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Curriculum Issues: The Role of Gender and Early Childhood Educational Experiences in Problem Solving and Enjoyment of Mathematics Curriculum

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Abstract

This research presents a report of an exploratory survey analysis of selected secondary data in mathematics learning. In doing this, relevant literature in relation to mathematics learning was reviewed. Second, some related hypotheses which arose from the literature review were proposed. Thirdly, the survey methods which were used in data collection for the purpose of hypothesis testing will be critically discussed. Fourth, the reliability and validity of the secondary data used in this research were appraised. Summary and analysis of data were given, making use of the advanced statistical techniques. Finally, the research discusses the implications of these survey findings for further research.

Keywords: Gender, Self-Belief, Confidence, Mathematics-Curriculum, Early-Childhood-Education, Sex Difference, Enjoyment-of-Mathematics

Background

Nigeria's emphasis on science, technology, engineering and mathematics is to ensure that education meets a country's' technological advancement. Mathematics which is applied in science and its related courses is regarded as a gateway to any nation's technological development. To this end, teaching and learning of mathematics in process and in principle are always given necessary attention in a school curriculum (National Policy on Education, 2008; Leong, Dindyal, Toh, Quck, Tay & Lou, 2011) so that mathematics content and methods of teaching will encourage the development of students' critical reasoning (Ozcan, 2016). There is no limit when narrating the importance of mathematics in education. It is in this respect that Nigeria like most countries make mathematics a compulsory subject for all their students at both primary and secondary school curriculum, as argued by Prendergast and O'Donoghue (2014). Leder, Forgasz and Jackson (2014) argue that learning mathematics trains learners to interpret the social world mathematically and to use mathematics to make decisions and predictions in all their financial and personal matters. Learning mathematics includes the acquisition of numeracy skills which is all about problem-solving (Kosyvas, 2016). The reasoning, analysis and critical thinking involved in solving mathematical problems undoubtedly will help to realise the science goal of producing scientists for a country's national development (National Policy on Education, 2008). To this end, emphasis is placed on learning mathematics and is considered a core component in the school curriculum (Ozcan, 2016). Universities and employers of labour are demanding that school leavers need to apply mathematical knowledge gained in order to solve problems in familiar and unfamiliar contexts (Jones, Swan & Pollitt, 2015). Perhaps, the nature and usefulness of mathematics and its career options has placed mathematics above other subjects in school curriculum (Morales, Avilla & Espinosa, 2016). This section highlights some factors that might influence the learning of mathematics. Specific attention is given to the following factors as being necessary ingredients for effective mathematics learning; influence of gender, attending early childhood education, enjoyment of mathematics, and confidence in solving mathematics problems.

Gender issue in mathematics

Despite the special preference accorded to the teaching and learning of mathematics in school curricular, the learning of mathematics has not been easy for all students as differences between boys and girls have been found to exist in the learning of mathematics (Ganley & Vasilyeva, 2014; So-Chen & Chia-Chang, 2016; Murray, 2016). This gender issues in mathematics has been the subject of debate and research for some decades now (Prendergast & O'Donoghue, 2014; Hossain & Tarmizi, 2012). Differences between boys and girls are often referred to as 'sex differences', but as this complex concept is related to socially accepted norms, 'gender differences' is the generally accepted term (Hall, 2014). Learning of mathematics is necessary as numeracy skills are very important in ordinary daily living such as counting change, shopping, telling time and in household matters irrespective of sex, age, race or colour, but researchers argued that learning mathematics is male dominated and is regarded as a male domain (Leder, Forgasz and Jackson, 2014; Mizala, Martinez & Martinez, 2015) and incompatible with femininity (Hall, 2014).

The imbalance or gap in learning of mathematics may perhaps be predicted by social and personal factors (Halpern, Benbow, Geary, Gur, Hyde & Gernsbacher, 2007; Leaper, Farkas, & Brown, 2012). More so, factors such as attitude and anxieties towards mathematics were also identified as a significant predictor of mathematics learning (Mizala, Martinez & Martinez, 2015; Ganley & Vasilyeva, 2014; Skouras, 2014; Dogan, 2012). Anxiety (Richardson & Suinn, 1972) as quoted in Mizala, Martinez & Martinez (2015, p71) is defined as the "feeling of tension and anxiety interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations". Anxiety is perhaps synonymous to worry. Females' low performance in mathematics was argued by Ganley and Vasilyeva (2014) to be as result of their anxiety and worry which utilizes working memory resources in them. As a result of this, female students may feel reluctant and unhappy to pursue studies in mathematics.

