

# **EMOTIONAL ABILITIES OF EMOTIONAL INTELLIGENCE (EI) AND ACADEMIC PERFORMANCE: EXAMINING THEIR RELATIONSHIP USING NIGERIA UNIVERSITY UNDERGRADUATE CHEMISTRY STUDENTS**

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**Abstract.** The relationship between emotional intelligence and academic performance is well established but less is known about how six emotional abilities predict academic performance. Using a sample of 164 undergraduate students, the researchers examined the relationships among the six emotional abilities of emotional intelligence and their academic performance in chemistry. The participants responded to Schutte emotional intelligence scale and provided informed consent for their total score in basic chemistry course to be paired with their responses (academic performance). Analyses tested the collective influence of six emotional abilities, gender, age and total emotional intelligence on academic performance. The examination revealed that except for, gender age and ERS ( $r = .053 - .117$ ), all emotional abilities of emotional intelligence and total emotional intelligence positively and significantly correlated with academic performance of students in chemistry ( $r = .321 - .537$ ). Gender differences exist between the six emotional abilities and academic performance

in chemistry with strong significant prediction among male students in all the six emotional abilities but not so among females. To better delineate the relationship between the emotional intelligence and academic performance, multiple regression using a stepwise method was performed. The results revealed that two key emotional abilities namely, emotional expression (EE) and utilization of emotion for problem solving (UEPS) were able to explain 30% of the variance in academic performance of students in chemistry. The study confirmed the results of the previous findings on the significant relationship between emotional intelligence and academic performance and proceeds further to provide an empirical evidence on dimensional influence of emotional intelligence on academic performance. Discussion was offered based on the findings and implication as well as direction for further research are briefly highlighted.

*Keywords:* emotional intelligence, emotional abilities, academic performance, undergraduate chemistry

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## **Introduction**

Evidence from the literature has shown that the academic performance of students can be predicted by the demographic variables as well as cognitive factors (Cohn et al., 2004; Sackett et al., 2009). Also, the admission process in the higher institutions all over the world depends on the high performance of students in high schools and university entrance examinations, the finding of Clark & Cundiff, (2011) that college performance and degree attainment is highly predicted by the students' prior academic performance in both high school and college entrance examinations also supported the above assertion. For instance, in the year 2005, Nigeria universities introduced Post-University Matriculation Examination (Post-UME) screening for her candidates who seek for admission into tertiary institutions on discovery that only the general University Matriculation Examination (UME) conducted by Joint Admission and

Matriculation Board (JAMB) is not sufficient enough. However, all these rigorous processes which depend on the cognitive factors do not promise high performance of students in semester chemistry courses, students' graduation with high-grade points or prevent some students from dropping out of university. Hence, cognitive processing differences in the candidates are not adequate to account for a full measure of academic performance (Duckwork et al., 2007).

Studies have equally shown that different psychological variables also predict academic performance (Nwosu et al., 2018; Thomas et al., 2017; Jennings, 2007; Smedly, 2007; Zhoc et al., 2018; Di Fabio & Palazzeschi, 2009). These psychological variables are latent and inherent in the students which manifest at every stage of their learning cycle. Of all these psychological variables, emotional intelligence has received greater attention in the literature with over 500 publications (Zhoc et al., 2017). From the literature reviewed by Fernández-Berrocal & Extremera (2006), emotional intelligence has three main theoretical models namely, ability model of emotional intelligence (Salovey & Mayer, 1990), Bar-On's (2000) emotional intelligence model and emotional competencies model (Goleman, 2001) with the ability model widely accepted in the field because of its highest peer-reviewed journals. Research on emotional intelligence has gained increasing attention in the literature because of its relationships with a lot of outcome variables which include student GPA, self-directed learning and student learning outcomes (O'Connor & Little, 2003; Di Fabio & Palazzeschi, 2009; Zhoc et al. 2018), social relationships and life satisfaction (Carmeli & Josman, 2006). Although researchers have established emotional intelligence as a significant predictor of academic performance, beyond the one-dimensional factor model by Schutte et al. (1998), less is known about how different six factors of the Schutte emotional intelligence scale (eg, emotional expression, emotional regulation of self, appraisal of emotion in self) identified by Zhoc et al. (2017) independently predict academic performance of undergraduate students in chemistry in Nigeria. Hence, this is the gap the present study is set to fill.

