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# COVID-19 Pandemic in Nigeria and Attitudes towards Mathematics Homeschooling among Pre-Tertiary Students

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**Abstract**

The emergence of COVID-19 in Wuhan, the Peoples Republic of China in December 2019 and it spread to Nigeria on February 27, 2020, has made the closure of educational institutions in the country a must and homeschooling inevitable. Aside from social distancing and putting on of the armour of basic health hygiene and using nose masks, COVID-19 pandemic has no curative vaccine to stop its further spread. This study investigated Nigerian pre-tertiary students' attitudes towards mathematics homeschooling during the period of COVID-19 pandemic. Deploying instrumentation survey research design, three research questions were answered and the sample consisted of 342 pre-tertiary students in South-West, Nigeria. Data collected through an internet-based questionnaire created using Google forms and loaded on the WhatsApp social media for the dissemination to the target sample were analysed using frequency, mean, standard deviation, independent samples t-test, and exploratory factor analysis. Results showed that attitudes towards mathematics homeschooling scale was a multi-dimensional construct consisting of four interpretable factor structure of distraction and parent negative attitude, home enjoyment, school enjoyment, and competition and parent positive attitude. Gender was not a factor in the attitudes towards mathematics homeschooling. Besides, pre-tertiary students recorded a high level of attitudes towards mathematics homeschooling during the period of COVID-19 pandemic. In line with these results, it was recommended that researchers and mathematics educators could adopt this assessment tool in exploring the background predictors and educational imports of attitudes towards mathematics homeschooling in mathematics learning milieu during the period of any pandemic.

## Introduction

No doubt, the world is facing a colossal public well-being catastrophe of coronavirus disease otherwise called COVID-19. It is a daunting challenge to the world because presently there is no curative vaccine to halt its further spread except social distancing and putting on the amour of basic health hygiene and using face masks. Declared as a pandemic by the World Health Organization (WHO) on March 12, 2020, the first index case of COVID-19 in Nigeria was an Italian man who came from Italy to Nigeria on February 27, 2020. Since then the spread of COVID-19 in Nigeria has been alarming. This unabated spread of COVID-19 not only led to the

closures of schools and tertiary institutions but also led to a total lockdown of the nation. The closure of schools means that students can no longer go to schools but stay at home to learn the various school subjects. This total lockdown in Nigeria offers parents the exceptional educational prospect to rap into their children inborn inquisitiveness regarding the COVID-19 and implement suitable instructions, hasty children to learn genuinely and preferably deliver a measure of cosiness in a period of upsetting captions and ample propaganda. From teaching the children basic health hygiene and how the virus spread to other intricate themes like ethical policymaking, the science underlying the spread of COVID-19, and the mathematics behind the pandemic, parents are now in the shoes of teachers to aid children to surpass the uproar with distinctive, solicitous instructions. Mathematics, habitually reflected as an exactingly sane subject, is capable of playing a significant passionate and psychosomatic function in ambiguous periods, providing students with dynamic trappings to fight terror and propaganda.

The unexpected swing to homeschooling could offer a worthy type of interruption that promotes prospect for students to engross in genuine and unfathomable learning of mathematics that lies in self-direction, additionally lively, more associated with young children's growth-and copiously stress-free for parents to cope with than loads of schedules. Before the emergence of COVID-19 pandemic in December 2019 in Wuhan, Peoples Republic of China, some parents in the developed countries naturally like to homeschool their children. Their decisions may hinge on displeasure with a formal system of schooling, attaining the basic requirement of their wards, a yearning to promote intense social association with their wards, a craving to inculcate positive morals and ethics into their wards, and a conviction that education is the exclusive duty of the parents and not the government (Adams & Purdy, 1996). A usual formal school day may recompense students with prospects to exhibit individuality, aid colleagues and overcome difficulties. The swing to homeschooling may allow children to cultivate sovereignty, exercise compassion and deploy their aptitudes-principally when parents build configurations around children attention span, then draw back to allow children gloss. Research evidence indicates that homeschooled children performed significantly better in academic achievement than their counterparts who attended formal schools (Murphy, 2012). Also, they possess strong social skills and are deeply involved in communal social activities. Homeschooled children are ethically persuaded, show more respect and tolerance for opposing rational and partisan viewpoints (Ray, 2012, 2013, 2016).

