Deploying Card Games as Tools in Learning Chemistry Concepts in Nigerian Classrooms

Isaac Sewanu Bankole
Ogun State Institute of Technology, Igbesa, Ogun, Nigeria
ibankole2015@gmail.com

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Abstract

Over the last three decades, chemistry educators are concerned with improving the teaching and learning of chemistry. But Nigerian senior secondary students’ are still under performing in school and public examinations. Process skills development has also failed to be meaningfully achieved. Several methods have been employed to arrest the declining performance has been unsuccessful. It is within this context that this study attempt to investigate the deployment of card games as a tool in learning difficult chemistry concepts in Nigerian classrooms. A quasi-experimental approach was employed for data gathering based on 2x2 factorial design (two teaching strategies—one experimental and one control and two levels of gender). A total of 215 senior secondary two students (113 female and 102 male) average age of 15 years from six senior secondary schools in three local government areas of Ogun State formed the sample. Redox Reactions Achievement Test (RRAT), Process Skills Assessment Test (PSAT&PSAF) with reliability coefficients of 0.85 and 0.81 respectively were used to collect data. Four research questions were posed for investigation alongside their corresponding null hypotheses, tested based on pretest, treatment and posttest protocols. Data were subjected to Descriptive and Multivariate Analysis of Covariance (MANCOVA) using IBM-SPSS version 17. MANCOVA results show that the value associated with Wilks’ lambda was 0.55; F=47.28; P<0.001, confirming the significance of the MANCOVA. Between subjects effect for the groups on the MANCOVA output showed that the achievement measure of the experimental (CG) and control groups were significantly different (mean score for CG = 18.43 and Control = 15.51; F=107.21; p<0.001) and for the process skills development (F=2.15; p<0.05) as experimental group (CG) developed greater process skills (mean score for CG = 18.12; LM = 17.24). Also, significant gender effect of cognitive achievement and process skills was found (Wilks’ Lambda = 0.98, F (2.266) = 2.94, p < 0.005). The study concluded that Card games should be integrated into Nigerian classroom instruction to reinforce the understanding of concepts taught since it makes students to be active participants in the teaching and learning process. It was recommended that teachers be trained in the use of innovative and interactive strategies such as card games in chemistry teaching.

Key words: Card games, Cognitive achievement, Difficult topics in chemistry, Process skills.

Introduction/Background

The contributions of chemistry to the social, industrial and economic life of the world in general and Nigeria in particular have been felt in all facets of human life. Chemistry is a relevant science subject, which is making essential contributions towards human life, society, industry and civilization. It was as a result of the recognition given to chemistry in the development of the individual and the society (nation) that it was made a core-subject among the natural science and other science-related courses in the Nigerian educational system.[14] opined that chemistry is the central science and the mother of all sciences. It has become a pre-requisite subject for most science oriented courses in tertiary institutions. Despite the relevance of knowledge of chemistry to the society, the achievements of students in African countries especially Nigeria in chemistry in recent times have been poor. The West African Examinations Council’s (WAEC) statistics indicated that, between the years 2012
and 2014 there was a consistent decline in the percentage of students who passed chemistry at Credit level. The record further shows, that 38.81%, 36.57% and 31.28% passed at credit level respectively in those examinations[7][12][30]. This is detrimental to required human capital development in Nigeria. Many studies have been carried out in an attempt to establish the causes and possible solutions to this problem but not much has been achieved since chemistry students at the secondary level continued to perform poorly. Some of such studies revealed factors as abstract nature of chemistry [25], location of schools, students’ and schools’ characteristics, and teaching method among others as responsible for low performance in external examinations. [3][24][28].

In addition to the above and occupying a central position as one of the factors militating against the achievement of progress in science education is the inadequate emphasis on the development of scientific process skills [14][16] which is due to the notion that most science teachers still employ the traditional method of instruction. The method encourages recitation and memorization of products of chemistry to the neglect of the processes of science (chemistry inclusive). It becomes imperative to emphasis the development of process skills in the learning of science. Teachers must be trained to involve their students in situations in which they can be led to practice and discuss the scientific methods for themselves.