The study was necessitated because chemistry courses in Nigeria remedial programmes and universities are among the courses that have recorded poor performance over the years. This might have created anxiety in the mind of the students who perceive chemistry as a difficult subject. During the teaching process, some students who find the subject difficult to understand may react to negative emotions by choosing to withdraw or drop-out from attending lectures while some may overcome the negative emotions by managing their emotions and investing more time and effort in tackling the problems either on their own or with assistance of others. The choice a student makes depends on how he manages his emotions during the learning process. Since emotions is the foundation of learning (Zull, 2006) and it plays a greater role in the learning process of every student (Rager, 2009); hence, the influence of emotional intelligence on academic performance may not be a generic one but specific depending on how students manage, regulate and utilize their emotions in the face of any challenges they encounter during the learning process. Therefore, we are interested in identifying the influence of different emotional abilities of EI based on Salovey & Mayer's (1990) model of emotional intelligence on undergraduate students' performance in chemistry.

### **Emotional intelligence**

Emotional intelligence can be defined as individuals' ability to appraise, express, regulate and utilize emotions by his or her self and others in solving any challenging problem or tackling any situation (Mayer & Salovey, 1997; Salovey & Mayer, 1990; Zhoc et al., 2018). Emotional intelligence was also conceptualized as "the ability to monitor one's and other's emotions, to discriminate among them and to use this information to guide one's thinking and action" (Salovey & Mayer 1990). Salovey & Mayer further conceptualized emotional intelligence as having three categories of adaptive abilities. The first is appraisal and expression of emotion in self (verbal and non-verbal) and others (non-verbal perception and empathy). The second is regulation of emotion in self and others

while the third is the utilization of emotion for flexible planning, creative thinking, redirected attention and motivation.

This Salovey & Mayer's (1990) model was revised by Mayer & Salovey (1997) by giving more emphasis to the cognitive components of emotional intelligence and conceptualized the concept in terms of potential for intellectual and emotional growth. The revised model consists of the following four broad categories namely; perception, appraisal and expression intelligence, emotional facilitation of thinking, understanding, analyzing and employing emotional knowledge and reflective regulation of emotion to further emotional and intellectual growth (Mayer & Salovey, 1997; Schutte et al., 1998). Although this revised model is an excellent process-oriented model, the original model conceptualizes the various dimensions of an individual's current state of emotional development (Schutte et al. 1998) but both models are similar in their basic components of emotional intelligence (Schutte et al., 1998; Zhoc et al., 2018). Therefore, the present study will be rooted on the original model because it captures both affective and cognitive dimensions of EI and it is widely accepted in the literature.

### **Emotional intelligence and academic performance**

Empirical evidence has shown that emotional intelligence relates to academic performance (Fernández et al., 2012; Thomas et al., 2017). For instance, Fernández et al. (2012) carried out a study on emotional intelligence as a predictor of academic performance in first- year accelerated graduate entry nursing students and found that it significantly related to academic achievement when treated in isolation from other predictor variables. Meta-analytic study on the relationship between trait emotional intelligence and learners' academic achievement conducted by Perera & Digiacomio, (2013) affirmed a moderate relationship between the emotional intelligence and academic performance with ( $r = 0.20, p < .05$ ). Similarly, study conducted by Thomas et al. (2017) using undergraduate students revealed that the emotional intelligence increased the

