

EFFECT OF THINK-ALOUD PAIR PROBLEM SOLVING ON STUDENTS' ACHIEVEMENT AND INTEREST IN BASIC TECHNOLOGY

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Abstract: *This study evaluated the effects of think-aloud peer problem solving (TPPS) on students' achievement and interest basic technology. To carry out the study effectively, four research questions and six hypotheses were formulated and tested. A quasi experimental design, specifically the non-randomized control group pretest posttest design involving two groups – the control group and experimental group was used in this study. 6125 (JS3) students who offered Basic Technology in 2018/2019 academic year in Minna Educational zone formed the population of this study. The sample for the study consisted of 241 Junior Secondary three (JSS3) students of two co-educational secondary schools doing Basic Technology. The two-co-educational secondary schools were randomly drawn using balloting from four co-educational schools offering Basic Technology in Minna educational zone. Two intact classes were used for the study. In each of the sampled schools, all the JS3 students in the intact class randomly selected belonged to one group – either the experimental (TPPS) or control (TAT) group and thus received the same treatment. Two instruments, the Basic Technology Achievement Test (BTAT) and the Basic Technology Interest Inventory (BTII), were developed and validated. An internal reliability consistency of BTAT was found to be 0.75 using Kuder Richardson formula 20(K – R20) and that of BTII was 0.85 using Cronbach Alpha. The BTAT and BTII were administered as pretest to the two groups. Treatment lasted for one month of 12 lesson periods for each group. After the treatment session, the same instruments were rearranged and re-administered as posttest to the same subjects. The data obtained were analyzed using Means and Standard Deviation for research questions; while analysis of covariance (ANCOVA) was used in testing the hypotheses at 0.05 level of significance. The result of the analyses indicated that the effect of TPPS on students' achievement and interest in Basic Technology was significant. Gender was not a significant factor on students' academic achievement and interest in Basic Technology. Thus, it is recommended that teachers should adopt the use of TPPS in assessing students since it seemed to be more effective in improving students' achievement and interest in Basic Technology.*

Keywords: *Think-Aloud, Pair, Problem Solving, Achievement, Interest*

Introduction

Thinking aloud pair problem solving, which was first developed by Arthur Whimbey, aims to better understand thinking among the students (Whimbey & Lochhead, 2009) and to develop students' cognitive processes associated with problem solving. Thinking aloud pair problem solving is mainly based on thinking aloud and listening (Jeon *et al.*, 2015). As the name suggests, this involves students working in pairs. One student (the problem solver) is required to read the problem aloud and think aloud during the problem solving process, which includes verbalizing everything they are thinking and doing. Another student (the listener) attends to the problem solver's thinking and reminds him/ her to keep saying aloud what he or she is thinking or doing, while also asking for clarifications and pointing out errors being made. It is important to highlight that listeners are not allowed to attempt to solve the problems or give correct answers. Instead of merely imitating worked examples, this instructional method focuses on helping the students learn by being aware of their thinking process in tackling mathematics problems. Students are not always able to express their mathematical understanding in detail. Often, answers from the students were given in the form of one word or sometimes, keywords. Thinking aloud during problem solving may reveal much more about the students' personally constructed understanding compared to assessing them from their written works (Jeon *et al.*, 2015). However this may also be restricted to how well the students are able to express their thinking process verbally.

Jeon *et al.* (2015) observed in their investigation on the effectiveness of TAPPS in improving problem solving performance of high school chemistry students that students in both the individual and TAPPS groups performed better in problem solving compared to the control group. They found that students in the individual and TAPPS groups performed better in recalling the related law and mathematics execution. The students in TAPPS group also performed better than the others on conceptual knowledge. Jeon *et al.* (2015) also stated that the verbal interactions between the solvers and listeners could help the students be “more cognizant of both their own thinking and the thinking of other students”. However, they discovered that listeners seemed to gain more benefits from TAPPS than the problem solvers. They found that listeners’ ‘pointing out’ behaviour showed the greatest correlation with their own problem solving performance; listeners’ ‘agreeing’ behaviour to the solvers’ statements was also positively correlated to the listeners’ problem solving performance. In this study, we investigated the effects of conducting Think-aloud Pair Problem Solving (hereafter, referred to as TAPPS) in a mathematics classroom on students’ mathematics achievement in Brunei Darussalam. We also explored whether thinking aloud has any significant effects on students’ problem solving performance. Different teaching and learning approaches in Basic Technology have been investigated and were found useful but students’ poor achievement in Basic Technology still persisted. For instance, Onwubiko (2011) applied the Student Centered Teaching Approach while Akudolu (2013) and Anekwe (2016) applied the Computer Assisted Instruction and Constructivist Based Instructional Model respectively. The findings of their studies proved to have significant effects on students’ achievement in Basic Technology. Despite their findings, students have not improved in their Basic Technology achievement. Offorma (2010) observed that class one Junior Secondary School (JSSI) students are very enthusiastic about Basic Technology and the enthusiasm lingers on and starts to dwindle from Junior Secondary class three (JS3). Akudolu (2013) made a similar observation that the exodus of students from Basic Technology class occurs mostly in the Junior Secondary School (JSS) after the students have learnt basic technology for at most three years.

