learning. Regular group projects and presentations were incorporated into the curriculum, promoting teamwork and collective responsibility. Additionally, students engaged in reflective journaling on personal growth and community contributions, encouraging self-awareness and recognition of their role within the larger classroom community.

To further strengthen relationships within the class, a series of community-building activities were organized. These included ice-breaker games and team-building exercises designed to build trust and camaraderie among students. Classroom roles and responsibilities were assigned on a rotating basis, giving each student the opportunity to contribute to the classroom community in various ways. Mathematics-themed community service projects were also organized, helping students see the real-world applications of their learning while fostering a sense of social responsibility. These Ubuntu practices were maintained consistently throughout the study period in both the experimental and control groups. This consistent application ensured that any differences observed between the groups could be attributed to the NZGT intervention rather than differences in the classroom environment. Regular check-ins with teachers and classroom observations were conducted to ensure fidelity to the Ubuntu principles across both groups.

### **NZGT Intervention Implementation**

The NZGT intervention was implemented in the experimental group over a 12-week period, covering the topics in the third term: Angles in a Polygon, Angles of Elevation and Depression, Bearing and Distances, the Use of Computer in ICT, Construction, Data Presentation, Probability, and Computer Application II. The implementation process was carefully designed to ensure consistent and effective application of NZGT principles throughout the intervention period. The process began with a comprehensive two-day intensive workshop (totaling 16 hours) conducted for mathematics teachers in the experimental school. This workshop covered several crucial areas: the theoretical background and benefits of NZGT, practical sessions on incorporating NZGT principles into lesson planning and assessment, and calibration exercises using sample student work to ensure consistent grading practices. Teachers were provided with detailed resources and guidelines to support their implementation of NZGT. Following the workshop, comprehensive lesson plans were developed for each topic, integrating NZGT principles throughout. These plans included clear learning objectives aligned with the Nigerian mathematics curriculum, ensuring that the intervention remained consistent with national educational standards. The plans

incorporated a variety of interactive teaching strategies, such as demonstrations, group discussions, and problem-solving sessions, designed to engage students actively in the learning process. Formative assessment opportunities were embedded throughout the lessons, allowing for continuous monitoring of student progress and understanding. Detailed guidelines for delivering constructive feedback were also included, emphasizing the importance of specific, actionable comments to support student learning.

The NZGT grading system was a key component of the intervention. The minimum score for any assignment or test was set at 50% of the total possible points, eliminating the possibility of zero grades. Partial credit was awarded for demonstrating understanding or effort, even if the final answer was incorrect, encouraging students to attempt all problems and rewarding the process of learning. A standardized rubric was used to assess students' performance, with conceptual understanding and problem-solving approach each accounting for 40% of the grade, and calculations making up the remaining 20%. This balanced approach ensured that students were evaluated on their overall mathematical thinking, not just their ability to arrive at correct answers. Detailed written feedback was provided on all assessments, emphasizing areas for improvement and recognizing students' effort and progress, reinforcing the growth-oriented mindset central to NZGT.

A variety of assessment strategies were employed to offer students multiple opportunities to demonstrate their understanding of the material. These included daily problem sets, group projects, in-class quizzes, and end-of-unit tests. Each of these assessment types contributed 25% to the final grade, providing a balanced and comprehensive evaluation of student performance. Crucially, students were given multiple opportunities to revise and resubmit work to improve their understanding and grades, a key principle of NZGT that encourages persistence and a focus on learning rather than performance. To ensure fidelity to the NZGT principles, a robust implementation monitoring process was put in place. Weekly check-ins were conducted with teachers to address any challenges and provide ongoing support. Each teacher was observed twice during the intervention period, allowing for feedback and assistance in refining their implementation of NZGT. Throughout this period, the control group continued with their regular grading practices while maintaining the Ubuntu classroom environment. This design allowed for a clear comparison between NZGT and traditional grading approaches within the context of an Ubuntu classroom.

### **Data Collection Procedure**

The data collection procedure was carefully structured to ensure the reliability and validity of the findings. One week before the intervention, a pretest was administered to students in both the experimental and control groups during regular class hours. This pretest consisted of both the Mathematics Interest Questionnaire (MIQ) and the Mathematics Achievement Test (MAT). Students were given 30 minutes to complete the MIQ, followed by a short break, and then 90 minutes for the MAT. This timing was determined based on the pilot study results to ensure students had sufficient time to complete both instruments without fatigue. The pretests were administered by trained research assistants who were blinded to the group assignments to prevent any potential bias.

