THE INFLUENCE OF GENDER ON THE USE OF ANALOGY ON BIOLOGY STUDENTS' UNDERSTANDING OF THE CONCEPT OF OSMOSIS AMONG SECONDARY SCHOOL STUDENTS IN MINNA, NIGER STATE

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Abstract

Result of the earlier study on" Effects of Analogy on the understanding of the concept of osmosis among secondary school students in Minna, Niger State, Nigeria" indicated that the use of analogy in teaching leads to meaningful learning (Koroka & Ezenwa 2009). This paper examined the influence of gender on the use of analogy on biology students' understanding of the concept of osmosis among secondary school students in Minna, Niger State. A total of 80 (40 male and 40 female) students in Senior Secondary class two (SS II) randomly selected from two secondary schools in Minna metropolis made up the sample for the study. The design for that study was a Pretest-Posttest Experimental group design. The treatment stimulus {Teaching-With-Analogy (TWA) model of Glynn, 1989} was used to teach the concept of "Osmosis" in Biology. The instrument used for data collection was a fifty-item achievement test on osmosis. It was validated and it's reliability determined as 0.91.Anlysis of the posttest results of the students (40 male and 40 female) data revealed that both male and female students taught osmosis using analogy strategy performed very well and there was no statistical significant difference between the mean scores of male and female students. Based on these findings, recommendations were made for adoption of analogy as an instructional method in schools.

Keyword: Analogy, Biology, Concept, Influence, Gender, Osmosis, Students and Niger State.

Introduction

The role of women in social and economic development seem to be culturally determined in traditional societies hence, their potentials are seriously constrained and taken for granted (Morenikeji, 2000). Consequently, women seem to be subjected to considerable industrial and occupational segregation. They are particularly concentrated in semi- and unskilled employment in retailing, in the clothing industry, catering and cleaning. Women are mostly employed to the lower-grade clerical and secretarial posts, while the relatively small portion of professional women employees are concentrated in the caring professions notably education, welfare and health (Morenikeji, 2000). Federal Office of Statistics (1996) in Morenikeji (2000) reported that one of the causes of low status accorded women in several societies is the discrimination against them in education. The current situation can be based on World Bank (1993a) in Morenikeji (2000) that there is a great disparity in male-female enrolment in secondary schools in favour of males. This finding was supported by a five years (2007-2011) enrolment analysis of Government Day Secondary School, Minna students of Senior School Certificate Examination (SSCE) as shown in table 1:

Table 1: Enrolment analysis of G.D.S.S. Minna, SSCE students (2007-2011)

Gender	2007	2008	2009	2010	2011
Male	340 (57.14%)	421 (64.67%)	447 (57.60%)	475 (56.48%)	511 (58.00%)
Female	255 (42.86%)	230 (35.33%)	329 (42.40%)	366 (43.52%)	370 (42.00%)
Total	595	651	776	841	881

Source: Secondary School Education Board, Minna.

It can be seen from table 1 that the percentage enrolment of males is higher than that of the females. Government Day Secondary School is one of the secondary schools in Minna where the study was carried out. This disparity in school enrolment in favour of male was attributed to the desire of some parents to educate male child rather than female child partly because; they believe that the male child has better employment opportunities than the female child (World Bank, 1993a).

Even before the Beijing Conference in (1995), attention of the world has been directed towards gender issues in developmental efforts, most especially, in the developing countries like Nigeria. Many researchers have shown much interest in the study of gender, schooling and gender related issues in Nigeria and the world over (Jegede & Inyang, 1989: Keith, 2001; Abimbola & Mustapha, 2001; Dunican, 2002; & Agbowuro, 2008). Their findings are in line with the report by World Bank (1993a) that more males were found in schools than females. They further asserted that female participation both in science and education in general have been observed to decline drastically (Dunican, 2002; Onwukwe, 2008; Onwukwe & Onwukwe, 2010). Lee & Lockhead (1989) in Lagoke (1992) have opined that factors responsible for this decline include early maturation and early marriage of the females, which leads to their removal from schools particularly in northern Nigeria. Lagoke (1992) reported that both the attendance rate and the quality of female education differ from region to region, stating that more girls attended schools in the southern and western part of the country than in the north. Studies by Erickson & Erickson (1984) also showed that there are differences in performance of boys and girls in science class. Jegede & Inyang (1989) reported that there was a significant superior achievement of boys over girls in integrated science in Junior Secondary Schools. Tobin (1988) in Lagoke (1992) reported that male students responded to teacher's questions by raising their hands and also manipulates equipment to a greater extent.

The differential understanding and performance of male and female students as observed by researchers could be as a result of abstract and difficult nature of some scientific concepts or the instructional method used by the teachers (Owolabi, 2002; Rigas & Valanides, 2003; Garner, 2005; Ikasi, Reamen & Awah, 2005; Onwukwe, 2005; Agbwuro, 2008 & Onwukwe; 2008). Osmosis has been reported to be one of the abstract and difficult concepts in biology (WAEC, 1997, 1998, 2000, 2005; Keith,2001, Koroka & Ezenwa, 2009;& Ijioma & Onwukwe, 2011).

