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The Role of Gender on the Isolation of Teaching Effectiveness Factors by Nigerian Senior Secondary School Chemistry Students

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Abstract

Students' evaluation of teaching is one area of educational research that is becoming increasingly emphasised in recent times in Nigeria, but limited attention is still given to the identification of teaching effectiveness factors from students' point of view, in order to develop a valid and reliable instrument. Students' evaluation is commonly used in developed countries to provide information that could be used by teacher to improve his/her teaching and by administrators to make personnel decisions like promotion .This study therefore analysed the isolated teaching effectiveness factors in chemistry according to the gender of the students. The study adopted survey research design of ex-post facto type. Two thousand nine hundred and eighty eight SSII chemistry students participated, using multistage and stratified random sampling techniques from the six states in the Southwest geopolitical zone of Nigeria. Data collected through validated and reliable "Students' Evaluation of Teaching Effectiveness Scale (0.78)" were analysed using factor analysis. The study found that there are significant similarities in the ratings of the teaching effectiveness factors in Chemistry classroom due to gender. Each gender profile reveals 11 pattern of underlying influence of which 7 are common to both gender. Educational planners, policy makers and administrators are therefore urged to work out modalities for the development and implementation of students' evaluation of teaching effectiveness instrument for use at the secondary level of education.

Keywords: role, gender, isolation, teaching effectiveness, factors, chemistry, students

1. Introduction

Despite a large contemporary literature on student evaluations, gender effects are infrequently mentioned and the available studies on it have been controversial and contradictory (Freeman, 1994; Marsh and Roche, 1997). Many researchers, mindful of the controversy, have concluded that most evaluation instruments are multi-dimensional and result in global scores that can be misleading and difficult to interpret (Greenwald, 1997; Marsh *et al*, 1997; Mckeachie, 1997).

One of the major reasons why researchers on students' evaluation appear controversial in education circles is that such student characteristics as gender whose influence could be significant are often neglected thereby raising validity question (Riger, 1993). But in the literature, some researchers showed that students' gender has little or no effect on their ratings of lecturers teaching effectiveness (Davis, 1993). Other researchers who have reported little or no relationships between students' gender and their rating of instructors are Basow and Silberg, (1987); Bennet, (1982);Marsh *et al*, (1992); Stathan, Richardson and Cook (1991).

In view of these controversies it is deemed necessary to look at the effect of gender on students' evaluation of teaching effectiveness.

2. Literature Review

From the literature on student evaluations, gender effects are seldomly mentioned and the available studies on it have been controversial and contradictory (Freeman, 1994; Marsh *et al*, 1997; Greenwald, 1997; Mckeachie, 1997).

However a number of works have recorded the influence of students' gender on their ratings of lecturers. For

instance, Krahn and Bowlby (1997) investigated the possible influence of gender on students' evaluation of teaching effectiveness of lecturers in University of Alberta. They made use of 1452 undergraduates. Findings indicated that students' gender influenced their pattern of rating. Chang (1997), also conducted a study which examined the effect of gender on students rating of teacher performance in a Taiwanese college. A total of 9843 students were asked to rate their lecturers totaling 132. Instruments used were evaluation forms containing 13 questions that focused on four dimensions of teacher performances. Results indicated that male students rated male lecturers higher than their female counterparts. Boggs and Wiseman (1995) in their own study examined the role of gender in University Students' Evaluation of lecturers. Results of the analysis of 120 students' responses showed the presence of subtle gender biases in the overall students' evaluation. In a similar vein, Tatro (1995) identified gender differences in college students' rating of their lectures. The result showed that female lecturers were found to have received higher ratings than their male colleagues who appear to be conservative with the marks'.

Amin (1994) also compared the evaluation of 1064 male and female undergraduates in the University of Yaoundé, Cameroon. Their lecturer effectiveness was the focus of evaluation. Also, Luck (1993) discovered that male students rated male instructors higher than female instructors while female students rated female instructors higher than the males. Another study by Feldman (1993) investigated college students' evaluation of their male and female teachers. Results revealed that gender interaction within the study was significant. In a similar study Vanoo Stendorp (1999) found that females were rated higher than the males by female raters while the male students rated male lecturers higher than the female lecturers.