Bench, Lench, Liew, Miner &Flores (2015) argued that the reported gender imbalance, where less girls pursue their mathematics and the related courses, is a result of students' estimation of their mathematics performance. They stated that boys overestimate their mathematics performance while girls underestimate their performance, thereby giving the boys an upper hand to be more interested in pursuing mathematics courses. In line with this mathematics estimation, Guo, Marsh, Parker, Morin and Yeung (2015, pp2) used Atkinson's (1967) "Expectancy-Value Theory; which proposes that expectancy of success in a given task and the degree to which the task is valued are determinants of achievement-related performance and choices" to argue that females' low performance in mathematics is influenced by their expectancy in mathematics as well as their subjective assessment of the inherent value of mathematics task. But to Wei, Chesnut, Barnard-Brak, Stevens & Olivarez (2014), interest contributes significantly when connecting self-beliefs to occupational decisions and performance. In view of this, boys' interest and self-beliefs lead them to better performance in mathematics as well as choosing applied mathematics related courses. On the other hand, in line with the males' overestimation of their performance, Sarouphim & Chartouny (2017) argued that it is a common belief in traditional culture that females do not perform equally with their male counterparts in mathematics. Their findings showed no significant gender difference in mathematics performance and attitude. The notion that males outperformed females in mathematics was argued by Hyde (2005) as over-inflated claims which are not consistent with scientific data. But, one might perhaps say, that even as males are overrepresented in mathematics, females are underrepresented (Mihaljevic-Brandt, Santamaira & Yullney, 2016) as well as receiving lower achievement in mathematics.

Early childhood education (ECE)

Early childhood education (ECE) is defined within the framework of policies of every nation. But the services articulated in early childhood education curriculum rendered during this programme remain the same. Various authors define early childhood education as educational training given to children mostly under the age of 5 years prior to their entry to primary school (Tesar, 2016; Mensa and Badu-Shayar, 2016; Akinrotimi and Olowe, 2016). ECE curriculum is designed in such a way that it can develop Childs' early literacy abilities, knowledge and skills which relate to science, mathematics and others. Its curriculum is concerned with how children from birth grow, develop and learn (Morrison, 2015). Epstein and Barnett (2012) state that early childhood education makes a significant effect on children's development that can continue well into the school years. Consequently, there has been growing demand to access qualitative ECE that will enhance education in later life (Cortazar, 2015; Aboud and Hossian, 2011) and for a better future (Kaplan and Hertzog, 2016). Attending ECE is argued by researchers as a key factor that influences student confidence in their ability to perform well in mathematics (Sulivan, 2013; Alejandra, 2015; Lee, Zhai, Brooks-Gunn, Han, and Waldfogel, 2014). Perhaps, one might argue that attendance in early childhood education may be seen to be associated with many academic gains like arithmetic calculations (addition and subtraction), reading and writing.

ECE regulates and nurtures children's attention in all areas of inductive and deductive reasoning. Williams, White and McDonald (2016) stated that early childhood education regulation of child's attention is directly associated with mathematics performance. Lehrl, Klucznoik, and Rossbach's (2016) study with 554 German children in ECE shows that early childhood mathematical skills positively predict elementary school mathematics quality. But Claessens and Garrett (2014) argued that skills acquired during ECE have a temporal and short-term effect. They maintained that all educational benefits acquired through attendance at such programmes ostensibly fade out in early elementary school years and thus have no effect in later school years learning. Claessens and Garretts' argument does not seem to agree with Schukajlow and Rakoczy's (2016) findings which state that students' enjoyment of mathematics affects their interest and performance in mathematics and that prior interest affects post interest. Perhaps, developing interest in mathematics at a Child's early stage may lead to interest and enjoyment of mathematics during later years.

Enjoyment of mathematics

Students' enjoyment of mathematics is predicated by interest and career options. Ing (2013) argued that external factors, such as interest and career options, influence the student's learning of mathematics. This agrees with Tossavainen and Juvonen's (2015) argument that enjoyment of mathematics is a result of an interest in mathematics that is based on the view of its importance and its usefulness. It was argued that the low level of women's participation in various spheres of work accorded females a dependent position and lower status, thereby affecting females' exposure to mathematics (Ayalon & Livneh, 2013). Ayalon and Livneh argued that to the female inclination towards the traditional belief of seeing mathematics as less important for their future tends to make mathematics a course uninteresting and unenjoyable, hence females put less effort (time and energy) into mathematics lessons. As stated earlier, prevailing negative stereotype about females' ability in mathematics create a conflicting identity that can lead to failure (Lane, Goh and Driver-Linn, 2012). This negative belief provides the female less opportunity to derive maximum benefit from mathematics teaching, resulting in less performance than the male students. Ahqvist, London- and Rosenthal (2013) argued that conflicting identity raises self-doubts about females belonging to the mathematics domain. They however added that conflicting identity can be harmful to success and satisfaction in mathematics. Hence stereotyping mathematics into a male domain is a way of increasing females' disinterest and less enjoyment of mathematics as argued by Prendergast and O'Donoghue (2014). Contrary to these views, females' involvement in careers which are mathematically oriented, such as teaching, engineering, architecture, medical studies and others is as a result of their interest and enjoyment of the mathematics. Piatek-Jimenez (2015) argued that an interest in mathematics and an enjoyment of it necessitate females' choosing a service-oriented career involving the application of mathematics.