Osmosis is the movement of water molecules (solvents) from a solution of lower concentration to that of higher concentration through a semi-permeable membrane. (Ndu, Asun, & Aina,1999; Ndu, Edwards, Dunquah & Ezenkwe,1999 & Koroka & Ezenwa,2009).Usefulness of osmosis to living organisms includes; absorption of water molecules by root hairs of plants ,movement of water molecules within the cells of living organisms, maintenance of turgidity of plant and animal cells as well as water re-absorption at the colon region of alimentary canal (Ndu, Edwards, Dunquah and Ezenkwe,1999).

Among the strategies found to bring about meaningful learning in science is analogy. Analogy Instructional Strategy involves the use of something familiar to the students to teach them a concept that is unfamiliar to them. Many studies found Analogy Instructional Strategy to be very effective in bringing about meaningful teaching and learning of science (Nkadi,2000; Esiobu, 2000; Abimbola & Mustapha,2001;Onwukwe, 2005; Onwukwe,2008; Okeke, 2009; Koroka & Ezenwa,2009; Onwukwe & Onwukwe, 2010 & Ijioma & Onwukwe, 2011). The study therefore analyzed the posttest results of the experimental group students only who performed significantly better than the control group students to determine the influence of gender on the understanding and performance of students using analogy instructional strategy.

Objective of the study

The main objective of this study is to determine whether there is gender difference when students are taught the biological concept of osmosis using analogy instructional strategy.

Research question

The present study was designed to address the research question:
Will the use of analogy in teaching the concept of osmosis in biology result in differential understanding by male and female students?

Hypothesis

Based on the above research question, the following null hypothesis was formulated and tested at the 0.05 significant level.
HO_I: There is no significant difference between the mean scores of male and female students taught with analogy.

Research methodology

Research design: A Pretest Posttest Experimental design was used for the study.
The aim of this research is to determine if gender differences exists in the understanding of concept of osmosis among secondary school male and female students when taught with the analogy instructional strategy using two State Government owned co-educational secondary schools. The students (male and female) were first pre-tested and thereafter, taught the topic 'OSMOSIS' using Teaching With Analogy (TWA) model of Glynn (1989). After the treatment, a posttest (same as pretest), consisting of a 50-item achievement test in osmosis was administered to both male and female SSII students taught the concept of osmosis using analogy strategy.

Sample and sampling techniques: The target population for the study was all the year II Senior Secondary (SS II) biology students, in Minna metropolis. The sample for the research study was made up of 80 Senior Secondary II (SS II) (40 male and 40 female) students from two state government - owned co-educational secondary schools. From the 160 (80boys and 80girls) used for the initial study (Koroka & Ezenwa, 2009), only the experimental group students consisting of 40 boys and 40 girls formed the sample for this study. This is because the result of the initial study, indicated that the experimental treatment (analogy strategy) was more effective than the traditional (lecture method). Hence, the experimental group students made up of 40 males and 40 females were compared to determine if there is gender influence using analogy to teach the concept of osmosis. Senior Secondary II (SS II) students were used for this study because the studied biology concept (osmosis) was part of their syllabus.

Research instrument: The instrument used for this study was a 50-item Multiple Choice Test Items on Osmosis (MCTIO) drawn from past question papers of Senior School Certificate

Examination (SSCE) conducted by the West African Examinations Council (WAEC) and National Examinations Council (NECO). These were standard examinations questions already tested at the national level. Each test item had four options (A-D) and only one of the options was correct. Each correct answer (option) carried two (2) marks.

Validation of test instrument: In order to obtain the final standardized 50 Multiple Choice Test Items on Osmosis (MCTIO) used for this research study, the researcher initially drew 60 items from the past question papers. It was subjected to face and content validity by three experts in biology. From their suggestions and corrections, ten (10) test items were dropped from the 60, leaving a total of 50 test items, which were used for the study. Though questions were standard WAEC and NECO questions, they were subjected to pilot study. A reliability coefficient of 0.91 was obtained using test-retest method.

Analogy Linkage Instructional Format (ALIF): The Teaching-With-Analogy (TWA) model by Glynn, (1989) was adopted for this study. The model consists of six operations shown below:

i. Introduce the target concept
ii. Recall analog concept
iii. Identify similar features of the concepts
iv. Map out the similar features of the concepts
v. Indicate where analogy breaks down and
vi. Draw conclusion about the target concept.

The six operational stages of the model were followed step by step during the teaching.

Method of Data Collection: The researcher first went to the four sampled schools under study to seek permission to use their schools for the study. Permission was granted to the researcher, who was then introduced to the biology teachers and the SS II students. The researcher taught both the male and female students personally, although he solicited the assistance of the school biology teachers in the administration of the pre- and posttests. The contact period for both groups was five (5) weeks. The first week was used for orientation and administration of pretest to the students. The students were introduced and acquainted with the model (TWA model) to be used during the study.