According to Arreola (1995), results in the literature regarding gender and ratings are inconsistent. Aleamoni and Hexner (1980) found no significant relationship between ratings and gender (of the instructor or student). Other researchers (Doyle and Whitely, 1974;McKeachie et al., 1964 cited in Arreola, 1995) support this conclusion. In Costin et al.'s (1971) review of the research; they also cite seven studies that confirm the absence of significant differences between the ratings made by male or female students, and the ratings received by male and female instructors.

In contrast, Costin et al and Aleamoni and Hexner also cite a study by Bendig (1952) cited in Costin et al., 1971) showed that female students tended to be slightly more critical of their male instructors than were their fellow male students. And another study by Walker (1969 cited in Costin et al., 1971) found that female students rated female instructors "significantly higher" than they rated male instructors (p. 520).Marsh and Roche (1997) concluded that the gender issue has "mixed findings but little or no effect" (p. 1194).

Since there is no generally agreed influence of gender on students' evaluation of teaching, the present study deemed it necessary to look at the effect of gender on the students' evaluation of teaching effectiveness.

3. Research Question

Does Gender influence the ratings of the senior school Chemistry students of teaching effectiveness factors?

4. Methodology

4.1 Research Design

This study is an ex-post facto type with a survey design. This is appropriate since the researcher has no direct control of the independent variables as their manifestations have already existed.

4.2 Population and Sampling Technique

The target population of the study was Senior Secondary School Class two (SS II) chemistry students in the six South Western States of Nigeria. The sample size was 2988 using multistage and stratified random sampling techniques.

4.3 Research Instrument

The development of the instrument was based on previous research works on students' evaluation of teaching effectiveness (March, 1982, Onocha, 1996). A large pool of items was obtained from literature together with interviews held with teachers and students about what makes up effective teaching. These were used to select items and the items selected covered all the major variables identified from the review of past literature on teaching effectiveness. SETES was scored based on a four-point Likert Scale ranging from strongly Agree, Agree, and Disagree to Strongly Disagree. Positive statements are to be rated 4, 3, 2 and 1 respectively while the ratings for negative statements were reversed.

4.3.1 Validation and Reliability of Instrument

Experts in item construction and evaluation assisted in the validation of the instrument. The language of presentation, clarity and applicability to the level of the participants were addressed. The instrument was also presented to experts in the field of science education and two secondary school chemistry teachers for content and construct validity. Based on their comments the initial 75 variables of SETES were reduced to 50. The instrument was again subjected to reliability test using a comparable sample who did not take part in the main study. The scores were analysed using Cronbach alpha method. The alpha value obtained was 0.781, which was quite high implying that the instrument is reliable.

4.4 Procedure for Data Collection

The researcher and two research assistants administered the instruments designed for the study to collect the required data directly from the participants.

4.5 Data Analysis.

Data collected were subjected to factor analysis with varimax rotation to answer the research questions raised.

5. Findings and Discussion

5.1 Knowledge of the Subject Matter Factor

This factor accounted for 19.121% of the total variance in male profile as first factor. In female profile this descriptive category is the 6th pattern. In the female profile it accounts for 3.504% of the total variance. The model below gives the latent dimension for both male and female profiles.

$$F_{1m} = 0.47Var_7 + 0.637Var_8 + 0.599Var_{10} + \quad 0.55Var_{12} + 0.468Var_{18} + 0.579Var_{21} + 0.463Var_{38}$$

$$F_{1f} = 0.809Var_{11} + 0.824Var_{12}$$

Where F= latent factor, m = male and f = female.

Although not all the same exact variables loaded on the two factors, all the variables centered on the same descriptive category. For instance, the variable Var_{12} loaded on the factor in the two profiles, the factor contributing 30.47% and 67.90% of the variances in the variable in male and female profiles respectively.