Following the pretest, the 12-week intervention period commenced. During this time, five 40-minute mathematics lessons were conducted each week in both groups. The experimental group implemented the NZGT approach as detailed in the intervention implementation section, while the control group maintained traditional grading practices. Both groups continued to operate within the Ubuntu classroom environment established at the beginning of the study. Additionally, classroom observations were conducted twice for each teacher during the intervention period. Immediately after the 12-week intervention period, a posttest was administered following the same procedure as the pretest. The MIQ and MAT were again given to all students in both groups, with the same time allocations as the pretest. The use of the same instruments for both pretest and posttest allowed for a direct comparison of changes in student interest and achievement over the intervention period. To minimize the potential for test-practice effects, the order of questions in both the MIQ and MAT was randomized in the post-test while maintaining the same content. Additionally, students were not informed of their pretest scores until after the completion of the posttest to prevent any potential influence on their performance or responses.

## Data Analysis

Descriptive statistics including means and standard deviations were calculated for both pretest and post-test scores on the Mathematics Interest Questionnaire (MIQ) and Mathematics Achievement Test (MAT) for both the experimental and control groups. These descriptive statistics provided an initial overview of the data and allowed for preliminary comparisons between groups and across time points. The primary statistical technique used to test the hypotheses was Analysis of Covariance (ANCOVA). ANCOVA was chosen for its ability to compare posttest scores between groups while controlling for pretest differences, thus increasing statistical power by reducing within-group error variance. For each hypothesis, an ANCOVA was conducted with the posttest scores (either MIQ or MAT) as the dependent variable, the group (experimental/control) as the independent variable, and pretest scores as the covariate. This analysis allowed for the isolation of the intervention effect by accounting for any initial differences between groups. Prior to conducting the ANCOVA, several assumptions were tested to ensure the appropriateness of the analysis.

## Ethical Considerations

Ethical considerations were thoroughly addressed throughout all stages of the study to ensure the protection and well-being of all participants. The research protocol was submitted to and approved by the Institutional Review Board (IRB) at Joseph Sarwuan Tarka University, Makurdi-Nigeria. This review process ensured that the study design met all ethical standards for research involving human subjects, including minimizing risks to participants, ensuring fair subject selection, and protecting participant privacy and confidentiality. Permission to conduct the study was secured from the Benue State Ministry of Education, acknowledging the importance of adhering to local educational policies and regulations. Additionally, approval was obtained from the administrators of the participating schools, ensuring that they were aware of the study's purpose and procedures. Informed consent was obtained from the parents/guardians of all student participants, and student assent was also collected to ensure their voluntary participation. Confidentiality and anonymity were strictly maintained throughout the study, with no personal identifiers collected. All data was securely stored and accessible only to the research team.

## PRESENTATION OF RESULTS

**Hypotheses 1:** There is no significant difference in the level of interest in mathematics among students after being exposed to the No Zero Grading Technique (NZGT) in an Ubuntulised classroom.

The result of this is presented in Tables 1a and 1b

**Table 1a: Pairwise Comparisons on Interest in Mathematics of Students exposed to the No Zero Grading Technique (NZGT) in an Ubuntulised classroom**

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig. <sup>b</sup>
Control	Experimental	-.410*	.106	.000
Experimental	Control	.410*	.106	.000

Table 1a shows a significant difference in the level of interest in mathematics between the control and experimental groups after exposure to the No Zero Grading Technique (NZGT) in an Ubuntulised classroom. The mean difference of 0.410 in favor of the experimental group is statistically significant ( $p < .005$ ), at 0.05 level of significance. This indicates that students exposed to NZGT in an Ubuntulised classroom demonstrated a higher level of interest in mathematics compared to the control group. Given these results, the null hypothesis can be rejected that there is no significant difference in the level of interest in mathematics among students after being exposed to NZGT in an Ubuntulised classroom.