amount of variance explained in four-year cumulative GPA ( $R^2$  change = 0.03,  $F(1,138) = 5.99$ ,  $p < .05$ ). Their results suggest that levels of emotional intelligence contribute significantly to GPA after controlling for previous academic ability ( $r = 0.19$ ,  $p < .05$ ). Contrary to above findings, the study conducted by Barchard (2003) on influence of emotional intelligence on academic success reveals that emotional intelligence does not significantly predict academic success when cognitive ability and personality domain have been accounted for. Similarly, in a study conducted by Zhoc et al. (2018) among higher education students in Hongkong, it was found that emotional intelligence scores did not directly correlate with GPA ( $r = 0.02$ ,  $p < .01$ ). In Nigeria, path-analytic study conducted by Adeyomo (2007) affirmed a direct relationship between emotional intelligence and students' learning outcome in mathematics. Most of the studies on emotional intelligence are carried out in higher institutions which are similar to the area of the present study. The present study will also confirm the relationship between emotional intelligence and academic performance of students similar to the studies reviewed but will further examines the influence of different emotional abilities on the academic achievement which is less known in the literature.

### **Emotional intelligence scale**

Emotional intelligence scale also known as assessing emotion scale and Schutte emotional intelligence scale is one of the most widely used measure of emotional intelligence (Siegling et al., 2015). Emotional intelligence scale was developed by Schutte et al. (1998) as a uni-dimensional factor based on Salovey & Mayer's (1990) model of emotional intelligence (Zeidner et al., 2002). The scale has the advantage of brevity that partially explains its popularity (Ng et al., 2010).

However, the emotional intelligence scale was criticized for having an unclear factor structure (Shi & Wang, 2007). Although the scale was design by Schutte et al. as a uni-dimensional measure, several studies reported it as having

different factor structure that varies from two to six factors. For instance, two factor models of the emotional intelligence were reported by Chan (2008). While several researchers reported four factor models of emotional intelligence scale (Petride & Furuham, 2000; Saklofske et al., 2003; Chan, 2004; Siu, 2009; Ng et al., 2010). Five factor models of the emotional intelligence scale were reported by Devies et al. (2010) while six factor models were reported by Gignac et al. (2005) and Zhoc et al. (2017).

One factor model proposed by Schutte et al. (1998) was not empirically tenable, given that the various measurement model fit indices were far below .90 (GFI =.85, CFI = .73, NFI =.73, NNFI=.71). the six-factor model by Zhoc et al. (2017) is the best model because on confirmatory factor analysis it produces root mean square error of approximation (RMSEA) of .04 which indicates excellent model fit unlike other models which produce RMSEA value ranging from .05 to .09. Also, by comparing Zhoc et al. (2017) six-factor model with other models using various measurement model fit indices namely comparative fit index (CFI), normal fit index (NFI), non-normed fit index (NNFI), Zhoc et al. (2017) model produces indices higher than .90 which indicates good fit unlike all other models that produces indices less than .90 which is considered unfit. Six factors of Zhoc et al. (2017) model are: (i) appraisal of emotions in self (AES); (ii) appraisal of emotion in others (AEO); (iii) emotional expression (EE); (iv) emotional regulation in self (ERS); (v) emotional regulation of others (ERO); and (vi) utilization of emotions in problem solving (UEPS).

From the literature reviewed, little or no evidence has examined how the six factors of emotional intelligence identified by Zhoc et al. (2017) have independently influence academic performance of students in chemistry. Also, the contradictory evidence on the influence of emotional intelligence on academic performance pointed to the fact that all the factors will vary in prediction of academic performance. Therefore, the present study will examine the influence of these six emotional abilities reported by Zhoc et al. (2017) on undergraduate students' achievement in chemistry.