A plot of the vectors of the factors and Var_{12} "*Apply the theories discussed in the teaching period during laboratory exercise*" on Cartesian coordinates shows that it has higher inclination and stronger relationship with factor 1 in females profile than in male's profile. The length of the vector is smaller in female (31.79) profile than male's (32.21). Thus, the total variation is slightly higher in male by about 1.32%

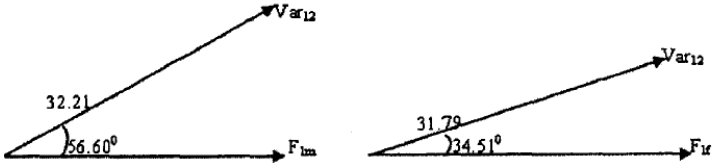

Figure 1. A plot of the vectors of the factors and Var_{12}

Moreover, variable Var_8, *"Explain clearly and give notes"* is not considered by the ratings of the female students as being very important to this latent factor in the female profile whereas in the male the vector is at angle 50.43^0 to the factor. The vector is at angle 85.60^0 with the factor in female profile. As the angle is very close to 90^0 in female profile, it indicates a very low and negligible correlation between the variable and factor 1. This factor accounts for only 0.57% of the variance in Var_8. However, the total variation of this vector is 28.87 in female profile as against 29.34 of the male profile.

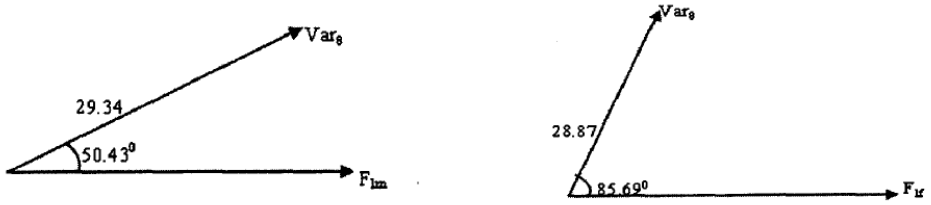

Figure 2. A plot of the vectors of the factors and Var_8

In addition, vector of Var_{11} "*Show a thorough knowledge of subject matter*" has an angle 36^0 with the vector, F_{1f} while it is negligible in the male profile.

5.2 Give Adequate Assignment Factor

This factor explained 7.088% of the total variance in the male profile. The highly loaded variables on the factor are: Var_{40} (0.567), Var_{41} (0.491) Var_{46} (0.501), Var_{47} (0.567), Var_{48} (0.654) and Var_{49} (0.495). The factor explained 42.77%, 32.15% and 25.1% in Var_{48}, "*Systematically supervise homework*"; Var_{40}, "*Give adequate assignments after each lesson*" and Var_{46} "*Effectively use assignments to enhance learning*" respectively. However, in female profile the factor is the 8th one. It accounted for 2.107% with characteristics root of 1.053. Its correlation with Var_{41}, "Give *adequate instructions concerning assignment*" increased from 0.491 in male profile to 0.603 in female profile. The vector of Var_{41} form an angle of 60.59^0 with length 30.72 and 52.91^0 with length 28.66 on vector F_{2m} and F_{2f} respectively showing a relatively higher correlation and lesser total variation with F_{2f} than F_{2m}

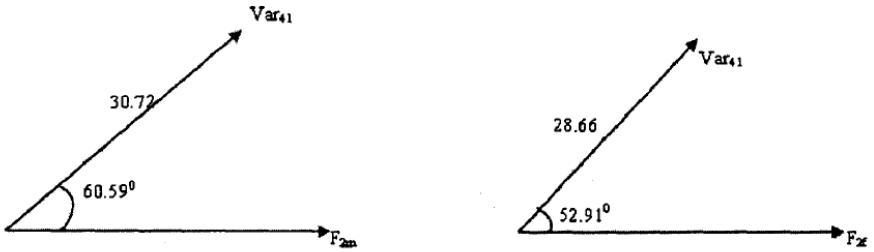

Figure 3. A plot of the vectors of the factors and Var_{41}

Also while this descriptive category explained a total variance of 24.11% in the Var_{41} in male profile, it accounts for 36.36% of the total variance of Var_{41} in female profile.