**Table 1b: ANCOVA Tests of Between-Subjects Effects on Interest in Mathematics of Students exposed to the No Zero Grading Technique (NZGT) in an Ubuntu classroom**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	34.984 <sup>a</sup>	2	17.492	37.824	.000	.318
Intercept	35.718	1	35.718	77.237	.000	.323
PRETEST	26.882	1	26.882	58.129	.000	.264
<b>GROUPS</b>	<b>6.915</b>	<b>1</b>	<b>6.915</b>	<b>14.953</b>	<b>.000</b>	<b>.085</b>
Error	74.917	162	.462			
Total	1706.730	165				
Corrected Total	109.900	164				

The ANCOVA results in Table 1b provide further evidence to reject the null hypothesis. The row labeled "GROUPS" shows a significant effect of the intervention ( $F = 14.953$ ,  $p < .05$ , partial  $\eta^2 = .085$ ). This indicates that after controlling for pretest scores, there is a statistically significant difference between the groups in their interest in mathematics. The partial eta squared value of .085 suggests a moderate effect size, with 8.5% of the variance in post-test scores being attributable to the group difference (i.e., the NZGT intervention). Additionally, the pretest scores are a significant covariate ( $F = 58.129$ ,  $p < .05$ ), accounting for 26.4% of the variance in posttest scores. This result also supports that the No Zero Grading Technique in an Ubuntu classroom significantly influenced students' interest in mathematics, contradicting the null hypothesis.

**Hypothesis 2:** There is no significant difference in the achievement scores of students in mathematics after being exposed to the No Zero Grading Technique (NZGT) in an Ubuntu classroom.

**Table 2a: Pairwise Comparisons on Achievement in Mathematics of Students exposed to the No Zero Grading Technique (NZGT) in an Ubuntu classroom**

(I) Groups	(J) Groups	Mean Difference (I-J)	Std. Error	Sig. <sup>b</sup>
Control	Experimental	-6.100 <sup>*</sup>	1.517	.000
Experimental	Control	6.100 <sup>*</sup>	1.517	.000

Table 2a demonstrates a significant difference in mathematics achievement scores between the control and experimental groups after exposure to the No Zero Grading Technique (NZGT) in an Ubuntu classroom. The mean difference of 6.100 in favor of the experimental group is statistically significant ( $p < .05$ ), which is well below the 0.05 level of significance. This indicates that students exposed to NZGT in an Ubuntu classroom achieved significantly higher scores in mathematics compared to the control group. Based on these results, the null hypothesis shows no significant difference in the achievement scores of students in mathematics after being exposed to NZGT in an Ubuntu classroom was rejected.

**Table 2b : ANCOVA Tests of Between-Subjects Effects on Achievement in Mathematics of Students exposed to the No Zero Grading Technique (NZGT) in an Ubuntu classroom**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5117.421 <sup>a</sup>	2	2558.711	27.176	.000	.251
Intercept	16465.923	1	16465.923	174.88	.000	.519
PRETEST	3984.692	1	3984.692	42.321	.000	.207

<b>GROUPS</b>	<b>1521.751</b>	<b>1</b>	<b>1521.751</b>	<b>16.162</b>	<b>.000</b>	<b>.091</b>
Error	15252.882	162	94.154			
Total	842225.000	165				
Corrected Total	20370.303	164				

The ANCOVA results in Table 2b provide additional evidence to reject the null hypothesis. The row labeled "GROUPS" shows a significant effect of the intervention ( $F = 16.162$ ,  $p < .05$ , partial  $\eta^2 = .091$ ). This indicates that after controlling for pretest scores, there is a statistically significant difference between the groups in their mathematics achievement. The partial eta squared value of .091 suggests a moderate effect size, with 9.1% of the variance in post-test scores being attributable to the group difference (i.e., the NZGT intervention). Additionally, the pretest scores are a significant covariate ( $F = 42.321$ ,  $p < .05$ ), accounting for 20.7% of the variance in posttest scores. These results support the conclusion that the No Zero Grading Technique in an Ubuntu classroom significantly influenced students' achievement in mathematics, contradicting the null hypothesis and demonstrating a positive impact on student performance.

## DISCUSSION

### Impact on Student Interest in Mathematics

The study revealed a significant positive impact of the No Zero Grading Technique (NZGT) within an Ubuntu classroom on students' interest in mathematics. The results showed a statistically significant difference between the experimental and control groups (mean difference = 0.410,  $p < .05$ ), with the experimental group demonstrating higher levels of interest. This finding aligns with and extends previous research on the importance of grading practices and classroom environment in shaping student attitudes towards mathematics. The observed increase in interest can be attributed to several factors inherent in the NZGT and Ubuntu classroom approach. Firstly, the elimination of zero grades and the provision of multiple opportunities for improvement likely contributed to a reduction in math anxiety, a factor known to negatively impact interest and achievement in mathematics.<sup>39</sup> By removing the punitive aspect of grading and emphasizing growth and learning, NZGT may have created a more psychologically safe environment for students to engage with mathematical concepts without fear of failure. This aligns with research by Yeager et al. on growth mindset interventions, which have shown particular effectiveness in mathematics education.<sup>40</sup> Secondly, the Ubuntu classroom environment, characterized by mutual respect, collaboration, and shared responsibility, may have fostered a sense of belonging and community among students. This socio-emotional aspect of the learning environment has been shown to be crucial in developing and maintaining interest in academic subjects, particularly those perceived as challenging.<sup>41</sup> The emphasis on collective progress rather than individual competition in the Ubuntu approach likely contributed to a more supportive atmosphere, encouraging students to persist in the face of difficulties and maintain their interest in the subject.