The objectives of the chemistry curriculum which were derived from the National Policy on Education (2008) were to prepare students to facilitate a transition in the use of scientific concepts and techniques acquired in basic science. Adequate laboratory and manipulative skills in chemistry, show chemistry and its link with industry, everyday life, benefits and hazards, and chemistry in its inter-relationship with other subjects as well as develop reasonable and functional scientific attitude. Science educators, over the years have identified difficult topics in chemistry. These include: the mole concept, redox reaction, calculations involving volumetric analysis, calculations in electrolysis and calculations involving chemical equations among others [18], WAEC Chief Examiners Reports [29][30]. Yet, there is the need for proper delivery of chemistry curriculum in senior secondary schools. It is only when concepts are not meaningfully understood by students that they avoid questions in Senior Secondary Certificate Examinations (SSCE), hence poor performance in these areas including the overall performance of students in chemistry at SSCE.

This makes it imperative to beam the searchlight on an approach for teaching chemistry that aims at enhancing understanding rather than promoting memorization and juggling of facts. An effective way of dealing with this problem is for the teacher to provide a bridge between the familiar concepts and the knowledge which students are yet to acquire. Research efforts have been directed to the teaching and learning of the difficult concepts of redox reaction, electrolysis and calculation involving chemical equations [14][18][23]. However, there have not been conclusive evidences on the most effective teaching strategies that could be employed by chemistry teachers in the teaching of these difficult concepts. This implies that more work need to be done to effectively teach the difficult concepts as identified in chemistry. It therefore becomes imperative to search for effective teaching strategies that could be employed to enhance meaningful learning of redox reaction concepts in which the students can read together, interact and clarify their difficulties among themselves. This study investigated the effect of deploying card games teaching strategy on achievement and student process skills development in Chemistry.

Purpose

The study investigated:

- the relative effectiveness of card games teaching strategy on the cognitive achievement of students in redox reactions.
- the relative effectiveness of card games teaching strategy on the scientific process skills development of students in redox reactions.
if the use of card games strategy in teaching redox reactions has the same effect on male and female cognitive achievement.

- the influence of gender on the scientific process skills development when students receive instruction on redox reaction through card games teaching strategy and lecture method.

Research questions

i. What is the relative effectiveness of card games teaching strategy on the cognitive achievement of students in redox reactions?

ii. What is the relative effectiveness of card games teaching strategy on the scientific process skills development of students in redox reactions?

iii. What is the difference between the cognitive achievement mean scores of male and female student’s taught redox reactions using card games teaching strategy?

iv. What is the influence of gender on the cognitive achievement and scientific process skills development of senior secondary school students when they receive instruction on redox reaction through card games teaching strategy and lecture method.

Research hypotheses

To determine the extent to which this strategy was effective in realizing the purpose of this study, the following null hypotheses were tested at 0.05 significance level.

\[ H_{01} \]: There is no significant difference in the cognitive achievement of senior secondary school students in redox reactions when taught using card games strategy and lecture method.

\[ H_{02} \]: There is no significant difference in the scientific process skills development of students taught redox reactions using card games teaching strategy and lecture method.

\[ H_{03} \]: There is no significant difference between the cognitive achievements mean scores of male and female student’s taught redox reactions using card games teaching strategy.

\[ H_{04} \]: There is no significant difference of gender on cognitive achievement and scientific process skills development of senior secondary school students when taught redox reactions using card games strategy and lecture method.

Design and methods

The sample consists of two hundred and fifteen students who were made of one hundred and two male and one hundred and thirteen female students selected from four intact secondary schools II classes. Four purposefully sampled co-educational schools from Ado – Odo/Ota Local government of Ogun state were used. Purposed sampling was used to minimize experimental contamination by using schools that are far from one another.

This study employed a quantitative methodology. In this study, quasi-experimental research design was adopted. A pre-test, post-test control groups 2 x 2 factorial design was employed. Factorial design is a form of true experiment where multiple factors (researcher controlled- independent variables) are manipulated or allowed to vary and they provide the researchers two main advantages. The researcher is allowed to examine the main effects of two or more individual independent variables simultaneously. Secondly, it allows the researcher to detect interactions among variables. In this design two teaching strategies (card games and lecture) were crossed with students’ gender (male and female). In using this design, one experimental (treatment) group and one control group was used. Two intact classes of subjects from four schools were randomly assigned to the experimental group and one control group. A quasi experimental design was considered most appropriate in this study since two intact classes were used and no randomization was done in the selection of subjects.