## **Hypotheses**

Since the present study sought to investigate the relationship between emotional abilities of emotional intelligence and academic achievement among university undergraduate chemistry students and based on the literature reviewed above, the following hypotheses emerge: (1) The emotional intelligence total is positively and significantly correlated with academic performance of students in chemistry; (2) The six emotional abilities of emotional intelligence are positively and significantly correlated with academic performance of students in chemistry; (3) There is no significant difference in the inter-correlations of the six emotional abilities and academic performance of students in chemistry based on gender

## **Method**

### *Research design*

The study adopted a correlational research design in order to explore the prediction of undergraduate chemistry students' academic performance from different emotional abilities of emotional intelligence.

### *Participants and procedure*

Data were collected from undergraduate chemistry students attending a federal university from Southeastern part of Nigeria. In compliance with the agreement with the course lecturer who is also one of the researchers to used complete filling of the measure as 5% mark for the course credit, all the participants consent was gotten and they were also informed about the reward prior to the commencement of the study.

One hundred and sixty-four participants (88 males and 78 females; mean age = 19.02 years,  $S.D = 1.63$ , age range 17 – 21 years) completed the measure

during their semester examination on the basic chemistry course. The participants were informed that there is no right or wrong answer rather they should tick options that best described their emotions and the essence of the study were to understand their true personal emotional experiences. Prior to the commencement of the examination, the researchers together with the research assistants who also serve as invigilators for the course examination distributed the questionnaire immediately the participants seated for the examination and were all available to provide help for the participants as well as ensure confidential and independent responding. 30 minutes were given for the filling of the questionnaire and collection as well. There was 100% completion of the measure.

*Measures: emotional intelligence scale*

Emotional intelligence scale is made up of 33-items developed by Schutte et al. (1998) as a unidimensional construct on the basis of Salovey & Mayer's (1990) theoretical model of emotional intelligence. It was designed on a 5-point Likert scale ranges from 1 (strongly disagree) to 5 (Strongly Agree) with internal consistency of .90. Several authors have validated the factor structure of the scale and different factors have emerged ranging from two to six dimensions but the latest validated factor structure which produces best fit indices is six-factor structure the present study adopts is Zhoc et al. (2017) factor model of emotional intelligence. The six emotional abilities identified by Zhoc et al. (2017) include: (i) appraisal of emotions in self (AES) (e.g., when my mood changes, I see new possibilities); (ii) appraisal of emotions in others (AEO) (e.g., I know what other people are feeling just by looking at them); (iii) emotional regulation of the self (ERS) (e.g., I seek out activities that makes me happy); (iv) emotional regulation of others (ERO) (e.g., other people find it easy to confide in me); (v) emotional expression (e.g., I present myself in a way that makes a good impression on others); (vi) utilization of emotions in problem

solving (UEPS) (e.g., I use good moods to help myself keep trying in face of obstacles).

Zhoc et al. (2017) reported that the McDonald's omega coefficients for the six emotional abilities ranges from .85 to .93 showing high level of internal consistency of the six factors. Also, they reported that all the six emotional abilities were highly correlated with the emotional intelligence total ( $r = .68 - .81, p = .001$ ) indicating that all of them were unidimensional and measure the same underlying construct. The present study validated the same result that all the emotional abilities were highly correlated with emotional intelligence total ( $r = .447 - .754, p = .001$ ) (see table I), hence support the finding.

### *The academic performance*

We use a final score in an undergraduate chemistry course as indicator of academic performance. This final score is determined by grading adding students' continuous assessments and their exam scores. The total score is 100%.

## **Results**

### *Statistical assumptions*

Statistical assumptions that is applicable to linear regression were conducted on the original data set to ensure the validity of the results. We first tested to see if either gender and age predict the academic performance. It was found that neither gender ( $r = .094$ ) nor age ( $r = .053$ ) (Table 1) did significantly predict academic performance. Hence, we conclude that relationship between the emotional abilities of emotional intelligence and academic performance is not affected by gender and age. We then conducted the normality test for the dependent variable (academic performance) of the study. The Shapiro-Wilk's test indicated that the academic performance,  $SW(164) = .973, p = .003$ , were not normally distributed. Fortunately, the bootstrapping method tends to reduce the effects on this statistical assumption as well as the small sample size.