Furthermore, the combination of NZGT and Ubuntu principles aligns closely with self-determination theory, which posits that intrinsic motivation (and by extension, interest) is fostered when individuals experience autonomy, competence, and relatedness.<sup>42</sup> The NZGT approach, by providing multiple opportunities for success and emphasizing progress over perfection, likely enhanced students' sense of competence. The collaborative nature of the Ubuntu classroom supported relatedness, while the focus on personal growth and multiple paths to demonstrating understanding may have increased students' sense of autonomy in their learning process. The moderate effect size observed (partial  $\eta^2 = .085$ ) suggests that while the intervention had a meaningful impact, there is still room for further enhancement of student interest in mathematics. This could potentially be achieved through longer-term

<sup>39</sup> Ashcraft and Krause, "Working Memory, Math Performance, and Math Anxiety"; Ramirez et al., "Math Anxiety, Working Memory, and Math Achievement in Early Elementary School."

<sup>40</sup> Yeager et al., "A National Experiment Reveals Where a Growth Mindset Improves Achievement."

<sup>41</sup> Sakiz, Pape, and Hoy, "Does Perceived Teacher Affective Support Matter for Middle School Students in Mathematics Classrooms?"

<sup>42</sup> Richard M. Ryan and Edward L. Deci, "Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being.," *American Psychologist* 55, no. 1 (2000): 68–78, <https://doi.org/10.1037/0003-066X.55.1.68>.

implementation or by combining NZGT and Ubuntu principles with other evidence-based practices in mathematics education, such as contextualized problem-solving or technology integration.<sup>43</sup>

### Impact on Mathematics Achievement

The study also revealed a significant improvement in mathematics achievement scores among students exposed to the NZGT in an Ubuntu classroom. The experimental group outperformed the control group by a substantial margin (mean difference = 6.100,  $p < .05$ ), indicating that the intervention not only increased interest but also translated into tangible improvements in mathematical performance. This finding is particularly noteworthy as it demonstrates that alternative grading practices, when combined with a supportive classroom environment, can lead to measurable gains in academic achievement. The improvement in achievement scores can be attributed to several factors inherent in the NZGT and Ubuntu approaches. The NZGT's emphasis on providing multiple opportunities for improvement likely encouraged students to persist in their efforts to master mathematical concepts. This aligns with research on mastery learning approaches, which have consistently shown positive effects on student achievement.<sup>44</sup> By allowing students to revise and improve their work, NZGT may have promoted deeper engagement with the material and a more thorough understanding of mathematical concepts, rather than superficial learning aimed solely at passing tests. More so, the Ubuntu classroom environment, with its focus on collaboration and mutual support, may have facilitated peer learning and collective problem-solving. Research has shown that collaborative learning can be particularly effective in mathematics education, especially for students who may struggle with the subject.<sup>45</sup> The emphasis on shared responsibility for learning outcomes in the Ubuntu approach likely created a classroom culture where students were more willing to seek help, share strategies, and engage in productive mathematical discussions.

The moderate effect size observed for achievement (partial  $\eta^2 = .091$ ) is encouraging, suggesting that the intervention had a substantial impact on student performance. This effect size is comparable to or exceeds those found in many educational interventions, particularly those targeting mathematics achievement.<sup>46</sup> The fact that this improvement was achieved through changes in grading practices and classroom environment, rather than through curriculum changes or increased instructional time, highlights the potential of these approaches as cost-effective strategies for enhancing mathematics education. Moreover, the simultaneous improvement in both interest and achievement is particularly noteworthy. This dual impact addresses a longstanding challenge in mathematics education: the often observed trade-off between promoting the enjoyment of mathematics and improving performance.<sup>47</sup> The NZGT in an Ubuntu classroom appears to offer a promising approach to fostering both affective and cognitive gains in mathematics education.