5.3 Dynamism of the Teacher Factor

In the male profile, this factor accounts for 3.174% of the total variance and it is the 3rd in strength and degree of comprehensiveness. There are three variables; Var_4, Var_{13} and Var_{39} that load on the factor. The factor explained 69.89%, 59.44% and 74.65% of these variables respectively. The loaded variables have correlations r: $0.771 \leq r \leq 0.864$. This factor does not exist in the female profile. However, the 3rd factor in the female profile is "Commitment". It explained 2.873% of the total variance of female profile. This common factor accounted for 36% of the variance in variable, Var_{18}, "*Be prompt and consistent in attending class*". The vector of the variable Var_{18} is at an acute angle of 53.13^0 with the common factor thus given a moderately high correlation r = 0.6. Other variables that loaded moderately high on the factor are Var_8 (0.446), Var_{21} (0.453) and Var_{40} (0.532).

5.4 Feedback Factor

This is the 4th Pattern that accounts for the greatest regularity in the male profile. It accounts for 2.544% of the total variance in the profile. Two variables loaded moderately high on the feedback common factor. These are Var_{33} "*Be concerned about students individual differences*" and Var_{45} "*Provide feedback on students' progress*" the two variables have correlation r = 0.519 and r = 0.562 respectively.

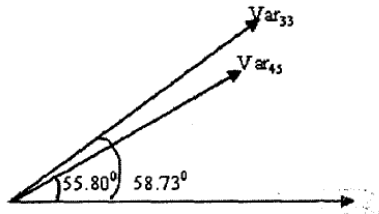

Figure 4. A plot of the vectors of the factor F_{4m}, Var_{33} and Var_{45}

From the figure above, the variables correlated with the factor and it explains 26.24% and 31.58% of the variances in the variables. However, this factor does not exist at all in the female profile. Considering the loadings of the entire 50 variables on all the 11 factors it was discovered that the var_{33} "*Be concerned about students' individual differences*" is almost at an angle 90^0 with all the factors in the female profile.

Table 1. Correlation of Var_{33} with all factors

Factor	Angle of inclination to the factor	Correlation with factor	% of variance explained by the factor
1	73.44^0	0.285	8.12
2	70.12^0	0.340	11.56
3	99.9^0	-0.172	2.96
4	75.11^0	0.257	6.60
5	75.05^0	0.258	6.66
6	87.46^0	0.044	0.20
7	75.29^0	0.254	6.45
8	82.59^0	0.129	1.66
9	77.17^0	0.222	4.93
10	93.83^0	-0.066	0.45
11	95.66^0	-0.098	0.97

The table above reveals a striking relationship between the various delineated patterns in the female profile and the teachers concern with students' individual differences. The vector of the variable is either at an acute angle almost perpendicular to the latent factor or at obtuse angle indicating an inverse relationship with the factor. The correlation of the variable with each factor is very low hence its variance contribution is very infinitesimal and negligible. This implies that females cherish their privacy and thus, anything that will expose them or bring their individual differences into the public glare is not regarded as an important teaching effectiveness factors in a Chemistry classroom. It should be noted that this class of students are adolescent and thus want to protect their ego.

5.5 Group Discussion Factor

In the female profile, this is the 5th factor and it contributes 3.344% to the total variance explained in the profile. There are two variables that loaded significantly high on the factor and the variables centered mainly on group discussion. The variables have significantly high correlations Var_{19} (0.611) and Var_{23} (0.710) with the factor. The common factor explained 37.33% and 50.41% total variance of the variables respectively. However, this latent pattern does not appear in the female profile. In addition the two variables on this descriptive category do not have any significant loadings on other factors in the female profile. Also in this profile the female students do not rank variables that deal with interpersonal relationship as teaching effectiveness factors in a Chemistry classroom.