Confidence in solving mathematics problems

Learning mathematics is a means of acquiring skills necessary for solving everyday problems. Kirwan's (2015) argument that mathematics is an engine for innovation and wherewithal for developing problem solving skills might be in line with Perdigones, Gallego, Garcia, Fernadez, Perez-Martin and Dell-Cerro (2014) position that mathematical modelling is basic, essential and necessary tool for developing other subjects. To this end, the mathematics student must be confident in solving mathematical problems in order to achieve this goal. Confidence is a state of being hopeful and optimistic. Confidence is defined as having full assurance or strong belief (Dictionary.com, 2022).

Developing interest in mathematics and consequently in problem solving in mathematics is a process that should start from childhood. Children's problem solving skills in mathematics can be developed early starting from the individual child's interest through the child initiated and adult led experience (Fox and Surtees, 2010). It is believed that in order for a child to be confident in solving mathematics problems it means that the child utilizes critical thinking abilities that will enhance the child's confidence to think and make rational decisions (Su, Ricci and Mnatsakanian, 2016). However, when necessary skills are not developed at the child's early stage, and also mathematics being a stereotyped male domain (Banjong, 2014), female students will not develop appropriate skills in mathematics and therefore will have low confidence in solving mathematics problems (Stoet and Geary, 2012).

It was said earlier that ECE is a programme that enables the child to learn and develop skills. Standing on the views that mathematics skills and abilities can be acquired, Good, Rattan and Dweck (2012, p1) maintained that acquisition of mathematics skills through learning mathematics skills during ECE helps to shield females from negative stereotypes thereby "allowing them to maintain high sense of belonging in mathematics" and to be confident in solving mathematics problems in the future. But contrary to Good's opinion, Hargreaves, Homer and Swinnerton (2008) reported that girls have low confidence in mathematics problem solving but at the same time perform on equal level with boys.

Moreover, attending ECE and concern about mathematics may perhaps be a big challenge in the ability to learn mathematics as well as confidence in solving mathematics problem. The literature reviewed has given diverse opinion in respect to learning mathematics. This study will focus on variables in learning of mathematics by the student which can eventually give them confidence in solving mathematics and everyday problem. In doing this, controlling demographic variables such as gender and attending ECE will be used to check if any of them has a predicting effect on student enjoyment of mathematics learning, as well as their confidence in solving mathematics problems. The study therefore seeks to find out if gender or attending ECE can predict: (1) student enjoyment of mathematics learning and (2) students' confidence in mathematics problem solving.

Null Hypotheses

- There is no significant prediction of students' enjoyment of mathematics learning by gender or attending ECE.
- There is no significant prediction of students' confidence in mathematics problem solving by gender or attending ECE.

Methodology

Under this section, the design of the study, the participants in the study and the questions to be used in the study will be discussed.

Design

This research is focussing on mathematics learning. The design is a cross sectional survey design implemented across a number of different countries grounded in students' enjoyment of mathematics learning and confidence in mathematics problem solving. The data to be used in this research is a survey database that was designed and conducted by OECD Programme for International Student Assessment (PISA) 2012 using cross sectional survey in their data collection. It is a quantitative study which analysed the PISA assessment of competencies of 15-year-olds in mathematics and sciences with a focus on mathematics

Participants

PISA 2012 followed an internationally representative sample of 5165 students because it was a large-scale survey. The sample is for the United Kingdom which covers Northern Ireland, England, Scotland and Wales.

Questionnaire

The questions selected for this assignment were designed to assess personal influences on a 15year old in learning mathematics. The questions cover gender, early childhood education, students' enjoyment of mathematics and confidence in mathematics problem solving. The questions are given in Appendix.

Ethical Issues

The data used for this study are publicly available. Being a secondary database conducted and collected by Organisation for Economic Co-operation and Development Programme for International Student Assessment (OECD-PISA 2012), there is no ethical issue with regard to the questions selected for this study because of the public availability.

Data Analysis

The analyses were carried out in relation to the two hypotheses stated above. These were done with respect to gender, early childhood education, enjoyment of mathematics and confidence in mathematics problem solving. But before the analysis, the steps that were taken to avoid violating conditions necessary for good regression analysis (Foster, 2001; Narayan, 2016) to be carried out were: dummy coding the data, checking for normal distribution of response variable and checking for outliers (extreme cases) as noted by Tacq (1997) to maintain regression model assumptions conditions.

Two independent nominal variables (gender and attending ECE) were dummy coded using Transform Analysis so that they can fit into regression analysis. There were some outliers which resulted in making the analysis three times. The first time 9 cases were removed and the second time, 3 extreme cases were removed and finally there were no further outliers. In checking for multicollinearity, two dummy variables (Attend-Less-One and Attend-More-Than-One) were highly correlated (r=0.872) and Attend-Less-One-Year was dropped from the analysis. Although there was need to go back to go back to the original variable and create a single dummy variable with two categories, but this was not done due to limitation of space in this research.