Interest has been defined by Anderson *et al.* (2008) as “the capacity to evoke an emotional response”. It is this emotional response that sustains the quests for learning. Olikeze (2009) defined interest as “a persisting tendency to pay attention and enjoy some activities; or content is of interest if it’s pleasing and engages one’s attention”. Anderson *et al.* (2008) added that “interest increases attention which, in turn increases learning.” However to test the statement, they conducted a series of experiments and found out that even when the factor of attention was removed, that interest was enough to promote learning. They also found out that as regards to language learning, interest has a profound positive effect on the learning of sentences and the students’ reading time. Akudolu (2013) explained that “educationists all over the world emphasize the need to consider the learners’ interest in the learning process”. According to Akudolu (2013), Tyler was one of early curriculum specialists who popularized the place of the learners’ interest in the curriculum planning, development and implementation. A learner needs to have interest in the target language for the learning to be effective. To what extent would students’ interest be sustained when taught Basic Technology using think-aloud pair problem solving (TPPS)? This gap in knowledge underscores the need to investigate the influence of think-aloud pair problem solving and Teacher Assessment Techniques on students’ interest in Basic Technology. Gender issues have arisen in studies carried out on many subjects in school curriculum. Findings from research carried out by Harding (2012) indicated that school curriculum and learning activities carry with it large dose of gender bias. Anekwe (2016) mentioned that the science and mathematics curricula are most frequently cited. He explained that such content area of force, gravity, pendulum, thermodynamics are closer to experiences boys would have or may have in the course of their development. Gender differences exist in career choice. It is observed that boys choose careers that can take them to top management or prestigious positions such as law, engineering, medicine, while girls go for careers in caring and service sector. The issue of concern is the embedded belief that some careers are exclusive to either sex, a trend which limits individual’s options and robs the society of possible benefits. Hence, learners react differently to instructions and instructional materials due to gender.

Statement of the problem

Students' poor achievement in Basic Technology over the years in both internal and external examinations in the Junior and Senior Secondary Schools has attracted a lot of concern. Based on the observed poor achievement, a number of methods of teaching designed to stimulate students' interest and learning of Basic Technology had been suggested and tried out by researchers in Nigeria. Despite these useful strategies, students' have not yet improved in their academic achievement. Since the teachers have made use of different instructional methods without the students improving in the academic achievement, perhaps an assessment technique like think-aloud pair problem solving could be of help. Think-aloud pair problem solving encourages students' active participation in their own learning and motivates students learning. Students' participation includes contributing during discussions, initiating ideas, clarifying points among students, students paying individual attention to their fellow students, asking and answering questions. All these will be done under the supervision and direction of the teacher. The role of the classroom teacher in Nigerian Secondary Schools does not give students the opportunity of being involved in their own learning. The 'chalk and talk' practice prevalent in Nigerian Secondary Schools has made the role of the student a passive one. The student is regarded as the recipient of learning while the teacher is the giver. Onukaogu and Arua (2010) saw the student in this regard, as one who "sits and swallows what the teacher has to give in terms of narration, exposition, instruction, classification, definition, etc". When the teacher needs to assess the success or the failure of the learning experience through class exercises, mid-term test or examination, the material is regurgitated on demand. Some studies have been conducted in the area of gender – related differences in the academic achievement and interest of students in the different learning method. It was discovered that in some cases (Anekwe, 2016; Akudolu, 013), there is no gender difference in students academic achievement and interest while in some, gender difference abound. The contradictory results/reports in academic achievement and interest due to gender has led to the need to find out the influence of TPPS on students' achievement and interest, by gender, in Basic Technology.