In this period of COVID-19 pandemic, it is expedient that parents monitor the educational development of their children while they stay at home. Parents are to ensure that all school-going children are skilful in learning mathematics since we do not know when the pandemic will fizzle out. More importantly, it is necessary to understand the attitudes of the children towards homeschooling in mathematics in this period of COVID-19 pandemic. Mathematics is specifically selected because it is a general language that all students must learn to be numerate members of society. More so, mathematics in Nigeria is a cross-cutting core subject at the pre-tertiary education level and a filter to entering the University for any Degree Course. Knowing the attitudes of pre-tertiary students in mathematics during this period of the pandemic will assist parents in ensuring that they are well prepared for remote learning outside of the school system. Although many studies have been carried out about students' attitudes towards mathematics in general (Awofala, 2000; Awofala,

2016; Awofala & Awolola, 2011; Ayob & Yasin, 2017), to date, there is a paucity of studies conducted in connection to the attitudes of students towards mathematics homeschooling in Nigeria and worldwide during this period of COVID-19 pandemic. In Nigeria, homeschooling is not a phenomenon and as such, there is no record of registered homeschoolers in the country. This is unlike in the US and the UK where the laws permit parents to homeschool their children.

It is expected that empirical findings from this investigation would assist parents, teachers and education authorities in designing suitable approaches in enhancing students' attitudes towards mathematics homeschooling in this era of COVID-19 pandemic. The purpose of this study was to examine students' attitudes towards mathematics homeschooling at the pre-tertiary level during the period of COVID-19 pandemic in Nigeria.

## Research Questions

RQ1. What is the factor structure of the attitudes towards mathematics homeschooling scale (AMHS) during the period of COVID-19 pandemic among Nigerian pre-tertiary students?
RQ2. What is the level of attitudes towards mathematics homeschooling during the period of COVID-19 pandemic among Nigerian pre-tertiary students?
RQ3. What is the influence of gender on attitudes towards mathematics homeschooling during the period of COVID-19 pandemic among Nigerian pre-tertiary students?

## Method

This investigative study used an instrumentation survey non-experimental research design that promoted the gathering of pertinent data in one location in time for revealing novel or revised instrument (Awofala, 2012). The respondents were 342 pre-tertiary students (184 males and 158 females) in Lagos State, Nigeria who had finished from senior secondary schools but were waiting for admission into the tertiary institutions in Nigeria. Their age ranged from 15 to 34 with a mean age of 19.2 years and standard deviation of 2.4 years. 249 were Christians while 93 were Moslems. Especially, data were collected through an internet-based questionnaire, which consisted of biographical information and attitudes towards mathematics homeschooling scale. The attitude towards mathematics homeschooling scale contained 18 items on a modified Likert scale, which centred on key dimensions of attitude towards mathematics such as, enjoyment, distraction, parent attitude, and competition. There were eight negative statements while the remaining 10 items were positive statements. The questionnaire was created using Google forms and loaded on Whatsup social media for online distribution to the respondents. Each respondent was expected to download the questionnaire, fill it and make a submission online. Frequency and percentage were deployed for the description of responses to each item on the attitudes towards mathematics homeschooling scale and on the biographical features of the respondents. The classical psychometric properties of the attitudes towards mathematics homeschooling were revealed using exploratory factor analysis. The influence of gender on attitudes towards mathematics

homeschooling was tested using an independent samples t-test. The data were analysed using SPSS version 20.

**Results and Discussion**

**Research Question 1:** What is the factor structure of the attitudes towards mathematics homeschooling scale (AMHS) during the period of COVID-19 pandemic among Nigerian pre-tertiary students?

Before EFA was carried out, descriptive statistics of each of the items of AMHS, which include mean, standard deviation, skewness, and kurtosis were found. Analysis of the descriptive statistics revealed that the EFA model variables did not stray from a normal distribution with the values of skewness and kurtosis falling in the acceptable range -3 to +3. Additional inspection of the input data showed their suitability as proven by Bartlett's test of sphericity, $\chi^2$ *= 1. 266E3; df=153; p*<.001 which put to test the null hypothesis that the correlation matrix is an identity matrix. The Kaiser-Meyer-Olkin measure of sampling adequacy (MSA) was within satisfactory range (values of .60 and above) with a value of .767. Each of the variables in the model was greater than the threshold value of (.60) of MSA, which vacillated from .708 to .846. However, virtually all the partial correlations were small as revealed by the anti-image correlation matrix. All these procedures led to the supposition that the set of 18 items of AMHS was suitable for PCA. To examine the factorial validity of this new scale, AMHS, EFA using principal components analysis with varimax rotation was adopted. Because this study tested the hypothesis about the factor to be extracted, the PCA was carried out to resolve the number of dimensions to be retained in the AMHS subcategories. For the AMHS, an inspection of the eigenvalues and scree plot reinforced a four-dimension model. The first dimension explained 20.55% of the variance, while the second, the third and the fourth dimensions explained 13.34%, 8.27% and 7.27% respectively. These underlying factors display distraction and parent negative attitude, home enjoyment, school enjoyment, and competition and parent positive attitude, respectively. All the four factors explained 49.42% of the variance.