Normal P-P Plot was used to check for normal distribution of the respondent variable as shown below:

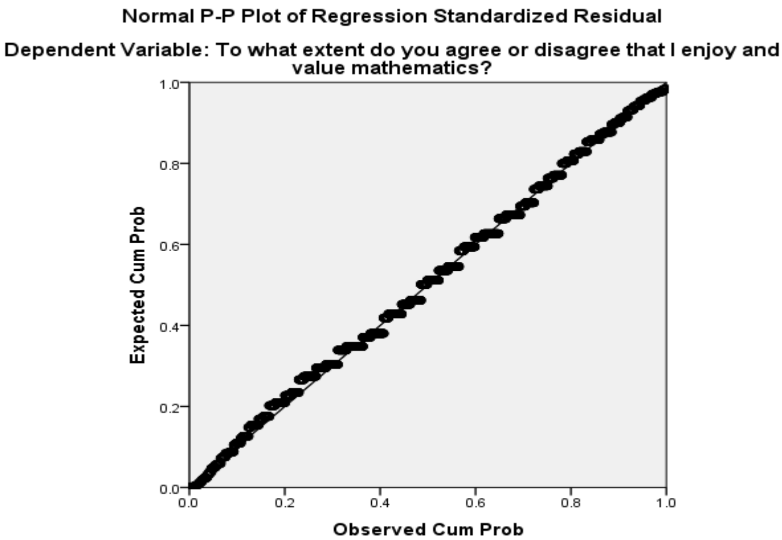

Figure 1

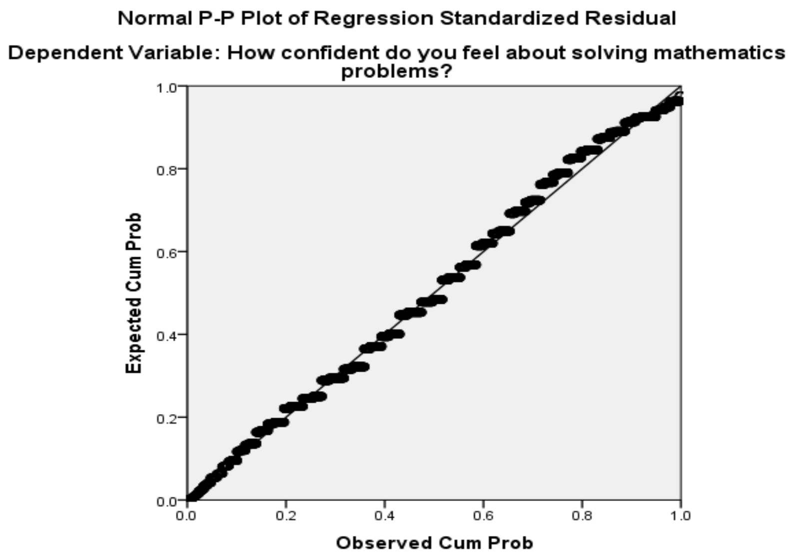

Figure 2

A cursory look at Figure 1 and 2 above, it can be said that the response variables were approximately normally distributed with mean.

Factor Extraction Model: Principal Component Analysis (PCA)
PCA is the underlying principle of transforming a given number of correlated variables into a smaller size of variables called principal components (Narayan, 2016; Jolliffe, 2002). It is a statistical technique within factor analysis that identifies the dependent structure behind a multivariate random observation so as to obtain a compact interpretation of it (Diamantaras and Kung, 1996; Abdi and Williams, 2010) in "terms of their common underlying factors (Hair, Black, Babin, Anderson and Tathan, 2000). PCA were carried out separately on 2 sets of 8 items each from PISA 2012 student questionnaire mathematics that constitute "enjoyment of maths" and "confidence in maths" to identify the dimension of construct by examining the relationship between the items and the factors (Kinear and Gray, 2000; Bryman and Cramer, 2011). The items used in the study were questions 28a-h and 30a-h. The items were recorded to give strongly agreed a high score and strongly disagree low score as well as more confidence high score and low confidence low score in Enjoyment of Maths and Confidence in Maths respectively. Apart from using PCA to reduce these two separate set of 8 items to two separate single factors, PCA increases the reliability of the scale by identifying inappropriate item(s) that have to be removed (Taecho and Richardson, 2015). But before checking item extraction, the strength of inter correlation among the variables was first determined by conducting a test to find out whether the variables are factorable. This was done using Kaise-Meyer-Olkin (KMO) measure of sample adequacy which should be greater than or equal to 0.5 to indicate the amount of variance in the variable that might be caused by a given factor and Bartlett's test of sphericity which need to be significant ($p<.05$) to assess the validity of the sample or whether the sample is correlated (Bryman and Cramer, 2011). The output of PCA would give dimension determined through inspecting the Scree Plot and Kaiser's Criterion of Eigenvalues above 1.