Research Questions

The following four research questions were posed to guide the research.

1. To what extent would any of the two assessment techniques, Think-aloud Pair problem solving (TPPS) and Teacher Assessment Technique (TAT) enable students to have higher academic achievement as indicated by their mean scores in Basic Technology Achievement Test (BTAT)?
2. Which group, male or female students has higher academic achievement as indicated by their mean scores in BTAT?
3. Which group of students, those assessed with TPPS or those assessed with TAT showed greater interest in Basic Technology as indicated by their mean scores in Basic Technology Interest Inventory (BTII)?
4. For male and female students, which group showed greater interest in Basic Technology as indicated by their mean scores in the BTII?

Hypotheses

Based on the research questions, the following null hypotheses are put forward in this study to be tested at $p < 0.05$ level of significance.

Ho₁: There is no significant difference in the BTAT scores of students exposed to think-aloud pair problem solving and those exposed Teacher Assessment Techniques.

Ho₂: There is no significant difference in the mean BTAT scores of male and female students exposed to think-aloud pair problem solving and those exposed to Teacher Assessment Techniques.

Ho₃: There is no significant difference in mean interest scores of students exposed to think-aloud pair problem solving and those exposed to Teacher Assessment Techniques as determined by the use of BTII.

Ho₄: There is no significant difference in the mean interest scores of male and female students exposed to think-aloud pair problem solving and those exposed to Teacher Assessment Techniques as determined by the use of BTII.

Ho₅: There is no interaction effect of gender and assessment techniques on the achievement of students in Basic Technology as measured by their mean achievement scores in BTAT.

Ho₆: There is no significant interaction due to exposure to assessment techniques and gender as measured by their mean interest scores in the BTII.

METHODOLOGY

The design is a quasi-experimental design. Specifically the design used is the non-randomized control-group pretest-post-test-design involving two groups - the experimental group and the control group. This study was conducted in Minna educational zone. The target population comprised of all the Junior Secondary School class three (JSS 3) students doing Basic Technology in all the state owned co-educational secondary schools in Minna educational zone. Two out of the four co-educational schools doing Basic Technology in the area of the study were randomly sampled using balloting. Using co-educational schools will enable the researcher obtain a true record of gender interaction. Two instruments were used for data collection in this study, which are; Basic Technology Achievement Test (BTAT) for JSS 3 and Basic Technology Interest Inventory (BTII) for JSS 3. The instrument was validated by two experts in Industrial and Technology Education Department, Federal University of Technology, Minna.

The reliability of internal consistency of BTAT was determined using the Kuder Richardson Formula 20(K-R20) technique. The procedure helped to establish the internal consistency of the BTAT items. The researcher administered the BTAT to 65 JSS 3 Basic Technology students of Government Secondary School, Bida. These students' scores were used to compute the coefficient of internal consistency of BTAT. Establishing this form of reliability for the BTAT was considered necessary since items were aggregated into a composite score for each individual. This practice presupposed that the items are homogenous. The reliability index of $r = 0.75$ was obtained for the BTAT and 0.85 for BTII.

The two instruments for collection in this study (BTAT and BTII) were administered to the students before the experimental treatment. Students' scores in this first administration served as the pretest of the study. After this, the treatment and control condition commenced. The teaching period of the research lasted for one month of twelve lesson periods.

The research questions were answered using mean and standard deviation. The hypotheses were tested at 0.05 level of significance Analysis of Covariance (ANCOVA).

RESULTS

Research Question 1:

To what extent would any of the two assessment techniques, Think-aloud Pair problem solving (TPPS) and Teacher Assessment Technique (TAT) enable students to have higher academic achievement as indicated by their mean scores in Basic Technology Achievement Test (BTAT)?

Table 1: Means and Standard deviation of Pre-test and Post-test scores of students in BTAT by treatment and gender

<i>Treatment</i>		Gender			Gender		
		Pretest Male	Pretest Female	Overall Mean	Posttest Male	Posttest Female	Overall Mean
Experimental (TPPS)	Mean	41.69	45.83	43.76	59.67	63.48	61.58
	SD	14.98	14.07	14.52	12.07	12.50	12.28
	N	58	65	123	58	65	123

	Mean	43.33	46.97	45.15	46.61	49.73	48.17
Control	SD	13.96	13.32	13.64	12.79	8.90	10.85
(TAT)	N	43	75	118	43	75	118

The overall mean post-test score of the students taught using Think-aloud Pair Problem Solving (TPPS) was 61.58 with standard deviation (SD) of 12.28. The group taught using Teacher Assessment Technique (TAT) had an overall mean post-test score of 48.17 with SD of 10.85. The difference between the experimental group and control group was 13.41. This suggested that students assessed with PAT have higher academic achievement than students assessed using TAT.