Accordingly, the eighteen items depict attitudes towards mathematics homeschooling with four factors. Table 1 shows the dimension loading for the leading items (factor loading >.40), as well as eigenvalues, the per cent of variance explained by each dimension, and the mean and standard deviation for each dimension. All the communalities ($h^2$) for the factor analysis fulfilled the smallest prerequisite of being greater than 0.50 and these vacillated from 0.504 to 0.655. As indicated in Figure 1 below, the scree plot which graphs the eigenvalue against the component number is reminiscent of a four-component model.

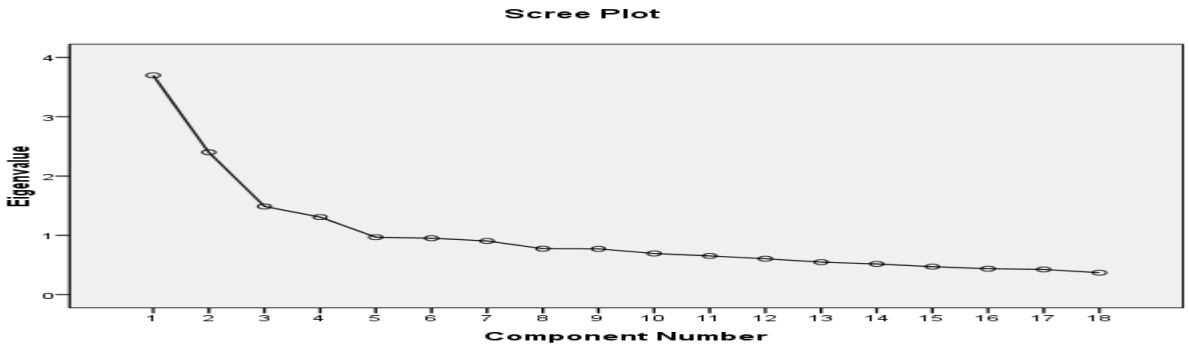


**Fig. 1.** Cattell scree plot showing the number of components and eigenvalues of the correlation matrix.

**Table 1.** Item Loadings and Communalities ($h^2$) for Principal Components Analysis on AMHS Items Depicting the Four-Factor Model