**Table 1.** Descriptive statistics and inter-correlations among six emotional abilities of EI, age and gender (N = 164)

	1	2	3	4	5	6	7	8	9	10
1. AES	1									
2. AEO	.433**	1								
3. ERS	.308**	.153*	1							
4. EE	.357**	.486**	.201**	1						
5. ERO	.513**	.452**	.119	.550**	1					
6. UEPS	.429**	.487**	-.043	.556**	.584**	1				
7. TOTALEI	.696**	.666**	.447**	.737**	.754**	.701**	1			
8. gender	.092	.077	.171*	.043	.082	.022	.145	1		
9. age	-.011	-.077	.040	-.073	-.042	-.072	-.052	.042	1	
10. Results Mean	.323**	.321**	.117	.510**	.387**	.467**	.537**	.094	.053	1
<i>SD</i>	12.82	7.65	15.51	11.05	13.12	12.13	80.49	1.46	19.02	65.63
	2.19	1.57	3.16	2.34	2.34	2.36	10.54	.50	1.63	12.59

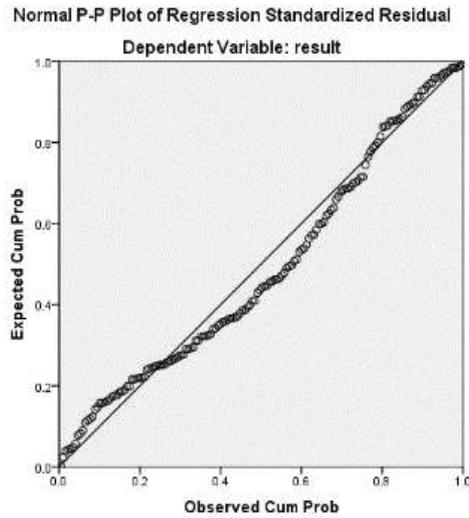
\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

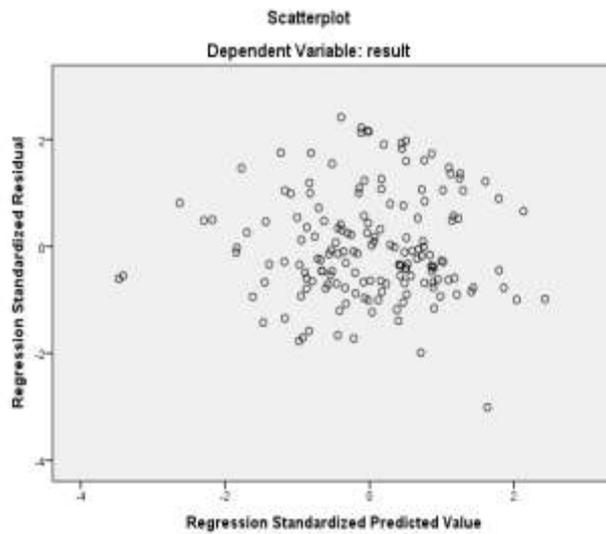
Note that AES = Appraisal of Emotion for Self, AEO = Appraisal of emotion for Others, ERS = Emotional Regulation for Self, EE = Emotional Expression, ERO = Emotional Regulation of Others, UEPS = Utilization of Emotion for Problem Solving, TOTALEI = Total Emotional intelligence; Gender is coded as “1” = male, “2” = female; Results = academic performance ( students’ final scores in the chemistry course); Age = Students’ actual age at the time of the research

We further checked for multi-collinearity between the six emotional abilities of emotional intelligence and found that their inter-relationship ranges from -.043 to .0584 (Table 1) which is less than .70. Therefore, we concluded that there is an absence of multi-collinearity among the independent variables. Graphical illustration of their linear relationship was shown using P-P plot (Fig. 1) where the dots almost maintain a straight-line graph and scatter plot (Fig. 2) where the dots did not significantly fell outside -3 to +3 on both axes but cluster

more at the center. Moreover, the cook's distance ranges from .000 to .089 and standard residual ranges from -2.879 to 2.470 which are both within the acceptable range (cook's  $< 1$ ; standard residual range  $-3 - +3$ ).