Research Question 2:

Which group, male or female students has higher academic achievement as indicated by their mean scores in BTAT?

With regards to influence of gender in Table 1, the male students taught with TPPS had a mean posttest score of 59.67 with a standard deviation of 12.07 while the female students had a mean posttest score of 63.48 with a standard deviation of 12.50. Also the male students in the control group (TAT) had a mean posttest score of 46.61 with a standard deviation of 12.79 while their female counterparts had a mean posttest score of 49.73 with standard deviation of 8.90. The differences in the mean scores 2.81 for TPPS and 3.12 for TAT were in favour of the females and this appears to indicate that female students scored higher than the males in BTAT.

Research Question 3:

Which group of students, those assessed with TPPS or those assessed with TAT showed greater interest in Basic Technology as indicated by their mean scores in Basic Technology Interest Inventory (BTII)?

Table 2: Mean and Standard Deviation (SD) of Pre and Post-test scores of students in BTII by treatment and gender

Treatment		Gender			Gender		
		Pretest Male	Pretest Female	Overall Mean	Posttest Male	Posttest Female	Overall Mean
Experimental (TPPS)	Mean	45.36	48.92	47.14	56.28	73.06	64.67
	SD	12.60	11.76	12.18	11.11	16.71	13.91
	N	58	65	123	58	65	123
Control TAT	Mean	46.23	49.35	47.79	49.19	50.53	49.86
	SD	13.40	11.71	12.55	11.87	10.26	11.06
	N	43	75	118	43	75	118

Table 2 showed that the students assessed using TPPS recorded higher overall mean interest score of 64.67 with a standard deviation (SD) of 13.91 while students taught using TAT had a less overall mean interest score of 49.86 and a SD of 11.07. It seemed that the experimental group (TPPS) showed more interest in Basic Technology than the control group (TAT) as indicated in their overall mean interest score in BTII.

Research Question 4:

For male or female students, which group showed greater interest in Basic Technology as indicated by their overall mean scores of BTII?

The post interest mean score of the female students in the experimental (TPPS) group was 73.06 with a SD of 16.71 while that of male students was 56.28 with a SD of 11.11. On the other hand, the post interest mean score of female students in the control group (TAT) was 50.53 with a SD of 10.26 while that of the males was mean interest score 49.19 and a SD of 11.87.

In order to make decision on students' academic achievement based on the use of PAT and TAT in teaching secondary school Basic Technology, hypothesis 1 was tested.

Hypothesis 1:

Ho₁: There is no significant difference in the BTAT scores of students exposed to think-aloud pair problem solving and those exposed Teacher Assessment Techniques.

Table 3: Analysis of Covariance (ANCOVA) of students' overall Post Achievement mean scores in BTAT (Assessment Technique and Gender)

Source of variation	Sum of squares	Df	Mean square	F calculate	Sig. of F	F table
Corrected model	28633.34	4	7158.34	125.71	.00	
Intercept	16343.68	1	16343.68	287.02	.00	
Pretest	17603.35	1	17603.35	309.14	.00	
Sex	65.80	1	65.80	1.16	.28	3.96
Treatment	11720.53	1	11720.53	205.83	.00	3.96
Sex x treatment	2.01	1	2.01	.04	.85	3.96
Error	13438.59	236	56.74			
Total	778375.00	241				
Corrected Total	42071.93	240				

The F calculated for assessment techniques in BTAT was 205.83 at the 0.05 level of significance and 236 degree of freedom (df) while the F critical value was 3.96. Since F calculated (205.83) was greater than f critical (3.96), the decision was to reject the null hypothesis. This implies that there is a significant ($P < 0.05$) difference between the two assessment techniques (TPPS and TAT) as measured by the students' mean BTAT scores using Analysis of Covariance (ANCOVA). This appears equally to suggest that the early observed difference between the means of the two groups was not attributed to chance error but due to the treatment.

Hypothesis 2:

Ho₂: There is no significant difference in the mean BTAT scores of male and female students exposed to think-aloud pair problem solving and those exposed to Teacher Assessment Techniques.