| Item | Factor Loadings | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | $h^2$ | M | SD |
| **Distraction and parent negative attitude (α= .726)** | | | | | | | |
| AMHS9: My siblings interfere with my learning of mathematics at home* | .681 | .039 | .258 | .053 | .564 | 2.31 | 1.15 |
| AMHS10: I get bored while learning mathematics at home* | .631 | -.213 | .280 | -.180 | .591 | 2.43 | 1.20 |
| AMHS11: I get distracted and sometimes loose concentration while learning mathematics at home*. | .604 | -.230 | .240 | -.169 | .551 | 2.76 | 1.10 |
| AMHS12: I hate learning mathematics alone at home* | .621 | -.269 | .259 | -.007 | .575 | 2.30 | 1.18 |
| AMHS13: Running errands for my parents do not allow me to concentrate on learning mathematics at home* | .638 | -.058 | .202 | -.213 | .596 | 2.40 | 1.18 |
| AMHS14: My parents are less concerned with my learning mathematics at home* | .706 | .151 | -.064 | .111 | .537 | 1.76 | 1.07 |
| AMHS15: My parents do not encourage me to learn mathematics at home* | .728 | .152 | -.079 | .099 | .569 | 1.52 | 0.91 |
| AMHS18: Learning mathematics at home is a waste of time* | .625 | -.054 | .050 | .141 | .516 | 1.59 | 1.07 |
| **Home enjoyment (α= .671)** | | | | | | | |
| AMHS1: I enjoy learning mathematics at home than in the school | -.021 | .664 | -.051 | .132 | .561 | 1.80 | 1.14 |
| AMHS2: Mathematics is better taught at home than at school | -.041 | .612 | .170 | .085 | .512 | 1.77 | 1.02 |
| AMHS5: I learn mathematics at my own pace at home than at school. | -.018 | .638 | -.137 | -.107 | .538 | 2.45 | 1.17 |
| AMHS8: I like being at home to learn mathematics online | -.016 | .603 | -.113 | .214 | .522 | 1.94 | 1.15 |
| AMHS16: I am more relaxed learning mathematics alone at home | .023 | .656 | -.040 | -.259 | .599 | 2.41 | 1.11 |
| **School enjoyment (α= .676)** | | | | | | | |
| AMHS3: I miss learning mathematics in a classroom setting when I learn at home. | .106 | -.087 | .795 | -.020 | .650 | 2.94 | 1.04 |
| AMHS4: I miss classroom affordances while learning mathematics at home. | .123 | -.057 | .796 | .053 | .655 | 2.69 | 1.19 |
| **Competition and Parent positive attitude (α= .685)** | | | | | | | |
| AMHS6: My parents hire a mathematics teacher to teach me at home | .082 | .016 | -.013 | .712 | .514 | 1.55 | 0.92 |
| AMHS7: I like to learn mathematics from my parents at home | .115 | .262 | .243 | .632 | .541 | 1.49 | 0.97 |
| AMHS17: I do not have anybody to compete with while learning mathematics at home | .195 | .268 | .225 | -.637 | .504 | 2.94 | 1.05 |
| Scale Mean | 2.13 | 2.07 | 2.81 | 1.99 | | | |
| Scale Standard Deviation | 0.69 | 0.73 | 0.97 | 0.58 | | | |
| Eigenvalue | 3.69 | 2.40 | 1.49 | 1.31 | | | |
| Variance explained | 20.55 | 13.34 | 8.27 | 7.27 | | | |

Note: $h^2$=communalities
Extraction Method: Principal Components Analysis.
Rotation Method: Varimax with Kaiser Normalization

***Reverse coding for a negative statement

Table 1 displayed the factor loadings for the orthogonal three-factor model of AMHS. All items loaded .587 and above on their primary factor and none of the secondary loadings exceeded .40. The Cronbach alpha reliability coefficient for the entire attitudes towards mathematics homeschooling is 0.78.

**Research Question 2:** What is the level of attitudes towards mathematics homeschooling during the period of COVID-19 pandemic among Nigerian pre-tertiary students?

In the attitude toward mathematics homeschooling scale, the score ranged from 0 to 4. A score of 2 is the middle point so higher scores indicate high attitudes towards mathematics homeschooling. Of 342 pre-tertiary students, 87 (25.44%) had scores less than 2 (*M*=1.64, *SD*=0.39, score range: 0.00-1.94, 95%*CI*= 1.56–1.72), 234 (68.42%) had scores greater than 2 (*M*=2.38, *SD*=0.24, score range: 2.06-3.17, 95%*CI*= 2.35–2.41), while 21 (6.14%) had scores equaled 2 (M= 2, SD=0, score range: 2.00, 95%*CI*=2.00). A large proportion of these pre-tertiary students had high attitudes towards mathematics homeschooling. However, the overall *M*=2.17, *SD*=0.42, score range: 0.00-3.17, and 95%*CI*= 2.12-2.21 for the entire sample showed high attitudes towards mathematics homeschooling of pre-tertiary students. Table 1 showed the descriptive statistics of the items in the AMHSS.