Procedures

Two instruments were used in the conduct of the study. The instruments were:
1. Process Skills Assessment Test (PSAT) and Process Skills Assessment Form (PSAF)

2. Redox Reactions Achievement Test (RRAT)

The process skills assessment test in Redox reaction (PSAT) was developed by the researcher to cover all concepts of oxidation, reduction, cell construction, balancing of redox reactions and identification of oxidizing and reducing agent taught. PSAT is divided into two sections, (i) personal data of the respondent (name of school, gender and age) and (ii) a question in four sub levels relating to process skills assessment in Redox reaction. It lasted for one hour. The skills assessed include observation, measurement, manipulating, predicting, inferring and recording. It was a practical section. The students were provided with 7.5 Volt battery, CuSO₄ solution, card board, copper electrodes, connecting wires, 1.5v bulb, measuring cylinder, distilled water, switch and four questions. This instrument was given to two SSII Chemistry teachers, who had over ten years teaching experience and two science education experts to validate. In order to assess the language used in the construction of the instrument. Their comments were considered in the construction of the final instrument.

The PSAT was administered to 41 (19 male, 22 female) SSS II Chemistry students in order to determine its reliability coefficient. It was a practical section given to SSSII chemistry students of school that does not participate in the study. The reliability was computed using the SPSS version 17. The Cronbach’s Alpha was found to be 0.81.

Findings

Research question 1:

What is the relative effectiveness of card games teaching strategy on the cognitive achievement of students in redox reactions?

<table>
<thead>
<tr>
<th>Treatment</th>
<th>N</th>
<th>Pre mean</th>
<th>Post mean</th>
<th>Mean gain</th>
<th>Pre S.D</th>
<th>Post S.D</th>
<th>Pre mean</th>
<th>Post mean</th>
<th>Mean gain</th>
<th>Pre S.D</th>
<th>Post S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Card Games</td>
<td>106</td>
<td>7.26</td>
<td>18.83</td>
<td>11.75</td>
<td>2.71</td>
<td>3.20</td>
<td>7.26</td>
<td>18.22</td>
<td>10.96</td>
<td>2.71</td>
<td>3.97</td>
</tr>
<tr>
<td>Lecture Method</td>
<td>109</td>
<td>6.93</td>
<td>14.72</td>
<td>7.79</td>
<td>2.90</td>
<td>1.97</td>
<td>6.86</td>
<td>15.20</td>
<td>8.34</td>
<td>1.90</td>
<td>2.13</td>
</tr>
</tbody>
</table>
Table 1 shows that the experimental subjects (card games strategy) obtained a higher mean score of 18.83 in the post cognitive test with a standard deviation of 3.20 compared with their counterparts in the control group (Lecture method) who had a mean of 14.72 with a standard deviation of 1.97. It can be observed that the pretest-posttest mean gain was higher in favour of the experimental group (11.75).

Null Hypothesis 1
There is no significant difference in the cognitive achievement of senior secondary school students in redox reactions when taught using card games strategy and lecture method.

The hypothesis was tested using the multivariate analysis of covariance (MANCOVA) statistical technique at p < 0.05 significance. This statistical tool was considered as the most appropriate since two dependent variables were of interest in the study—cognitive achievement and process skills development, and random assignments of experimental and control groups was not achieved.

Table 2: Multivariate test of the effect of strategy on post cognitive achievement and scientific process skills scores

<table>
<thead>
<tr>
<th>Source</th>
<th>Value</th>
<th>F</th>
<th>Hypothesis</th>
<th>df</th>
<th>Error df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilks' lambda</td>
<td>0.729</td>
<td>38.59</td>
<td>b</td>
<td>2.00</td>
<td>208.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

The preliminary multivariate test result in Table 4.2 shows that the data satisfied the assumptions of homogeneity of covariance, independence of observations and normality. Using SPSS version 20, the pretest and posttest cognitive achievement and process skills development data from the experimental and control groups were inserted into the MANCOVA equation. The result shows that the Wilks’ lambda associated with the overall multivariate analysis of covariance (MANCOVA) is \( \lambda = 0.729; (F = 38.59, p < 0.001) \) confirming the significance of the MANCOVA. This indicated that the univariate F for the cognitive achievements and scientific process skills of students have strong statistical value thus justifying deeper probe into the F values relating to the independent variables of the study on the dependent variables of cognitive achievement and process skills.