**Figure 1.** Normal P-P plot of standardized residual



**Figure 2.** Scatter plot

Finally, the tolerance (T) and variance inflation factors (VIF) for the linear trends in each regression fell within the acceptable limits (tolerance ranges from .504 - .819;  $T > .20$ ; VIF ranges from 1.221 – 1.925;  $VIF < 5$ ) (Table 2).

**Table 2.** Unstandardized coefficients, standardized coefficients and collinearity statistics for the six emotional abilities of emotional intelligence

Model		Unstandardized Co- efficients		Standardized Co- efficients	t	Sig.	Collinearity Statis- tics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Con- stant)	21.185	6.583		3.218	.002		
	AES	.482	.482	.084	.998	.320	.613	1.630
	AEO	-.062	.659	-.008	-.095	.925	.646	1.548
	EE	1.785	.476	.332	3.752	.000	.554	1.806
	ERO	.110	.492	.020	.223	.824	.520	1.925
	UEPS	1.278	.495	.240	2.584	.011	.504	1.985
	ERS	.134	.290	.034	.462	.645	.819	1.221

a. Dependent Variable: result

#### *Descriptive and correlational analysis among study variable*

Table 1 shows the descriptive statistics and correlation matrix among variables of the study for combined sample of both male and female students ( $N = 164$ ). As we predicted in hypothesis 1, emotional intelligence total was positively and significantly correlated with academic performance of students in chemistry ( $r = .537, p < 0.01$ ) (Table 1). Moreover, except for ERS ( $r = .117$ ), all emotional abilities of emotional intelligence as predicted in hypothesis 2 positively and significantly correlated with academic performance of students in chemistry AES ( $r = .323, p < 0.01$ ), AEO ( $r = .321, p < 0.01$ ), EE ( $r = .510, p < 0.01$ ), ERO ( $r = .387, p < 0.01$ ), UEPS ( $r = .467, p < 0.01$ ) (Table 1).

Table 3 shows the same broken down by gender with lower triangle portion reflecting the relationships among variable of the study for male students ( $N = 88$ ) and the upper triangle portion reflecting the same for female students ( $N = 76$ ). Contrary to our prediction in hypothesis 3, the six emotional abilities positively and significantly related to academic performance ( $r = .285 - .506$ ,

$p < 0.01$ ) among male students, but not so for females. While three emotional abilities (EE, ERO, UEPS) were found to be positively and significantly related to academic performance ( $r = .383 - .469$ ,  $p < 0.01$ ), three emotional abilities (AES, AEO, ERS) were not significantly related to academic performance ( $r = -.057 - .220$ ) among female students.

**Table 3.** Inter-correlations among variables in the study, by gender of participants

		1	2	3	4	5	6	7	8	9
1.	AES	1	.440**	.422**	.356**	.379**	.278*	.644**	.033	.139
2.	AEO	.418**	1	.235*	.578**	.499**	.544**	.759**	-	.220
3.	ERS	.164	.034	1	.223	.160	-.022	.513**	.047	-.057
4.	EE	.354**	.380**	.168	1	.670**	.613**	.786**	-	.423**
5.	ERO	.624**	.407**	.059	.444**	1	.628**	.752**	.010	.383**
6.	UEPS	.561**	.440**	-.071	.509**	.551**	1	.706**	-	.469**
7.	TO- TALEI	.742**	.563**	.348**	.692**	.757**	.709**	1	.151	.369**
8.	Age	-.055	-.152	.021	-.076	-.087	-.018	-.071	1	.077
9.	Result	.506**	.427**	.285**	.602**	.385**	.471**	.702**	.026	1