Table 2 showed the general pattern of pre-tertiary students' attitudes towards mathematics homeschooling. According to table 2, 57.0% of the pre-tertiary students strongly disagreed/disagreed to the statement ‘during COVID-19 pandemic I enjoy learning mathematics at home than in the school’ (Item 1). 70.2% of the pre-tertiary students strongly disagreed/disagreed to the statement ‘during COVID-19 pandemic mathematics is better taught at home than at school’ (Item 2). 80.1% of the pre-tertiary students strongly agreed/agreed to the statement ‘during COVID-19 pandemic I miss learning mathematics in a classroom setting when I learn at home’ (Item 3). 72.5% of the pre-tertiary students strongly agreed/agreed to the statement ‘during COVID-19 pandemic I miss classroom affordances while learning mathematics at home’ (Item 4). 52.4% of the pre-tertiary students strongly agreed/agreed to the statement ‘during COVID-19 pandemic I learn mathematics at my own pace at home than at school’ (Item 5). 80.1% of the pre-tertiary students strongly disagreed/disagreed to the statement ‘during COVID-19 pandemic my parents hire a mathematics teacher to teach me at home’ (Item 6). 70.7% of the pre-tertiary students strongly disagreed/disagreed to the statement ‘during COVID-19 pandemic I like to learn mathematics from my parents at home’ (Item 7). 54.3% of the pre-tertiary students strongly disagreed/disagreed to the statement ‘during COVID-19 pandemic I like being at home to learn mathematics online’ (Item 8). 52.4% of the pre-tertiary students strongly disagreed/disagreed to the statement ‘during COVID-19 pandemic my siblings interfere with my learning of mathematics at home’ (Item 9). 52.4% of the pre-tertiary students strongly disagreed/disagreed to the statement ‘during COVID-19 pandemic I get bored while learning mathematics at home’ (Item 10).

Table 2. General Pattern of Pre-tertiary students' Attitudes towards mathematics Home Schooling

| S/No | Statement. During Covid-19 pandemic… | Frequency (%) | | | | |
|---|---|---|---|---|---|---|
| | | U | SD | D | A | SA |
| 1 | I enjoy learning mathematics at home than in school | 49(14.3) | 94(27.5) | 101(29.5) | 74(21.6) | 24(7.0) |
| 2 | Mathematics is better taught at home than at school | 34(9.9) | 102(29.8) | 138(40.4) | 46(13.5) | 22(6.4) |
| 3 | I miss learning mathematics in a classroom setting when I learn at home | 20(5.8) | 14(4.1) | 34(9.9) | 174(50.9) | 100(29.2) |
| 4 | I miss classroom affordances while learning mathematics at home | 42(12.3) | 4(1.2) | 48(14.0) | 172(50.3) | 76(22.2) |
| 5 | I learn mathematics at my own pace at home than at school | 27(7.9) | 40(11.7) | 96(28.1) | 111(32.5) | 68(19.9) |
| 6 | My parents hire a mathematics teacher to teach me at home | 28(8.2) | 157(45.9) | 117(34.2) | 23(6.7) | 17(5.0) |
| 7 | I like to learn mathematics from my parents at home | 51(14.9) | 130(38.0) | 112(32.7) | 40(11.7) | 9(2.6) |
| 8 | I like being at home to learn mathematics online | 35(10.2) | 100(29.2) | 86(25.1) | 92(26.9) | 29(8.5) |
| 9 | My siblings interfere with my learning of mathematics at home | 28(8.2) | 44(12.9) | 135(39.5) | 74(21.6) | 61(17.8) |
| 10 | I get bored while learning mathematics at home | 29(8.5) | 71(20.8) | 108(31.6) | 88(25.7) | 46(13.5) |
| 11 | I get distracted and sometimes lose concentration while learning mathematics at home | 16(4.7) | 89(26.0) | 150(43.9) | 50(14.9) | 37(10.8) |
| 12 | I hate learning mathematics alone at home | 30(8.8) | 60(17.5) | 97(28.4) | 100(29.2) | 55(16.1) |
| 13 | Running errands for my parents do not allow me to concentrate on learning mathematics at home | 21(6.1) | 67(19.6) | 112(32.7) | 75(21.9) | 67(19.6) |
| 14 | My parents are less concerned with my learning mathematics at home | 44(12.9) | 20(5.8) | 58(17.0) | 127(37.1) | 93(27.2) |
| 15 | My parents do not encourage me to learn mathematics at home | 36(10.5) | 11(3.2) | 28(8.2) | 124(36.3) | 143(41.8) |
| 16 | I am more relaxed learning mathematics alone at home | 27(7.9) | 42(12.3) | 84(24.6) | 142(41.5) | 47(13.7) |
| 17 | I do not have anybody to compete with while learning mathematics at home | 17(5.0) | 108(31.6) | 158(46.2) | 41(12.0) | 18(5.3) |
| 18 | Learning mathematics at home is a waste of time | 49(14.3) | 23(6.7) | 34(9.9) | 114(33.3) | 122(35.7) |