Table 3: Summary of multivariate analysis of covariate of teaching strategies on students’ cognitive achievement scores

<table>
<thead>
<tr>
<th>Source</th>
<th>Type sum squares</th>
<th>III of Df</th>
<th>Mean square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>341.897a</td>
<td>5</td>
<td>68.379</td>
<td>7.517</td>
<td>.000</td>
</tr>
<tr>
<td>Intercept</td>
<td>5161.641</td>
<td>1</td>
<td>5161.641</td>
<td>567.397</td>
<td>.000</td>
</tr>
<tr>
<td>Strategy (Main effect)</td>
<td>238.760</td>
<td>1</td>
<td>238.760</td>
<td>26.246</td>
<td>.000</td>
</tr>
<tr>
<td>Gender</td>
<td>36.949</td>
<td>1</td>
<td>36.949</td>
<td>4.062</td>
<td>0.045</td>
</tr>
<tr>
<td>Strategy*Gender</td>
<td>1901.284</td>
<td>209</td>
<td>9.097</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>79435.000</td>
<td>215</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>2243.181</td>
<td>214</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R squared = .867 (Adjusted R squared = .862) Computed using alpha = 0.05
The results in Table 3 show that teaching strategies (card games and lecture method) is a significant factor in senior secondary school students’ cognitive achievement in redox reactions \( (F_{(1, 214)} = 26.246, p < 0.001) \). Based on the results of the multivariate analysis of covariance, the null hypothesis of no significant difference in the cognitive achievement of students is rejected. This means that there is a significant difference in the cognitive achievement of students in Redox Reactions when taught using card games strategies and lecture method is not rejected. In addition, the R squared was 0.867 and Adjusted R Squared obtained was 0.862. This shows that 86.2% variance is contributed by the teaching strategies. Bonferroni post hoc analysis result shows that the card games strategy were responsible for the significant.

**Research question 2:** What is the relative effectiveness of card games teaching strategy on the scientific process skills development of students in redox reactions?

This question was answered with mean and standard deviation was used. The result is presented in table 1. The table 1 shows that the card games group had higher mean gain (M=10.96, S.D=3.97) in the process skills development than their lecture method group counterparts (M=8.34, S.D=2.13). This implies that card games had effect on the skills development of senior secondary school chemistry students.

**Null Hypothesis 2:** There is no significant difference in the scientific process skills development of students taught redox reactions using card games teaching strategy and lecture method.

**Table 4: Summary of multivariate analysis of covariate of teaching strategies on students’ scientific process skills development scores**

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III sum squares</th>
<th>III of Df</th>
<th>Mean square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>844.364</td>
<td>5</td>
<td>172.813</td>
<td>15.356</td>
<td>.000</td>
</tr>
<tr>
<td>Intercept</td>
<td>6135.060</td>
<td>1</td>
<td>6135.060</td>
<td>544.952</td>
<td>.000</td>
</tr>
<tr>
<td>Strategy (Main effect)</td>
<td>651.663</td>
<td>1</td>
<td>651.663</td>
<td>57.885</td>
<td>.000</td>
</tr>
<tr>
<td>Gender</td>
<td>189.783</td>
<td>1</td>
<td>189.783</td>
<td>15.079</td>
<td>.001</td>
</tr>
<tr>
<td>Strategy*Gender</td>
<td>100.616</td>
<td>1</td>
<td>100.616</td>
<td>8.937</td>
<td>.003</td>
</tr>
<tr>
<td>Error</td>
<td>2352.918</td>
<td>209</td>
<td>11.258</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>82667.000</td>
<td>215</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>3217.314</td>
<td>214</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b. R Squared = .692 (Adjusted R Squared = .687) Computed using alpha = 0.05

The results in Table 4 show that teaching strategies (card games and lecture method) is a significant factor in senior secondary school students’ scientific process skills development \( (F_{(1, 214)} = 57.89, P < 0.000) \). Furthermore, the R Squared was found to be 0.692 and the adjusted R Squared was 0.687 indicating that the strategy contributed 68.7 % to the variance. Based on the results of the multivariate analysis of covariance, the null hypothesis of no significant difference in the scientific process skills development of students is rejected.