Table 3 revealed that gender is not a significant factor on students' academic achievement in BTAT. The F calculated for gender was 1.16 against a table value of 3.96 for 1df for numerator and 236 df for denominator at the 0.05 level of significance. Therefore, the null hypothesis of no significant difference on the effect of gender in the mean achievement of male and female students was upheld. This meant that though female students appeared to achieve more than their male counterparts, the achievement was not statistically different.

Hypothesis 3:

Ho₃: There is no significant difference in mean interest scores of students exposed to think-aloud pair problem solving and those exposed to Teacher Assessment Techniques as determined by the use of BTII.

Table 4: Analysis of Covariance (ANCOVA) of students' overall Post-Interest mean scores in BTII (Assessment Techniques and Gender)

Source of variation	Sum of squares	df	Mean square	F calculate	Sig. of F	F table
				d		

Corrected model	35421.46	4	8855.36	5.44	.00	
Intercept	12070.25	1	12070.25	7.41	.01	
Pretest	12996.91	1	12996.91	7.98	.01	
Sex	2820.71	1	2820.71	1.73	.19	3.96
Treatment	13343.06	1	13343.06	8.19	.01	3.96
Sex x treatment	3323.81	1	3323.81	2.04	.15	3.96
Error	384387.61	236	1628.76			
Total	1223588.00	241				
Corrected Total	419809.06	240				

The F calculated for assessment technique was 8.19 against the critical value of 3.96 at the 0.05 level of significance, 1 df for numerator and 236 df for denominator. Since the calculated value exceeded the critical value, the null hypothesis of no significant difference in the mean interest scores is rejected. It is therefore inferred that the effect of think-aloud pair problem solving on students' interest in Basic Technology is significant.

Hypothesis 4:

Ho₄: There is no significant difference in the mean interest scores of male and female students exposed to think-aloud pair problem solving and those exposed to Teacher Assessment Techniques as determined by the use of BTII.

Table 4 revealed that gender was not a significant factor in students' overall interest in Basic Technology. The F ratio calculated was 1.73 against a table value of 3.96 at the 0.05 level of significance, 1 df for numerator and 236 df for denominator. Therefore the null hypothesis of no significant difference on the effect of gender in the mean interest score of male and female students was not rejected. This meant that the female students' interest was not statistically different from the male students' interest.

Hypothesis 5:

Ho₅: There is no interaction effect of gender and assessment techniques on the achievement of students in Basic Technology as measured by their mean achievement scores in BTAT.

The Analysis of Covariance (ANCOVA) of the students' overall achievement scores presented in Table 3 showed that the interaction effect due to assessment technique and gender (sex x treatment) was not significant. The calculated F-ratio of 0.04 was less than the table value of 3.96 for 1 df for numerator and 236 df for denominator at the 0.05 level of significance. Therefore the null hypothesis of no significant interaction effect of gender and assessment technique was upheld.

Hypothesis 6:

Ho₆: There is no significant interaction due to exposure to assessment techniques and gender as measured by their mean interest scores in the BTII.

As could be seen from table 4, the interaction due to assessment technique and gender was not significant. The calculated F-ratio was 2.04 against a critical value of 3.96 at the 0.05 level of significance, 1 df for numerator and 236 df for denominator. This then meant that the effect of assessment technique was consistent across the levels of gender. Therefore the null hypothesis was not rejected.

DISCUSSION OF RESULTS

The study has revealed that students taught using TPPS achieved significantly better than students taught using TAT. The higher achievement of students taught using TPPS could be attributed to the fact that the students were involved in their own learning starting from setting of criteria to assessment of their fellow students' work. This could excite them and boost their enthusiasm to learn Basic Technology. Oboh (2008) noted that peer assessment encourages creativity on the part of the students, promotes students' independence and limits teacher's interference on students' output. The students' achievement in peer assessment could be explained on the basis of expectations from fellow students, coupled with the fact that a student's achievement will be made known to other students.