Note: U=undecided, SD=strongly disagree, D=disagree, A=agree, SA=strongly agree

69.9% of the pre-tertiary students strongly disagreed/disagreed to the statement 'during COVID-19 pandemic I get distracted and sometimes lose concentration while learning mathematics at home' (Item 11). 45.9% of the pre-tertiary students strongly disagreed/disagreed to the statement 'during COVID-19 pandemic I hate learning mathematics

alone at home' (Item 12). 52.3% of the pre-tertiary students strongly disagreed/disagreed to the statement 'during COVID-19 pandemic running errands for my parents do not allow me to concentrate on learning mathematics at home' (Item 13). 64.3% of the pre-tertiary students strongly agreed/agreed to the statement 'during COVID-19 pandemic my parents are less concerned with my learning mathematics at home' (Item 14). 78.1% of the pre-tertiary students strongly agreed/agreed to the statement 'during COVID-19 pandemic my parents do not encourage me to learn mathematics at home' (Item 15). 55.2% of the pre-tertiary students strongly agreed/agreed to the statement 'during COVID-19 pandemic I am more relaxed learning mathematics alone at home' (Item 16). 77.8% of the pre-tertiary students strongly disagreed/disagreed to the statement 'during COVID-19 pandemic I do not have anybody to compete with while learning mathematics at home' (Item 17). 69.0% of the pre-tertiary students strongly agreed/agreed to the statement 'during COVID-19 pandemic learning mathematics at home is a waste of time' (Item 18).

**Research Question 3:** What is the influence of gender on attitudes towards mathematics homeschooling during the period of COVID-19 pandemic among Nigerian pre-tertiary students?

The results in Table 3 below showed that the male pre-tertiary students recorded slightly higher mean score (M=2.14, SD=0.72) than their female counterparts (M=2.13, SD=0.66) on distraction and parent negative attitude dimension of attitudes towards mathematics homeschooling and this lean mean difference was statistically not significant t(2, 340)=0.20, p=0.84. Therefore, it was concluded that there was no significant influence of gender on pre-tertiary students' distraction and parent negative attitude. Also, the male pre-tertiary students recorded higher mean score (M=2.16, SD=0.70) than their female counterparts (M=1.97, SD=0.76) on home enjoyment dimension of attitudes towards mathematics homeschooling and this high mean difference was statistically significant t(2, 340)=2.46, p=0.01. Therefore, it was concluded that there was a significant influence of gender on pre-tertiary students' home enjoyment. Table 3 showed that the male pre-tertiary students recorded slightly lower mean score (M=2.72, SD=0.97) than their female counterparts (M=2.92, SD=0.97) on school enjoyment dimension of attitudes towards mathematics homeschooling and this lean mean difference was statistically not significant t(2, 340)=1.85, p=0.07. Therefore, it was concluded that there was no significant influence of gender on pre-tertiary students' home enjoyment. Also, the male pre-tertiary students recorded slightly lower mean score (M=1.97, SD=0.58) than their female counterparts (M=2.02, SD=0.59) on competition and parent positive attitude dimension of attitudes towards mathematics homeschooling and this lean mean difference was statistically not significant t(2, 340)=0.86, p=0.39. Therefore, it was concluded that there was no significant influence of gender on pre-tertiary students' competition and parent positive attitude. Table 3 showed the male pre-tertiary students recorded slightly higher mean score (M=2.18, SD=0.42) than their female counterparts (M=2.15, SD=0.43) on attitudes towards mathematics homeschooling and this lean mean difference was statistically not significant t(2, 340)=0.65, p=0.51. Therefore, it was concluded that there was no significant influence of gender on pre-tertiary students' attitudes towards mathematics homeschooling.

Table 3. Independent Samples t-test analysis of pre-tertiary students' attitudes towards mathematics homeschooling based on gender

| Construct | Gender | N | Mean | SD | Std. Error Mean | Df | t | p |
|---|---|---|---|---|---|---|---|---|
| Distraction and parent negative attitude | Male | 184 | 2.14 | 0.72 | 0.05 | 340 | 0.20 | 0.84 |
| | Female | 158 | 2.13 | 0.66 | 0.05 | | | |
| Home enjoyment | Male | 184 | 2.16 | 0.70 | 0.05 | 340 | 2.46 | 0.01 |
| | Female | 158 | 1.97 | 0.76 | 0.06 | | | |
| School enjoyment | Male | 184 | 2.72 | 0.97 | 0.07 | 340 | 1.85 | 0.07 |
| | Female | 158 | 2.92 | 0.97 | 0.08 | | | |
| Competition and parent positive attitude | Male | 184 | 1.97 | 0.58 | 0.04 | 340 | 0.86 | 0.39 |
| | Female | 158 | 2.02 | 0.59 | 0.05 | | | |
| Attitudes towards mathematics homeschooling | Male | 184 | 2.18 | 0.42 | 0.03 | 340 | 0.65 | 0.51 |
| | Female | 158 | 2.15 | 0.43 | 0.03 | | | |