**Research question 3**

What is the difference between the cognitive achievement mean scores of male and female student’s taught redox reactions using card games teaching strategy?
Table 5: mean scores and standard deviations of male and female subjects

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Gender</th>
<th>N</th>
<th>Pre mean</th>
<th>Post mean</th>
<th>Mean gain</th>
<th>Pre S.D</th>
<th>Post S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Card Games (Experimental)</td>
<td>Male</td>
<td>48</td>
<td>9.91</td>
<td>21.22</td>
<td>11.31</td>
<td>2.58</td>
<td>3.32</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>58</td>
<td>7.54</td>
<td>18.58</td>
<td>11.04</td>
<td>2.80</td>
<td>3.11</td>
</tr>
<tr>
<td>Lecture method (Control)</td>
<td>Male</td>
<td>54</td>
<td>5.73</td>
<td>16.52</td>
<td>10.79</td>
<td>3.28</td>
<td>3.84</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>55</td>
<td>5.40</td>
<td>14.81</td>
<td>9.41</td>
<td>2.43</td>
<td>3.92</td>
</tr>
</tbody>
</table>

The results in Table 5 indicated that the male subjects in the card games group obtained a higher mean of 21.22 in the posttest with mean gain of 11.31 compared to their female counterparts who had a mean of 18.58 with mean gain of 11.04. It can also be observed that both male and female subjects in the experimental group (Card games) had higher mean gain (11.31 and 11.04) compared with their counterparts in the control (Lecture method) group (10.79 and 9.41). To verify whether or not the difference in the mean gain in cognitive achievement of male and female subjects is significant, hypothesis 3 was tested.

Null Hypothesis 3:

There is no significant difference between the cognitive achievements mean scores of male and female student’s taught redox reactions using card games teaching strategy.

Results in Table 3 show the significant of gender in the cognitive achievement scores of male and female student’s when taught redox reactions using card games strategy \( F(1,214) = 4.062; p<0.05 \). This implies that there is a significant difference between male and female students’ taught Redox reactions with card games strategy. Therefore, the null hypothesis of no significant difference (hypothesis 3) is rejected.

Research question 4

What is the influence of gender on the scientific process skills development of senior secondary school students when they receive instruction on redox reaction through card games teaching strategy and lecture method.

Table 6: mean and standard deviations of male and female subjects in relation to scientific process skills development scores

<table>
<thead>
<tr>
<th>Scientific Process Skills</th>
<th>Gender</th>
<th>N</th>
<th>Pre mean</th>
<th>Post mean</th>
<th>Mean gain</th>
<th>Pre S.D</th>
<th>Post S.D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Card Games</td>
<td>Male</td>
<td>48</td>
<td>7.12</td>
<td>16.81</td>
<td>9.69</td>
<td>2.59</td>
<td>3.69</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>58</td>
<td>7.75</td>
<td>18.77</td>
<td>11.02</td>
<td>2.39</td>
<td>4.00</td>
</tr>
<tr>
<td>Lecture</td>
<td>Male</td>
<td>54</td>
<td>7.20</td>
<td>16.84</td>
<td>9.64</td>
<td>2.65</td>
<td>3.90</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>55</td>
<td>7.74</td>
<td>15.48</td>
<td>7.74</td>
<td>1.80</td>
<td>3.51</td>
</tr>
</tbody>
</table>

Table 6 shows that the females mean gain of subjects in the card games group is higher than the male counterparts (11.02 and 9.69). Also, the card games group’s female and male had a posttest mean of 18.77 and 16.81 which is higher than their counterparts in the Lecture group (15.48 and 16.84) respectively in favour of the card games group. This means that experimental group which was exposed to redox reactions through card games developed more process skills in chemistry compared to their counterparts in the control group exposed to
lecture method. This question was further answered by testing hypothesis 4.

**Null Hypothesis 4**
There is no significant influence of gender on scientific process skills development of senior secondary school students when taught redox reactions using card games strategy and lecture method.