The next three (3) weeks were used for teaching the students the topic 'OSMOSIS' using Teaching-With-Analogy (TWA) model. The teaching was followed by one week revision and thereafter, posttest was administered. The posttest was scored according to the prepared marking scheme and the students' scores formed the data for testing the study hypothesis. Since the experimental group exposed to analogy teaching performed significantly better than the control group taught with traditional method, the data obtained from the treatment group only consisting of 40 males and 40 females were analyzed to determine the influence of gender on students' understanding of osmosis using analogy strategy.

Results and discussion

The results of the pretest and posttest of male and female SSII student taught the concept of osmosis using analogy are presented below:

Table 2: t-test comparison of pretest scores of male and female students

Group	N	df	$\bar{X}$	SD	Calculated t-value	Critical t-value	*P*
Male	40		23.58	5.11			
Female	40	39	24.38	6.57	0.81^{ns}	1.67	0.423

ns = Not significant at the 0.05 level.

Table 2 presents the t-test result of the pretest for the male and female students. From the table 2, the calculated t-value (0.81) is less than the t-value critical (1.67). This indicates that there is no statistically significant difference between the mean score of the male students (23.58) and the mean score of the female students (24.38) at the 0.05 significant level (t=0.81, df = 39, p>0.05). This, therefore, meant that both male and female students were found to be equivalent with respect to their prior knowledge of the concept of osmosis in biology before treatment.

Posttest performance of the male and female students

H_{o1}: There is no significant difference between the mean scores of male and female students taught with analogy strategy.

Table 3: t-test Comparison of Posttest Scores of Male and Female Students

Group	N	df	Mean	SD	Calculated t-value	Critical t-value	P
Male	40		71.80	9.43			
Female	40	39	70.40	7.28	0.98^{ns}	1.68	0.335

ns = Not significant at the 0.05 level.

Table 3 shows the t-test comparison of the posttest mean scores of male and female students. The mean score for the males was 71.80 as opposed to that of the females, which was 70.40. The scores when compared showed no statistically significant difference. From the table, the calculated t-value of 0.98 is less than the t-value critical of 1.68. This indicates that there is no statistically significant difference between the mean score of the male students (71.80) and that of the female students (70.40) at the 0.05 level (t=0.98, df=39, P> 0.05). Therefore, the research hypothesis that there is no significant difference between the mean scores of male and female students taught with analogies was retained. This result of gender performance seem not to contradict the findings of Erickson and Erickson (1984), Jegede & Inyang (1989), Lagoke (1992), Ikobi (1999), Dunican (2002) & Agbowuro (2008) who found differences in the performance of boys and girls but in line with findings of Glynn (1989), Abimbola & Mustapha (2001) who found no gender difference from their study. The instructional strategy (Analogy) used seem to be gender friendly as the performance of male students improved from a mean of 23.58 to 71.80 while that of the female students improved from a mean of 24.38 to 70.40.They both seemed to evenly understand the concept of osmosis when taught with analogy strategy.

Major findings of the study

The result of this research study has shown that:

(i) Analogy is an effective strategy for classroom instruction as it has improved the students' understanding and performance.

(ii) Analogy affects boys and girls alike and is gender friendly.

There was no statistically significant difference between the mean scores of male and female students as indicated by the posttest results. This means that the use of analogy as a teaching strategy improved the performance of both boys and girls equally. There will be no improvement in students' performance unless there is an effective instructional strategy (Okebukola, 1998; Dunican, 2002; Onwukwe,2005; Onwukwe,2008;Okereke, 2009; Onwukwe & Onwukwe, 2010 & Ijioma & Onwukwe,2011). Analogy as indicated by the findings of this study seemed to be an effective instructional strategy of classroom instruction that could lead to meaningful learning hence, improvement in students' performance. Therefore, if the use of analogy as an instructional strategy in such a limited contact period (five weeks) could result in such high improvement in performance of both male and female students, it can then be reasoned that under normal classroom situations,

Teaching-With-Analogy (TWA) model, as an instructional strategy, would prove to be very efficient and effective.

Conclusions and recommendations

The result of this study revealed that both male and female students benefited equally from the instructional strategy used. On this basis, it is concluded that there was no significant difference in the performance of male and female students exposed to teaching with Analogy.

Recommendations:

It is recommended that:

(i) Government should organize and sponsor teachers to undertake training courses on the use of analogies as an instructional strategy as it seems to benefit male and female students alike.

(ii) Science teachers should harness appropriate and familiar analogies from the environment and use them in teaching to enhance better understanding of science concepts. This would help avoid misconceptions of the target concept by students.

(iii) Authors should use relevant and familiar analogies for presenting specific concepts and principles in their textbooks. This would make students' learning more meaningful as the familiar analogies in the book would encourage them to read on their own.

(iv) More research should be carried out on the use of analogy as a teaching strategy as well as on science teachers' awareness and use of analogy instructional strategy in classroom instruction.

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