Reliability Test
Reliability test is an assessment of an instrument or scale or questionnaire to determine its consistency in producing results (Kinner and Gray, 2008; Brace, Kemp and Snelgar, 2009). The reliability of the instruments used was determined using Cronbach's alpha coefficient which ranges from a value of 0.00 to 1.00. Although, there was no minimum value of alpha coefficient from the existing literature, Kinner and Gray suggest that for a scale or instrument to be useful, its reliability should at least be 0.8. Items in any factor with low alpha value will be removed if those items shows negligible effect on the factor's alpha. Brace, Kemp and Snelgar (2009) and Foster (2001) reported that with a rule of thumb, an instrument should have a minimum threshold Cronbach's alpha value of 0.7.

Findings and Discussion
The 8 items in both questions Q28 (ENJOYMATH) and Q30 CONMATHS) of PISA 2012 student questionnaire mathematics were subjected to PCA. But before PCA, the data was first assessed for its suitability of factor analysis.

Factor Analysis

Table 1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.886
Bartlett's Test of Sphericity	Approx. Chi-Square	15426.189
	Df	28
	Sig.	.000

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.871
Bartlett's Test of Sphericity	Approx. Chi-Square	10281.342
	Df	28
	Sig.	.000

As shown in Table 1 and 2, KMO was found to be .886 for Q28 (ENJOYMATH) and .871 for Q30 (CONMATHS) respectively. These values are close to 1 and above 0.5 as identified by Narayan (2016) as the condition necessary for factor analysis. Also on the same Table 1 and 2 of Bartlett's test of sphericity, both ENJOYMATH and CONMATHS were found to be statistically significant at $p<.05$, meaning that the 8 items in ENJOYMATH are related and also 8 items of CONMATHS are equally related. Therefore, PCA can be conducted on both ENJOYMATH and CONMATHS since they were significant at $p<.05$ and their respective KMOs were greater or equal to 0.5 in line with the Narayan (2016) assertion.

PCA was computed and all items in each question loaded on one factor each (items in Q28 on ENJOYMATH and items in Q30 on CONMATHS). The initial and extraction communalities in ENJOYMATH and CONMATHS are shown in Tables 3 and 4 respectively. The initial communalities indicates that the proportion of variance accounted for in each variable by the other variables is high. Also on the same Tables, the estimates of variance in each variable, which is accounted for by ENJOYMATH and CONMATHS in the factor solution, are high in both factors. This indicates that the items fit well with the factor solution (Taecho and Rechardson, 2015) since the factors loading with their variables were above .3 (Foster, 2001), so all items were retained because they correlate with their factors. Although, Figures 1 and 2 shows Scree Plot that indicates that the slope changes at 2, which means 2 factors are to be extracted in each of the analysis, and eigenvalues above 1 are few, but in each case, all the variables loaded in one factor resulting in retention of all the variables .

Table 3: Communalities

	Initial	**Extraction**
st29q01R	1.000	.706
st29q02R	1.000	.689
st29q03R	1.000	.768
st29q04R	1.000	.847
st29q05R	1.000	.717
st29q06R	1.000	.756
st29q07R	1.000	.691
st29q08R	1.000	.705

Extraction Method: Principal Component Analysis

Table 4: Communalities

	Initial	**Extraction**
ST37q01r	1.000	.405
sT37Q02r	1.000	.543
st37q03r	1.000	.604
st37q04r	1.000	.478
st37q05r	1.000	.517
st37q06r	1.000	.559
st37q07r	1.000	.498
st37q08r	1.000	.456

Extraction Method: Principal Component Analysis.