Unlocking pre-tertiary students' attitudes towards mathematics homeschooling during this period of COVID-19 pandemic is vital for instructional and professional success in mathematics occupation. Lamentably, mathematics educators and mathematics teachers lack dependable and operational valuation implements to accurately appraise and determine pre-tertiary students' attitudes towards mathematics homeschooling during the period of COVID-19 pandemic. In the study, a fundamental impression is created through the establishment of a robust and multifaceted pre-tertiary student-report survey tool for gauging pre-tertiary students' attitudes towards mathematics homeschooling during the period of COVID-19 pandemic. This investigation is distinctive in the extant literature in that it is the first to show that attitudes towards mathematics homeschooling scale is a multi-dimensional construct. This multi-dimensional model shows that the pre-tertiary student attitudes towards mathematics homeschooling is branded via all-encompassing attitudes towards mathematics homeschooling model, as well as four unique and interpretable factors: distraction and parent negative attitude, home enjoyment, school enjoyment, and competition and parent positive attitude. By illuminating the all-encompassing attitudes towards mathematics homeschooling and numerous particular dimensions of pre-tertiary students' attitudes towards mathematics homeschooling, one will be at the realm of ascertaining the groupings of attitudes towards mathematics homeschooling that most flawlessly predict mathematics-reliant learning results.

In this elucidation of dimensions, one is adept at analyzing the additive and interactive effects amid numerous factors. Consequently, the researcher will be capable of exploring the association between mathematics-reliant outcomes and the all-encompassing attitudes towards mathematics homeschooling model, and the unique function of the specific dimensions to mathematics results that are dissimilar from the all-encompassing attitudes towards mathematics homeschooling model. This result is consistent with the avalanche of results on attitudes towards mathematics in general, which showed that attitudes towards mathematics scale is a multi-dimensional construct (Tapia & Marsh, 2004). In this study, four putatively distinct factors of attitudes towards mathematics homeschooling have been created and these do not agree with seeing attitudes towards mathematics homeschooling on a range comparatively than exploiting a factorial perspective. A multifaceted position on pre-tertiary student attitudes towards mathematics homeschooling allows a richer representation of how pre-tertiary students do, feel and deliberate with

colleagues in mathematics outside the classrooms, comparatively than viewing each of the dimensions conspicuously. Seeing attitudes towards mathematics homeschooling as a multifaceted model could aid mathematics educators to reflect on the consequence of each dimension of attitudes towards mathematics homeschooling markedly on mathematics outcome. The four factors of attitudes towards mathematics homeschooling create a corporate factor of all-encompassing attitudes towards mathematics homeschooling, which show the combined variances pooled by the four factors of the attitudes towards mathematics homeschooling. Besides, each factor of pre-tertiary student attitudes towards mathematics homeschooling represents specific elements, which portray their unique variances, far greater than the all-encompassing factor of pre-tertiary student attitudes towards mathematics homeschooling. Although not researched in the study, these specific elements could be adapted to specifically forecast academic accomplishment and educational motivations, independent of the all-encompassing attitudes towards mathematics homeschooling factor. Thus, this study backs the notion that distraction and parent negative attitude, home enjoyment, school enjoyment, and competition and parent positive attitude are not only hypothetically associated to one another at the all-encompassing model level, but also portray diverse and unique models.

A large proportion of the pre-tertiary students showed high attitudes towards mathematics homeschooling in the study. This outcome could be ascribed to the fact the pre-tertiary students might have enjoyed positive attitudes towards mathematics in their primary and secondary school days. This finding agreed with the general result on attitude toward mathematics by Awofala (2016) who found that pre-service teachers exhibited high attitude toward mathematics. Although the pre-tertiary students may have challenges in their learning of mathematics, the present study showed that the majority of them possess a positively high attitude towards mathematics homeschooling. This result is good since positively high attitudes towards mathematics homeschooling could serve as an antecedent to a successful career in mathematics and mathematics-related disciplines (Awofala, 2016).