The above finding appears to be consistent with that of Anekwe (2016) and Akudolu (2013). They observed that students' achievement in Basic Technology were statistically significant using the Constructive Based Instructional Model (CBIM) and Computer Assisted Learning (CAL) respectively. The works of Agbaegbu (2011), Ifeakor (2012) and Anaekwe (2016), were also consistent with the above finding. They studied on the effects of peer assessment techniques on students' cognitive achievement in their different subject areas and found out that the students' cognitive achievement using TPPS was statistically significant. However, the finding of this study with respect to cognitive achievement in Basic Technology contradicts those of Onwubiko (2011) in which they reported that the teaching approaches he studied using Basic Technology, were not statistically significant to the conventional teaching method. Peer assessment exposes students to the skills of critical reflection and analysis and increases students' confidence in their ability to perform according to special criteria, as well as their awareness of the quality of their work.

The result of the research question revealed that female students had a higher mean score on achievement than their male counterparts but how significant is the difference in the achievement of males and females. Evidence from the analysis in table 3 confirmed that the difference was insignificant. Though the female students appeared to achieve more than their male counterparts, the difference in achievement was not statistically significant. Hence gender was not a significant factor in this study. This finding could be as a result of learners' much involvement in the learning. It could also have resulted from the fact that TPPS was new to all the students. So all the students, irrespective of gender were excited with TPPS. Subsequently each student performed as best as he could. Anekwe (2016) and Akudolu (2013) had similar findings. They found out that gender had no effect on the achievement of students in Basic Technology learning instructions like the Contextual Teaching Method (CTM) and CBIM. Nevertheless, some contradictory findings were reported in gender related differences in achievement. Akudolu (2013) in his study, found out that girls achieved better in mixed-ability pairing than in like-ability pairing.

The study has revealed that students taught using Think-aloud Pair Problem Solving (TPPS) showed significant interest in Basic Technology than those taught using Teacher Assessment Technique (TAT). The finding of this study in respect to students' interest with regards to assessment techniques agrees with that of Agbaegbu (2011), who observed that the mean interest score of students in the peer assessment group was greater than the mean interest score of students in the teacher assessment group. Also in agreement with the findings of this study in respect to students' interest in Basic Technology is the finding of Anekwe (2016) on the Effects of Constructivist –Based Instructional Model (CBIM) on students' Interest and Achievement in Basic Technology. He observed that students taught with CBIM (experimental) showed greater interest in Basic Technology than those taught with TCM (control). This means that modes of assessment and instruction have significant effect on the interest rating of students. Akudolu (2013) observed on the contrary in his finding, that mode of instruction had no significant effect on the interest rating of the student.

The study revealed that gender was not a significant factor in students overall interest in Basic Technology. Though the female students tended to show more interest than their male counterparts, their better interest ratings were not statistically different. This finding is in consonance with that of Anekwe (2016) in which he reported that students' interest in Basic Technology was significantly independent of sex. However, it appeared to contradict the findings of Anaekwe (2016) and Ifeakor (2012) who reported statistically significant effect of gender on students' development of interest in chemistry and Biology respectively. They noted that female students showed greater interest than male students.

Some studies on gender influence on students' interest in arts subjects were of the opinion that girls were inclined to arts than boys. Boys, as it was reported by Ifeakor (2012) and Akudolu (2013), are more exposed to scientific activities very early in life than girls. Moreover, they are encouraged to enter for science related professions like engineering and technology while girls go for Biology, Home Economics, Basic Technology and other allied subjects. In this study, though female students manifested greater interest than their male counterparts, it was very minimal and therefore negligible because it was not statistically significant. It was therefore upheld that gender

was not a significant factor in students' interest in Basic Technology. This would imply that the use of TPPS might reduce or eliminate gender related differences in students' interest towards Basic Technology.

The interaction effect of treatment and gender on students' overall cognitive achievement in Basic Technology was not significant (Table 3). This is in agreement with the findings of Anaekwe (2016) and Agbaegbu (2011) in which they reported that the combined effect of assessment technique and gender on overall cognitive achievement in chemistry and geography respectively were not significant. However, this disagrees with Ifeakor (2012) who found a significant interaction effect between gender and assessment technique on students' achievement in chemistry.

On the combined effect of Think-aloud Pair Problem Solving and gender on students' interest in Basic Technology, there was no significant effect. This conformed with Agbaegbu (2011) who found the combined effects on TPPS and gender on students' interest towards Geography not significant. This meant that the efficacy of TPPS on students' interest was consistent across sex levels.

From the findings of this study, it could be deduced that with an innovative assessment technique like TPPS in which male and female students have shown equal interest, they could equally attend to high standard in Basic Technology achievement.