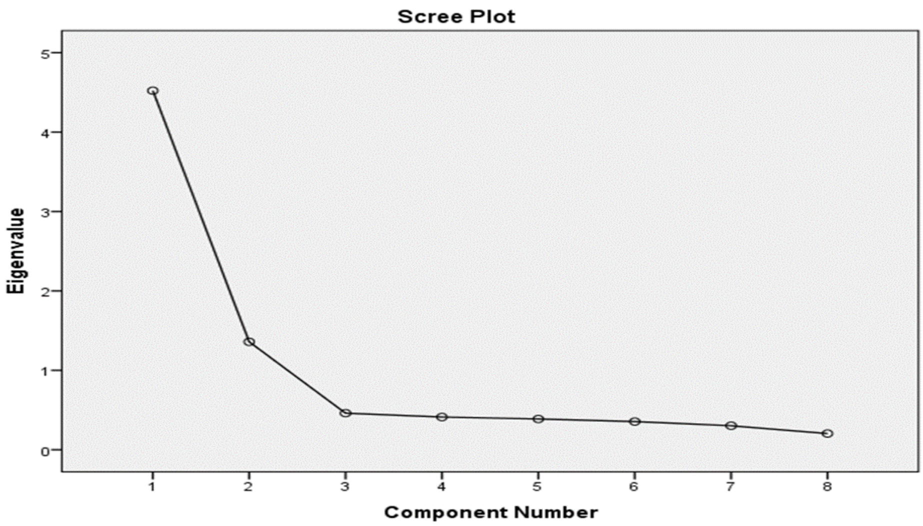

Figure 3

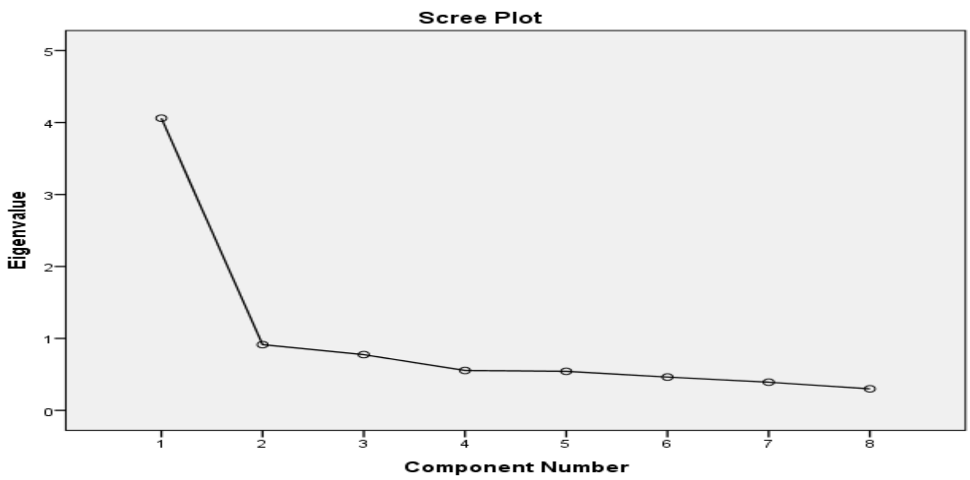

Figure 4

Reliability Test

In checking the reliability of the analysis, reliability tests were conducted using Cronbach's alpha coefficient test. All the items were being considered because they had high alpha which reflected high effect on the factors. The Cronbach's alpha coefficient test indicates that their alpha coefficients are above .7 as proposed by Brace, Kemp and Snelgar (2009) and Foster (2001), so all the variables were retained and in effect, both ENJOYMATH and CONMATHS were assumed to be internally reliable.

Regression Analysis

Note: For the purpose of this analysis, ECE stands for early childhood education. The regression analysis was carried out four times using the predictors and response variables shown in the table below. The dummy att ECE more than one year has more effect value and therefore more correlated to the two response variables than dummy ECE less one year. For this reason, dummy att ECE more than one year were used for the analysis.

Table 5: Regression Model Table

Regression Model	Predictors Variables	Response Variables
1	Gender & dummy Att ECE Less One Yr	ENJYOYMATH
2	Gender & dummy Att ECE More than One Yr	ENJOYMATH
3	Gender & dummyAtt ECE Less One Yr	CONMATHS
4	Gender & dummy Att ECE More than One Yr	CONMATHS

Hypothesis 1: The predictor variables used here are dgender (ST04Q01), att ECE (ST05Q01) and the response variable is students' enjoyment of mathematics learning (ENJOYMATH). Statistical significant of prediction of gender or early childhood education on students' enjoyment of mathematics learning were conducted using linear multiple regression analysis. The multiple regression model equation is; Predicted ENJOYMATH = a + b1 (dgender) + b2 (dummy att ECE)

Table 6: Model Summary[b]

					Change Statistics					
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.064[a]	.004	.003	4.77544	.004	6.832	2	3341	.001	1.950

a. Predictors: (Constant), dummy_attan_more_one, d_gender
b. Dependent Variable: To what extent do you agree or disagree that I enjoy and value mathematics?

Table 6 shows how gender and attending early childhood education can predict the student's enjoyment of mathematics learning. As can be seen in Adjusted R Square from the table, the proportion of the variation in ENJOYMATH that can be accounted for by the combined effects gender and ECE is .003 which is just only 0.3%. The 99.7% cannot be accounted for by gender and ECE. Table 6 (ANOVA) below indicates that the result is statistically significant at ($p \leq 0.05$, F = 6.832, df = 76190.939). It shows that there is still evidence that the model (gender and ECE) has some level of predictions of variations on the student's enjoyment of mathematics learning.

Table 7: ANOVA[a]

Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	311.616	2	155.808	6.832	.001[b]
	Residual	76190.939	3341	22.805		
	Total	76502.555	3343			

a. Dependent Variable: To what extent do you agree or disagree that I enjoy and value mathematics?
b. Predictors: (Constant), dummy_attan_more_one, d_gender

Table 8: Coefficients[a]

		Unstandardized Coefficients		**Standardized Coefficients**			**95.0% Confidence Interval for B**		**Collinearity Statistics**	
Model		**B**	**Std. Error**	**Beta**	**t**	**Sig.**	**Lower Bound**	**Upper Bound**	**Tolerance**	**VIF**
1	(Constant)	21.981	.166		132.778	.000	21.657	22.306		
	d_gender	.592	.166	.062	3.572	.000	.267	.916	.995	1.005
	dummy_attan_more_one	-.118	.172	-.012	-.686	.493	-.456	.220	.995	1.005

a. Dependent Variable: To what extent do you agree or disagree that I enjoy and value mathematics?