The high attitudes towards mathematics homeschooling in this study revealed that pre-tertiary students did not seem to enjoy learning mathematics at home than in the school during the COVID-19 pandemic (item 1) thereby alluding to the fact that mathematics is better taught at school than at home (item 2). The pre-tertiary students admitted that they missed learning mathematics in a classroom setting when they learn at home (Item 3) and this reinforced them to miss classroom affordances while learning mathematics at home during the period of COVID-19 pandemic (Item 4). While the pre-tertiary students admitted that they learn mathematics at their own pace at home than at school (Item 5), they did not see their parents hiring mathematics teachers to teach them at home during the period of COVID-19 pandemic (Item 6). More so, the pre-tertiary students did not like to learn mathematics from their parents at home (Item 7) and they did not like being at home to learn mathematics online (Item 8). While the pre-tertiary students admitted that, their siblings do not interfere with their learning of mathematics at home (Item 9), they were interested in learning mathematics at home during the period of COVID-19 pandemic (Item 10). In this study, the pre-tertiary students were neither distracted nor lost concentration while learning mathematics at home (Item 11) but they liked to learn mathematics alone at home during the period of COVID-19 pandemic (Item 12). The pre-tertiary students thought that they could run errands for their parents and at the same time have full concentration in learning mathematics at home during the period of COVID-19 pandemic (Item 13). To the pre-tertiary students, their parents were less concerned with their learning of mathematics at home (Item 14) and they do not encourage them to learn mathematics at home (Item 15) during the period of COVID-19 pandemic even though the pre-tertiary students were more relaxed learning mathematics alone at home (Item 16). To sum it

all, the pre-tertiary students had fellow students to compete with while learning mathematics at home (Item 17) but that their learning of mathematics at home is a waste of time (Item 18) during the period of COVID-19 pandemic.

Besides, the results of this study showed that gender had no statistically significant influence on pre-tertiary students' attitudes towards mathematics homeschooling. These results imply that both male and female pre-tertiary students had similar attitudes towards mathematics homeschooling. In general, some studies had found a significant influence of gender on students attitudes towards mathematics (Meelissen & Luyten, 2008; Odell & Schumacher, 1998; Hyde, Fennema, Ryan, Frost, & Hopp, 1990; Awofala, 2008a) while others had supported no significant influence of gender on attitudes toward mathematics (Awofala, 2017, 2016; Kögce, Yildiz, Aydin & Altindag, 2009; Mohd, Mahmood & Ismail, 2011; Nicolaidou & Philippou, 2003). In Nigeria, mathematics is considered a masculine domain (Awofala, 2016; Awofala & Anyikwa, 2014; Ogunleye, Awofala & Adekoya, 2014; Awofala, 2008b). This view seemed to be disappearing with regards to the fact that females like males have been socialized in today's knowledge determined economy to be more comfortable with studying mathematics and mathematics-related fields and this may have lessened the obstacles professed by females in mathematics teaching and learning (Awofala, 2016). Thus, the amplified females' involvement in mathematics and mathematics-related fields in schools has reduced the growth of gender variances in attitudes towards mathematics and this is encouraging (Awofala, 2016) because it did not only motivate them (Awofala, 2016; Awofala & Falolu, 2017) but made them more creative (Awofala & Fatade, 2015) in mathematical learning.

## Conclusion

Two limitations are associated with this study. Foremost, the excessive dependence on survey method is a drawback that may diminish one's aptitude to holistically explore the attitudes towards mathematics homeschooling as other methods such as interviews and observations may be more useful in the construct exploration. Second, this study did not answer the question of how each dimension of attitudes towards mathematics homeschooling could explain academic outcomes in mathematics. The multidimensional scale developed in this study could aid researchers in ascertaining the relationship between each dimension of attitudes towards mathematics homeschooling and underlying outcomes in theoretical exemplifications and engender different pre-tertiary students' attitudes towards mathematics homeschooling profiles. In this study, the pre-tertiary students had a high level of attitudes towards mathematics homeschooling and this is encouraging. Besides, gender was not a factor in pre-tertiary students' attitudes towards mathematics homeschooling. This means that both male and female pre-tertiary students had similar attitudes towards mathematics homeschooling. Objectively, this study has provided investigational evidence supportive of the factorial validity of the attitudes towards mathematics homeschooling scale. In conclusion, this assessment tool will be of great value for researchers exploring the background predictors and educational imports of attitudes towards mathematics homeschooling in mathematics learning milieu.

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