Conclusion

The study had shown that TPPS has significant effect on students' cognitive achievement and interest in Basic Technology. The TPPS enabled students to learn more Basic Technology grammar than their counterparts who were taught using the TAT. The TPPS appeared to be more efficacious than TAT in engendering the aforementioned criterion measure.

The influence of gender on cognitive achievement in Basic Technology was not significant though the female students tended to exhibit superior achievement over their male counterparts. The study indicated no significant gender influence on interest in Basic Technology but the female students tended to show more interest towards the subjects.

The combined effects of TPPS and gender on students' cognitive achievement and interest were not significant. Both male and female students demonstrated equal level of achievement and interest in the TPPS.

Recommendations

1. Since TPPS has been found to enhance the quality of achievement and interest in Basic Technology, Basic Technology teachers should be encouraged to employ it more in the teaching and assessment of the subject. By so doing, the students' achievement and interest in the subject could be increased.
2. Innovations like TPPS demand well-trained personnel and make training and retraining of staff imperative. Heads of teacher training tertiary institutions should include TPPS as one of the methods of evaluation and should impart the usage to the student teachers.
3. There should be no discrimination or gender factor in any teaching and learning situation. Both the male and female learners should be made to see themselves as co-learners and discrimination against sex must be sincerely avoided.
4. The Ministry of Education in Nigeria should organize seminars, workshops and conferences for Basic Technology teachers on how to use TPPS in teaching and evaluating students of Basic Technology. The same ministry of education should consider adopting TPPS for the purposes of promoting gender equality in Basic Technology classroom.

REFERENCES

- Agbaegbu, C.N. (2011). Effects of peer assessment techniques on students academic achievement and Interest in Geography. *Unpublished PhD Thesis*. University of Nigeria, Nsukka.
- Akudolu, L.I. (2013). Effect of Computer-assisted Instruction on the Learning of Basic Technology. *Unpublished PhD Thesis*. University of Nigeria, Nsukka.

- Anderson, R.C. Shirely, L.L., Wilson, P.T.& Fielding, L.G. (2008). Interestingness of children's Reading Materials. In R.E. Snow & J.F. Marshall (Eds). *Aptitude, learning and Instruction*. 3 Hillsaade: Lawrence Elbaum associates. Inc.
- Anekwe, J.U. (2016). Effects of Constructivist-Based Instructional Model on Students' Interest and Academic Achievement in Basic Technology in Anambra State. *Unpublished Ph.D Thesis*. University of Port Harcourt.
- Harding, J. (2012). Science and technology: A future for women. *UNESCO Paper to World Conference to Review and Appraise the Achievement of Women. UN Decade for Centre*.
- Ifeakor, A.C. (2012). Effects of Peer Assessment on Students' Academic Achievement and Interest in Chemistry. *Unpublished M.Ed Thesis*: University of Nigeria, Nsukka.
- Jeon, K., Huffman, D., & Noh, T. (2015). The effects of thinking aloud pair problem solving of high school students' chemistry problem-solving performance and verbal interactions. *Journal of Chemical Education*, 82(10), 1558-1564.
- Oboh, L.U. (2008). Methodologies in Communicative Skills. Implications of Class Size, Peer Assessment and Team Teaching. In Otagburuagu (Ed). *Common Frontiers in Communication Skills. Focus on the Nigerian University System*. Kano: Global Links Communications.
- Offorma, G.C. (2010). Impact of Teachers' use of Resources on Secondary School Students' Learning Outcomes in Basic Technology. *Unpublished Ph.D Thesis*. University of Nigeria, Nsukka.
- Olikeze, F.C. (2009). Effect of Computer-Assisted Instruction on Secondary School students' Cognitive Achievement and Interest in Biology. *Unpublished Ph.D Thesis*. University of Nigeria, Nsukka.
- Onukaogu, C.E. & Arua, A.E. (2010). The workshop model as a device for the integrative teaching of communicative skills in the use of English Curriculum. In Otagburuagu, E.J. (Ed). *Common Frontiers in communication skills: Focus on the Nigerian University System*. Kano: Global Links Communications.
- Onwubiko, J.U. (2011). Effect of Student-Centred and Teacher-Centred Approaches in Teaching on Achievement in Basic Technology. *Unpublished M.Ed Thesis*: University of Nigeria, Nsukka.
- Whimbey, A., & Lochhead, J. (2009). *Problem solving and comprehension*. Mahwah, NJ: Lawrence Erlbaum Associates.