To test this hypothesis, data obtained from student’s pretest and posttest scientific process skills developments including gender were organized and subjected to Multivariate analysis of covariance. The result is presented in table 4. Table 4 revealed that there was a significant influence of card games strategy on senior secondary school student’s chemistry process skills development \(F(1, 214) = 15.079; p<0.05\). Therefore, the hypothesis that states that there is no significant influence of gender on scientific process skills development of senior secondary school students when taught redox reactions using card games strategy and lecture method is hereby rejected.

**Discussion of results**

This study sought the deployment of Card Games as Tools in Learning Chemistry Concepts in Nigerian Classrooms. Findings from this study reveals that the experimental subjects (card games strategy group) obtained a higher mean score of 18.83 in the post cognitive test with a standard deviation of 3.20 compared with their counterparts in the control group (Lecture method) who had a mean of 14.72 with a standard deviation of 1.97. In addition, the pretest-posttest mean gain was higher in favour of the experimental group 11.75 as shown in Table1. This position further conforms with the earlier findings of [4] that card games constituted a better strategy for enhancing cognitive achievement of students when taught difficulty concept such as redox reactions at the senior secondary school level than lecture teaching method. Teaching strategies contributed 86.2% variance as indicated by the adjusted R squared Table 3. Also, a significant difference was found between those taught redox reactions with card games and those taught with lecture method \(F(1, 214) = 26.246, p<0.001\). This result may not be unconnected with the fact that the students were motivated by the card games strategy captured the attention and aroused their interest. They were able to utilize the concept learnt in an active manner because they interact with both materials and other students, shared and make decisions together. The students in this group were free with one another in the course of the teaching and learning process. These findings aligned with the findings of [20] in the study in which they investigated the impact of designed Object Based game on the performance of JSS 2 students mathematics in which the experimental group instructed with object based game, performed significantly better in the learning of mathematics than those in the control group that used the lecture method for instruction. The better performance of the experimental group was attributed to other factors such as ability of the students to communicate freely with each other, support and encourage one another thereby increasing their problem solving skills and they were able to relate mathematical information to everyday life. This claim was supported by [5][11][19]. The study of [26] which investigated the effectiveness of an educational card game for learning how human immunology is regulated found that students from the game group significantly outperformed their counterparts in terms of their understanding of the processes and connections among different lines of immunological defense confirming the effectiveness of card games in teaching and learning of science.

Further findings that the female in the card games group had higher mean gain than the male counter parts (11.02 and 9.69) in chemistry process skills development test. Also, the card games group’s female and male had a posttest mean of 18.77 and 16.81 which is higher than their counterparts in the Lecture group (15.48 and 16.84) respectively in favour of the card games group. This means that experimental group which was exposed to redox reactions
through card games developed more process skills in chemistry compared to their counterparts in the control group exposed to lecture method. The study also revealed that there was a significant influence of card games strategy on senior secondary school student’s chemistry process skills development \[ F_{(1,214)} = 15.079 \; p<0.05 \]. This findings is in agreement with that of [23][27]. They reported among other things that a significant difference was found in the scores of male and female on cognitive outcomes of group exposed to card games strategy. This was further reported by [10]; which found gender difference in male in favour of cognitive achievement in science. However, this do not agrees with many research findings [13][24][18]. This disagreement must have been because of the environment in which the teaching strategies adopted in this study were used and the classroom settings and the effect of the location in which the study was carried out. This was because the teaching strategies are gender friendly and both male and female found it as an easy way to learn better. This implies that given the right conditions of learning chemistry both male and female students would perform equally.

**Recommendations**

From the result of this study, the following recommendations were made.

1. Chemistry teachers should consider using card games strategy to teach chemistry concepts especially redox reactions. This strategy is student’s centered, which would avail the students the opportunity of constructing learning in their own way thereby enhancing achievement in chemistry.
2. This study could be replicated using some other difficult chemical concepts such as mole, rate of reaction and some others.
3. Teachers should keep abreast with current findings that could enhance their lesson delivery by attending regularly workshops, seminars and conferences to update their knowledge and be encouraged to write text materials that incorporate the use of such strategies.

**References**