From Table 8 above, in the standardized coefficient column it is obvious that gender has predicting effect (.062) and attending ECE is statistically significant ($p \geq 0.05$), shows that attending ECE more than one year has some predicting effect on student's enjoyment of mathematics. Table 9 is also used to estimate level of predictions of enjoyment of mathematics by gender (male and female) and attending early childhood education by putting the figures from the unstandardized coefficient column in the model equation as follows:

Predicted ENJOYMATH = 21.981 + 0.592 (d gender) – .118 (ECE). Holding gender constant, ENJOYMATH varies with ECE by 21.981 – 0.118 (1) = 21.863 and also holding ECE constant, ENJOYMATH varies with dgender by 21.981+0.592 (1) = 22.573. These figures confirm the statements earlier that gender has much more effect in predicting ENJOYMATH than ECE. However, in checking how male and female contribute separately in predicting ENJOYMATH will be;
Predicted ENJOYMATH = 21.981 + 0.592 (male) + 0.592 (female) = 21.981 + 0.592 (1) for male = 22.573 and female is 21,981+ 0.592 (0) = 21.981. Therefore boys enjoy maths more than girls do. This agrees with the finding that the female dependent position as well as the conflicting identities have an effect on the females' enjoyment of mathematics (Ayalon & Livneh, 2013; Ahqvist, London- and Rosenthal (2013). Moreover, the available literature reviewed indicate that attending early childhood education contributes to students' learning of mathematics, although from this analysis, attending early childhood education has less impact than gender in predicting enjoyment of mathematics learning. From this analysis, the predictor variables added statistically significantly to predict ENJOYMATH thereby rejecting the hypothesis stated above but their level variation differs.

Hypothesis 2: In this case, Gender and ECE are predictor variables, while CONMATHS is the response variable used for the analysis. Linear multiple regression analysis were used to analyse the statistical significant of prediction of Gender and attendance in ECE on student confidence in mathematics problem solving. The R Square is significantly different from zero (Table 10), with the evidence that probability value is less than 0.05 (Table 11). Therefore, there is a linear relationship between the predictor variables (dgender and att ECE) and response variable (CONMATHS). From Table 10 in Adjusted R Square column, the proportion of variance that can be account for by gender and ECE on CONMATHS is 0.034 (3.4%), whereas 96.6% cannot be accounted for by the predictor variables. The correlation between the predictor variables combined and the response variable is higher here (0.187 on table 8) compared to that of ENJOYMATH (0.064 on Table 5). This account for higher variability in response variable which is left unexplained by the regression equation in ENJOYMATH (76190.939 on table 6) than this CONMATHS (75177.305 on Table 8).
The multiple regression model equation is;

Predicted CONMATHS = a + b1 (dgender) + b2 (att ECE

Table 9: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change
1	.187[a]	.035	.034	4.72732	.035	60.975	2	3364	.000

a. Predictors: (Constant), dummy_attan_more_one, d_gender

Table 10: ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2725.285	2	1362.643	60.975	.000[b]
	Residual	75177.305	3364	22.348		
	Total	77902.590	3366			

a. Dependent Variable: How confident do you feel about solving mathematics problems?
b. Predictors: (Constant), dummy_attan_more_one, d_gender

Using Table 11 below; Predicted CONMATHS = 22.632 +1.630(dgender) + 0.926(ECE).

Therefore, gender is adding 1.630 points and ECE is adding 0.926 point to any single change in CONMATHS. Hence the multiple regression analysis ran to predict CONMATHS from gender and attending ECE shows that they statistically significantly predicted CONMATHS, $F(2, 3364) = 60.975$, $P < 0.0005$, RSquare = 0.035 thereby rejecting the second hypothesis stated above. Moreover, from the model equation, male contributed 24.262 points and female contributed 22.632 points in predicting CONMATHS. This agrees with Homer and Swinnerton (2008); Stoet and Geary (2012); Bench, Lench, Liew, Miner &Flores (2015) findings that male are more confident in solving mathematical problems than the female.

Table 11: Coefficients[a]

Model		Unstandardized Coefficients: B	Unstandardized Coefficients: Std. Error	Standardized Coefficients: Beta	t	Sig.	95.0% Confidence Interval for B: Lower Bound	95.0% Confidence Interval for B: Upper Bound	Collinearity Statistics: Tolerance	Collinearity Statistics: VIF
1	(Constant)	22.632	.163		138.629	.000	22.312	22.952		
	d_gender	1.630	.163	.169	9.975	.000	1.309	1.950	.995	1.005
	dummy_attan_more_one	.926	.170	.092	5.446	.000	.593	1.259	.995	1.005

a. Dependent Variable: How confident do you feel about solving mathematics problems?