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

Note: The correlation matrix for male participants is shown in the lower triangle, for female participants, it is shown in the upper triangle; N for male students = 88 (mean age = 18.95,  $SD = 1.71$ ); N for female students = 76 (mean age = 19.09,  $SD = 1.53$ )

*Multiple regression analysis examining how the different emotional abilities of EI predict academic performance of students in chemistry*

Multiple regression analysis was performed using the students' academic performance as the dependent variable and the six emotional abilities of emotional intelligence as independent variables in step one as well as the total emotional intelligence in step two. Using a stepwise method in order to eliminate any emotional abilities that does not significantly correlates with academic performance of students in chemistry, we entered in the first step all the six

emotional abilities of emotional intelligence. Of all the six emotional abilities, the multiple regression analyses clearly delineate the two emotional abilities via, emotional expression (EE) and utilization of emotion for problem solving (UEPS) were able to explain 30% of the variance in academic achievement of students in chemistry (adjusted  $R^2 = .30$ ,  $F(2,161) = 35.997$ ,  $p < .01$ ) (Table 4). Among the two emotional abilities, EE was the highest predictor of academic performance ( $\beta = 0.362$ ,  $p < .000$ ) while the UEPS follows ( $\beta = .266$ ,  $p < .001$ ). In step two, we entered total emotional intelligence (TOTAL EI) as the independent variable to see how emotional intelligence as a unidimensional construct predicts academic performance. The total emotional intelligence ( $\beta = .537$ ,  $p = .000$ ) was able to explain a total of 28.4 variance of academic performance in chemistry. (adjusted  $R^2 = 0.284$ ,  $F(1, 162) = 65.632$ ,  $p < .000$ ) (Table 4).

**Table 4.** Multiple regression analyses examining how the different emotional abilities of EI and total EI influence students' academic performance in chemistry

Step	Variable	Unstandardized coefficients	Standard Error	Standard Beta	Sig	Adjusted R <sup>2</sup>	F	Sig
1	EE	1.944	0.423	0.362	0.000**	0.30	35.997	0.000**
	UEPS	1.418	0.420	0.266	0.001**			
2	Total EI	0.641	0.079	0.537	0.000**	0.284	65.632	0.000**

Note: \*\* $p < 0.05$

## Discussion

In this study, we examined the relationship between emotional intelligence and academic performance of students in chemistry. We did this by exploring how six emotional abilities of emotional intelligence (Zhoc et al., 2017) influence academic performance using the total sample size on the one hand, and comparing them based on gender, on the other hand. Our finding showed

that the six emotional abilities of emotional intelligence positively and significantly correlated with total emotional intelligence which means the all the six factors are unidimensional as well as measuring the same construct. The finding concurs with Zhoc et al. (2017) finding supporting the internal consistency of the six emotional abilities. Our findings that both gender and age did not significantly correlate with students' academic performance in chemistry shows that the relationship between emotional intelligence and academic performance is not affected by either of the two demographic variables.

We found that total emotional intelligence is positively and significantly correlated with students' academic performance having controlled for gender and age of the participants. This finding is in line with the results of the previous findings confirming the strong influence of emotional intelligence on academic performance having controlled for other predictor variables (Fernández et al., 2012; Thomas et al., 2017). Our finding is contrary to the findings of some authors who found non-significant relationship of emotional intelligence with academic performance once accounting for other individual predictor variables like cognitive and personality factors (Barchard, 2003), test anxiety and coping strategies (Thomas et al., 2017) and self-directed learning (Zhoc et al., 2018). This finding confirmed that student with high emotional intelligences have full control of their emotions and enjoy high academic success in their university careers.