5.6 Good Sense of Humour Factor

This factor is only peculiar to the male profile. It accounts for 3.259% of the total variance in the male profile. It is a specific factor and the only variable that loads on it has a correlation of r = 0.58.

5.7 Communication Skills Factor

This is the 7th factor in both profiles indicating the same degree of strength. It accounted for 3.217% of the total variance explained in the male profile and 3.256% in the female. Thus, in both profiles, they represent almost the same degree of comprehensiveness. It is a specific factor in females. When represented in vector geometry, the dominant variable in the factor Var_9 "Summarise major points" shows that in the female profile, the correlation is higher with the factor than male profile. Both vectors are in the same positive direction. Also the length of the vector is slightly higher in male profile than female. On the whole both profiles attach a higher premium to "Summarise major points" in a Chemistry classroom.

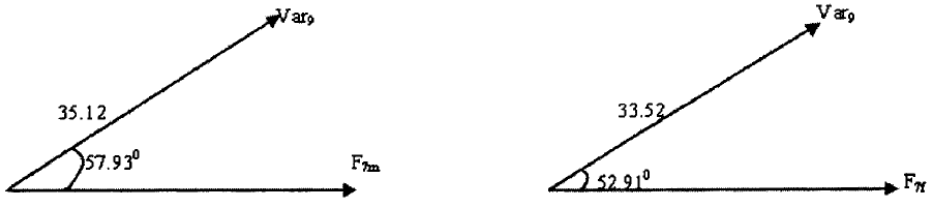

Figure 5. A plot of the vectors of the factors F_{7m}, F_{7f} and Var_9

The orthogonal factor accounted for 28.20% of the variance in the variable in the male profile while it accounts for 42.64% of the variance in the female profile. This shows that both male and female students recognize communication skills as an important factor for effective teaching of Chemistry.

5.8 Good Rapport Factor

This factor is the 8th in male and 9th in female. In both profiles it is a specific factor. It accounts for 2.785% in males profile and 2.469% in the female profile.

5.9 Teacher –Student Interaction Factor

Teachers - students Interaction is the 9th construct in the male profile, and, accounts for 2.712% of the total variance explained. However, four variables loaded very high on the factor with correlation r: $0.450 \leq r \leq 0.557$, in the female profile and the construct is the 4th one. It accounts for 5.355% of the total variance explained in the female profile, thus it is more comprehensive and stronger in the female profile. Out of the four variables that loaded high in the female profile, two and only two loaded on the construct in the male profile. In Cartesian plane, the vectors of the constructs and the two variables Var_{25}: "*Be friendly towards students*" and Var_{27} "*Be available to give help to students*" are compared.

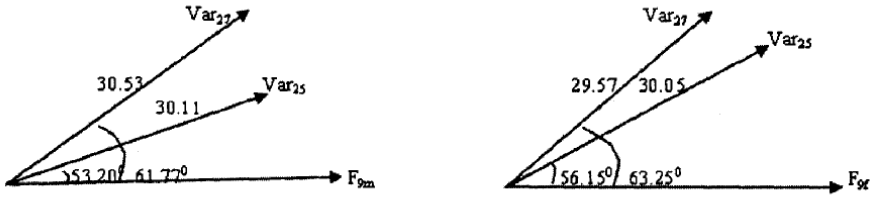

Figure 6. A plot of the vectors of the factors F_{9m}, F_{9f}, Var_{25} and Var_{27}

From the above geometrical vectors, Var_{25} has a higher correlation with the factor than Var_{27} in male profile, whereas in the female profile, Var_{27} has a higher correlation with the factor than Var_{25}. Nevertheless, the length of Var_{25} is almost the same in both profiles while the length of Var27 is about 3.25% higher in male profile than female. This implies that the variability of the ratings is higher in male than female. On the other hand, the females are more consistent in the rating of Var_{27} "*Be available to give help to students*" than the males.