However, it is important to note that while the intervention showed significant positive effects, there is still considerable unexplained variance in both interest and achievement outcomes. This suggests that individual differences, such as prior achievement, socioeconomic background, or learning disabilities, may moderate the effectiveness of the intervention. Future research could explore these potential moderating factors to refine and optimize the NZGT and Ubuntu approach for diverse student populations. Additionally, the relatively short duration of the intervention (12 weeks) raises questions about the long-term sustainability of these gains. Longitudinal studies would be valuable in determining whether the observed improvements in interest and achievement persist over time and whether they translate into broader academic benefits or career choices related to mathematics and STEM fields. Conclusively, the findings of this study provide strong evidence for the efficacy of combining the No Zero Grading Technique with Ubuntu classroom principles in enhancing both student interest and

<sup>43</sup> Gravemeijer et al., "What Mathematics Education May Prepare Students for the Society of the Future?"

<sup>44</sup> Mhide et al., "Effect of No-Zero Grading Policy on Achievement, Self-Efficacy and Attitude towards Physics in Secondary Schools in Benue North-East Senatorial District, Benue State"; Kulik, Kulik, and Bangert-Drowns, "Effectiveness of Mastery Learning Programs: A Meta-Analysis"; Guskey and Pigott, "Research on Group-Based Mastery Learning Programs: A Meta-Analysis."

<sup>45</sup> Slavin, Lake, and Groff, "Effective Programs in Middle and High School Mathematics: A Best-Evidence Synthesis"; Murata et al., "Making Connections among Student Learning, Content, and Teaching: Teacher Talk Paths in Elementary Mathematics Lesson Study."

<sup>46</sup> Hattie and Timperley, "The Power of Feedback."

<sup>47</sup> Xin Ma and Nand Kishor, "Assessing the Relationship between Attitude toward Mathematics and Achievement in Mathematics: A Meta-Analysis," *Journal for Research in Mathematics Education* 28, no. 1 (January 1997): 26, <https://doi.org/10.2307/749662>.

achievement in mathematics. These results contribute to the growing body of literature on alternative assessment practices and culturally responsive pedagogies in mathematics education. They also underscore the importance of considering both cognitive and affective dimensions in designing effective mathematics instruction.

## **RECOMMENDATIONS**

Based on the comprehensive findings and theoretical underpinnings of this study, several key recommendations emerge for enhancing mathematics education through the NZGT and Ubuntu classroom approach. Educational institutions should systematically integrate the No Zero Grading Technique within Ubuntu classroom environments, supported by comprehensive professional development programs that equip teachers with the necessary skills for effective implementation. Policymakers should revise assessment frameworks to accommodate growth-oriented grading practices while maintaining academic rigor, and school administrators should establish mentoring systems where experienced NZGT practitioners can guide new implementers. Mathematics departments should develop standardized rubrics and guidelines for NZGT implementation that align with national curriculum standards while preserving the flexibility needed for diverse learning contexts. Educational researchers should conduct longitudinal studies examining the long-term impacts of NZGT and Ubuntu classroom practices on STEM career choices and mathematical self-efficacy. Teacher education programs should incorporate modules on alternative assessment practices and culturally responsive pedagogies, specifically focusing on the integration of NZGT and Ubuntu principles. Finally, education ministries should establish monitoring and evaluation frameworks to assess the scalability and sustainability of NZGT implementation across different socio-economic contexts, with particular attention to resource-constrained environments where innovative, cost-effective interventions are most needed.

## **CONCLUSION**

This experimental study provides compelling evidence for the effectiveness of integrating the NZGT within an Ubuntu classroom environment to enhance both student interest and achievement in mathematics. The findings make several significant contributions to the field of mathematics education and have important implications for educational practice and policy. The study demonstrates that alternative grading practices, when implemented thoughtfully and in conjunction with supportive classroom environments, can lead to measurable improvements in both affective and cognitive outcomes in mathematics education. The significant increases in both student interest and achievement scores challenge traditional notions of assessment and grading, suggesting that more growth-oriented, less punitive approaches can yield positive results. The research also highlights the potential of culturally responsive pedagogies, such as the Ubuntu philosophy, in creating inclusive and effective learning environments. The Ubuntu classroom approach appears to create a conducive atmosphere for mathematics learning, particularly when combined with supportive grading practices by emphasizing interconnectedness, mutual respect, and collective progress. Further, this study contributes to the growing body of literature on addressing math anxiety and fostering positive attitudes toward mathematics. The simultaneous improvement in interest and achievement suggests that the NZGT in an Ubuntu classroom may offer a promising approach to breaking the cycle of math anxiety and underachievement that plagues many students.