Implications and Conclusion

Problem solving and enjoyment of mathematics were identified as the main focus of teaching and learning of mathematics. Various factors were found to be influencing mathematics problem solving and its enjoyment. There is a linear relationship between attending early childhood education and enjoyment of mathematics, but this does not necessarily mean that attending early childhood education will improve student enjoyment of mathematics at a later level. Also the rate at which males and female enjoys mathematics varies to the males' advantage. Stakeholders in education should make concerted effort through mathematics curriculum to stop negative stereotype of females' ability in mathematics as this may affect their confidence in solving mathematics problem as well as enjoying mathematics lessons.

Attending early childhood education was found to influence students' confidence in solving mathematics problems. Children should be given quality education from their childhood so that they build up the imaginative, thinking and reasoning abilities necessary for solving mathematical problems in their later years. ECE is very important when it comes to confidence in mathematics. Mathematics curriculum should not be gender sensitive and all effort should be made so that students will enjoy mathematics teaching so as to build their confidence in solving mathematical problems.

Limitations and Future Research

This study demonstrates the benefit of examining the gender effect and the effect of attending early childhood education on students' confidence in solving mathematics problems and enjoyment of mathematics in the United Kingdom. Although, there were significant revelations, the study has some notable limitations that needs future attention. Because of small space and time, this study could not access, analyse and discuss the influence of student enjoyment mathematics on their confidence in solving mathematics problems. In this study, it was noticed that predictor variables shows little predicting effect on the response variables. Future research should consider studying other predicting variables such as anxiety, interest, and socioeconomic background as well as missing classes on the same response variables.

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APPENDIXES

Appendix. Questionnaires

The questionnaire and the code for each item were taken from OECD Programme for International Student Assessment 2012.

Instruction: Please tick only one box.

1. Are you female or male? (Gender = ST04Q01).
   Female Male
   ( ) 1 ( ) 2
2. Did you attend <ISCED 0> [Attending Early childhood education (Att. ECE)=ST05Q01]
   No ( )1
   Yes, for one year or less ( )2
   Yes, for more than one year ( )3
3. Thinking about your views on mathematics: to what extent do you agree with the following statements? (enjoyment of mathematics = ENJOYMATH)
   a) I enjoy reading about mathematics
      Strongly agreed ( )1 Agreed ( )2 Disagree ( )3 Strongly disagree ( )4
   b) Making an effort in mathematics is worth it because it will help me in the work that I want to do later on.
      Strongly agreed ( )1 Agreed ( )2 Disagree ( )3 Strongly disagree ( )4
   c) I look forward to my mathematics lessons.
      Strongly agreed ( )1 Agreed ( )2 Disagree ( )3 Strongly disagree ( )4
   d) I do mathematics because I enjoy it.
      Strongly agreed ( )1 Agreed ( )2 Disagree ( )3 Strongly disagree ( )4
   e) Learning mathematics is worthwhile for me because it will improve my career <prospect, chances>.
      Strongly agreed ( )1 Agreed ( )2 Disagree ( )3 Strongly disagree ( )4
   f) I am interested in the things I learn in mathematics.
      Strongly agreed ( )1 Agreed ( )2 Disagree ( )3 Strongly disagree ( )4
   g) Mathematics is an important subject for me because I need it for what I want to study later on.
      Strongly agreed ( )1 Agreed ( )2 Disagree ( )3 Strongly disagree ( )4
   h) I will learn many things in mathematics that will help me get a job.
      Strongly agreed ( )1 Agreed ( )2 Disagree ( )3 Strongly disagree ( )4

4. How confident do you feel about having to do the following mathematics task? (confident about solving mathematics problems = CONMATHS)

	Not at all Confident	Not very confident	confident	Very confident
a) Using a train timetable to work Out how long it would take to get From one place to another.	( ) 1	( ) 2	( ) 3	( ) 4
b) Calculating how much cheaper a TV would be after a 3% discount.	( ) 1	( ) 2	( ) 3	( ) 4
c) Calculating how many square Metres of tiles you need to Cover a floor.	( ) 1	( ) 2	( ) 3	( ) 4
d) Understanding graphs presented				

	In newspapers.	( ) 1	( ) 2	( ) 3	( ) 4
e)	Solving an equation like 3x+5=17.	( ) 1	( ) 2	( ) 3	( ) 4
f)	Finding the actual distance between two places on a map with a 1 : 10,000 scale.	( ) 1	( ) 2	( ) 3	( ) 4
g)	Solving an equation like 2(x+3) = (x+3) (x-3).	( ) 1	( ) 2	( ) 3	( ) 4
h)	Calculating the petrol consumption rate of a car.	( ) 1	( ) 2	( ) 3	( ) 4