Also there is a peculiarity in one variable in female profile, that is, Var_{21}, which indicates a factorial complexity of two and it loaded moderately high on both factor 3 (0.453) and factor 4 (0.543). This implies that the female students believe that "*Make students feel free to ask questions and express their ideas*" is a cogent pathogen of teachers "commitment" and "Teacher -Student interaction".

5.10 Statement of Objectives Facto

In both profiles, this factor is the 10th orthogonal factor. It accounts for 2.377% of the variations in male profile and 2.055% in the female profile. This means they have the same strength but slightly different in comprehensiveness. The factor is specific in female but has two variables loaded on it in male profile. Var_1 contributes 54.91% in female but 26.01% in male profile. Moreover, the vector of Var_1 intercepts female latent construct at acute angle 42.18^0 and male latent construct at an acute angle 59.34^0 indicating a grater correlation and influence in female profile than in male profile.

5.11 Analytical Ability Factor

Here also, this construct is a specific factor in male profile. Male and female students' believe that teacher's ability to identify salient and cogent points of his/her topic is tangential to effective teaching in a Chemistry classroom. It has a total eigenvalue of 1.010 and accounts for 2.302% of the total variance in the male profile. The common factor in male accounted for 36.12% of the variance in Var_2 and is the only variable that loaded moderately high on the factor with a correlation r = 0.601. In female it is the 5th factor with eigenvalue of 2.156 and explained 4.312% of the total variance. It predicts 33.41%, 24.06%, 20.80% and 23.72% of the variances in Var_2, Var_3, Var_4 and Var_{10} respectively.

In addition there are 3 factors that exist in female profile but not in males. The most comprehensive factor in female is "Examination" with five variables loading moderately high. "Examination" explained 7.089% of the variation in female. The variables on the factor has correlation r; $0.504 \leq r \leq 0.611$. Also the 2nd most comprehensive orthogonal factor in the female is "Proper Examination Management". It has correlation r: $0.462 \leq r \leq 0.596$. It accounts for 6.386% of the total variance in female. The female also consider the "Instructional

materials usage" as important factor for teaching effectiveness in a Chemistry classroom. It accounts for 2.302% of the total variance in the profile. These three factors do not exist in male profile.

Table 2. Comparison of factor structure of male and female profiles

Root Mean Square	Coefficient of Congruence	Latent factors
0.2399	0.5464	Knowledge of Subject Matter
0.2256	0.5361	Assignment
0.1544	0.6116	Communication Skills
0.2064	0.1286	Good Rapport
0.2052	0.4882	Teacher-Student Interaction
0.1555	0.4452	Statement of Objectives
0.1899	0.4527	Analytical Ability

The Table 2 above is the computation of root mean square (RMS) and coefficient of congruence (Co) to compare the factor structure of both male and female profiles. Out of the 11 factors that emerged in each profile, 7 of them appeared in both profiles. From the table the RMS is in the interval $0.1544 < RMS < 0.23999$. All values are closer to zero than 2 and $RMS < 0.5$ for every factor. This implies that there is a perfect match between male and female profiles both in pattern and magnitude. Moreover, the coefficient of congruence from the table also indicates that both male and female teaching effectiveness rating profiles show pattern and magnitude similarities.

6. Conclusion

The study found that there are significant similarities in the ratings of the teaching effectiveness factors in a Chemistry classroom due to gender. Each gender profile reveals 11 pattern of underlying influence of which 7 are common to both gender. The root mean square and coefficient of congruence measures indicate clearly that the two profiles are similar in pattern and magnitude though with slight variations in degree of comprehensiveness and strength.

However, four factors from each profile differentiate these profiles according to gender. While the male students believe in "Dynamism" of the Teacher in the class, "Feedback" on students' progress, "Group Discussion" and "Good Sense of Humour" of the teachers, the female students extended their interest to "Examinations", "Proper Classroom Management", "Commitment and Use of Instructional materials". Thus, while there is slight difference in factor pattern, the factor structures are similar.

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