Furthermore, the research underscores the importance of considering both cognitive and affective dimensions in mathematics education. The dual focus on interest and achievement in this study provides a more holistic view of student success in mathematics, aligning with the contemporary understanding of the interplay between emotions, motivation, and cognitive performance in learning. The implications of this study are far-reaching. For educators, it provides evidence-based strategies for improving mathematics instruction and assessment. The NZGT offers a practical approach to grading that can be implemented in various educational contexts, while the Ubuntu principles provide a framework for creating supportive classroom environments. For policymakers, the study suggests the need to reconsider traditional grading policies and to support more flexible, growth-oriented assessment practices in mathematics education. For researchers, this study opens up several avenues for future investigation. Longitudinal studies could explore the long-term effects of NZGT and Ubuntu classroom principles on

mathematics achievement and STEM career choices. Cross-cultural studies could examine the applicability of these approaches in diverse educational contexts. Additionally, research into the specific mechanisms by which NZGT and Ubuntu principles influence student outcomes could further refine these approaches. This study makes a significant contribution to the field of mathematics education by demonstrating the potential of innovative grading practices and culturally responsive pedagogies to enhance both student interest and achievement in mathematics. As educators and policymakers continue to grapple with the challenges of improving mathematics education, the integration of NZGT within Ubuntu classrooms offers a promising path forward, one that nurtures both the minds and the spirits of learners in their mathematical journeys.

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## ABOUT AUTHORS

Dr Terungwa James Age is currently a postdoctoral Fellow with the University of South Africa, Pretoria in the Department of Mathematics Education. He holds B. Sc. (Ed) Mathematics/ Computer Science Education, M. Ed. Mathematics Education and PhD in Mathematics Education all from the University of Agriculture, Makurdi – Nigeria in 2010, 2017 and 2021 respectively. Dr. Age is also a Lecturer in the department of Computer Science Education, Joseph Sarwuan Tarka University, Makurdi -Nigeria, where he has served as the Departmental Examination officer, Departmental Students' adviser and College students' adviser all between 2019 to 2023. His research works addresses digital inequalities, digital literacy, digital inclusion, and innovations in STEM education with strong focus on underserved educational environments and digital pedagogies and ethnomathematics. He has served as a reviewer to many local and international journal, he is an editorial board member to the following journals; American Journal of Education, and information Technology Member, Al-Jabar Jurnal Pendidikan Matematika Member, VillageMath Educational Review. Dr. Age is also a Guest Editor, Eurasia Journal of Mathematics, Science and Technology Education, Special issue: STEM Education – Innovations, Challenges, and Future Directions.

Prof. Masilo France Machaba is a Full Professor at the University of South Africa and the Acting Chair of Department, Mathematics Education in the same institution. He holds a Doctoral degree in Mathematics Education from Tshwane University of Technology (TUT) (2014), a Master's degree in Education from Tshwane University of Technology (2003), a B. Tech (Educational Management, 1999) and B. Tech in Natural Science (Mathematics & Physics, 2000) also from TUT, and a BSc (Hons) (Mathematics Education) from Wits University (2005). Prof Machaba is a reviewer of articles in journals, including the Pythagoras Journal, the African Journal of Research in Mathematics, Science and Technology Education, the European Journal of Social Sciences, the Mathematics and Science International Journal and The International Journal of Science, Mathematics and Technology Learning and African Education review journal. He is one of the guest editors of the Journal of Education studies of a special issue entitled, "Mathematics Education and Quest for mathematics educating in the 4IR and Covid-19". He is also a Guest Editor in a special issue in Eurasia Journal of mathematic, Science and Technology Education. Furthermore, he is a co-editor of the IGI Global book, titled *Global Perspectives on Equity, Diversity, and Inclusion in Mathematics Classrooms*. He is a registered member of the Southern African Association for Research in Mathematics, the Association for Mathematics

Education of South Africa (AMESA), and the Institute for Science and Technology Education (ISTE). He has received awards in mathematics education including the best Honours research award in mathematics education from Wits University. Prof. Machaba is a NRF C2 rated professor whose research interest includes: The integration of mathematics and everyday context, Relationship between Mathematics and Mathematical Literacy and Misconceptions in Mathematics.