Furthermore, by examining the relationship among the six emotional abilities and academic performance, except for ERS ( $r = .117$ ), all emotional abilities of emotional intelligence positively and significantly correlated with academic performance of students in chemistry with EE and UEPS been the highest predictors of students' academic performance in chemistry. These are possibly acquired during the chemistry lessons because the course contents in basic chemistry II which include kinetic theory of gases, stoichiometry, chemical reactions, reaction rates and chemical equilibrium require emotional expressions in reporting experimental findings and utilization of emotions for problem

solving during mathematical calculations in the course contents. Emotional expressions (EE) can also be largely acquired during group chemistry practical discussions when every student has right to discuss the findings based on how he views the result. This is the basis for self-directed learning. Also, utilization of emotion for problem solving (UEPS) will be acquired from interaction between the students and their teachers as well as their fellow students while tackling problems in chemistry especially the calculations most of the students find difficult during the teaching periods.

We also examine the influence of six emotional abilities of emotional intelligence on academic performance across gender. It is worthy to note that gender differences exist on three emotional abilities namely AES, AEO, ERS which is significant among male students but not significant among female students. while no gender difference was witnessed in EE, UEPS and ERO. Our findings on gender difference is consistent with the meta-analytical studies of Costa et al. (2001) which showed that men have high emotional stability than women ( $d=0.5$ ). Similarly, Nguyen et al. (2006) reported the same findings that relationship between emotional stability and academic performance was strong among males than female students. The implication of this study is that relevant intervention will be put in place while chemistry lessons is going on so as to help the students manage and regulate their emotions especially the female students. Also, adequate guidance and counselling should be provided time to time to the students as well as feedback practices inform of formative and diagnostic assessments by the chemistry lecturers while the teaching is going on.

### **Limitations**

Despite the positive and significant findings accorded to the present study, there are several limitations to the study. First, the use of small sample size in this study may affect both the statistical conclusion validity as well as the external validity of our results. Although bootstrap approach tends to reduce

this effect on statistical assumptions but it cannot ensure that our sample represents the behavior of all the chemistry students in the university. Restriction of our sample to one university in Nigeria makes this study impossible to be generalized to other universities in Nigeria. Hence, the study can be replicated across chemistry departments and other universities to ensure generalizability of the findings. Also, since trait emotional intelligence is a self-report measure, the scale may be subject to response bias and cannot reflect the students' true behavior (Mega et al., 2014), the study may be triangulated using focus group discussion (FGD) as well as the use of behavioral measure (Zhoc et al., 2018) in the future studies.

### **Conclusions**

In Nigeria, admission process into tertiary institutions is based on ability measure (cognitive intelligence) which is assessed using UTME organized by JAMB and Post-UME organized by tertiary institutions but none of the organizers incorporates non-ability measure (e.g., emotional intelligence). Previously, the use of only ability measure has not promised persistent of students in studying chemistry and successful graduation with high grade. This study shows total emotional intelligence was able to explain a total of 28.4 variance of academic performance in chemistry and two emotional abilities of emotional intelligence namely, emotional expression (EE) and utilization of emotion for problem solving (UEPS) were able to explain 30% of the variance in academic performance of students in chemistry. This is evident that admission officials like JAMB and admission offices in tertiary institutions in Nigeria should consider emotional intelligence of prospective students as a factor during awarding of admission especially to those seeking for admission to study chemistry also bearing in mind the potential effect of emotional intelligence due to gender. Also, chemistry lecturers should periodically make assess the emotions of their students using diagnostic assessment and provide support mechanisms like

feedback practices occasionally. This will help the students to manage and regulate their emotions which is a foundation for learning. Further research can be done to examine the influence of emotional intelligence in other areas of sciences as well as triangulate it with qualitative approach like interview.

**Acknowledgements.** The authors are grateful to all the students who participated in this study and the invigilators for the course examination who acted as the research assistants. The research received partly support from office of the head of Science Education, Nnamdi Azikiwe University, Awka, in producing all the questionnaires used to gather data for the study while no external funding was received from government and non-governmental body.

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