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Students' perception of Timed Think-Pair-Share and Circle Chat in the learning of Basic Chemistry Concepts

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Abstract: *The study investigated the chemistry students' perception of Timed Think-Pair-Share (TTPS) and Timed Circle Chat (TCC) and Conventional Lecture Method (CLM) effectiveness in the learning of Basic Chemistry concepts. Four hundred and twenty-one samples were randomly sampled from twelve senior secondary schools in Oyo Educational Zone. The schools were randomly assigned to the learning strategies. The research design was quasi-experimental of a 3x3x2 factorial matrix. The research instruments were a learning package, adapted to the learning strategies, a mathematical ability test, for categorisation of the chemistry students into mathematical ability levels and the students' perception which was a 4-point rating scale on the effectiveness of learning strategies. Three chemistry educators validated the research instruments for content and construct validity before the instruments were pilot-tested. The reliability coefficient values were positive and high. The chemistry teachers who had been trained on the learning strategies involved the sampled students in active learning for six weeks using the assigned learning strategies to the schools. The students' scores on students' perceptions questionnaires before and after the treatment were analysed based on treatment, mathematical ability levels and gender using Analysis of Covariance (ANCOVA). The findings indicate significant main effects of treatment and mathematical ability and significant interaction effect of gender and mathematical ability on students' perception of basic chemistry concepts in favour of Timed Think-Pair-Share.*

Keywords*: Gender, Learning Package, Mathematical Ability, Students' Perception, Timed Circle Chat, Timed Think-Pair-Share.*

1. INTRODUCTION:

There is a shift in the method of teaching and learning in science from teacher-dominated instruction to student-active involvement in the teaching and learning process. Teacher-dominated instruction involves the dissemination of scientific facts, knowledge, principles, laws, and theories via telling. In this pattern of teaching, students are recipients of standardised knowledge from teachers who are seen as the custodians of valid information in the field. In active learning, the teacher facilitates learning by organising learning experiences to engage the students in constructing knowledge from the experiences.

2. LITERATURE REVIEW:

Active learning is in line with the constructivist theories of learning, especially that of [1]. Dewey was the champion of learning by doing, known as experiential learning. He discovered that students learn better when they are actively engaged. He believed that education should be the cultivation of thoughtful, critical reflective, socially engaged individuals rather than passive recipients of established knowledge. He rejected rote learning and child-centered approaches that do not critically follow students' interests and strengths. These interactions and experiences lead individuals to continually develop new concepts, ideas, practices, and understandings, mediating the learners' experiences and social interactions. According to Dewey, when students communicate ideas and meanings within a group, they have the opportunity to consider, take on, and work with other students' perspectives, ideas, and experiences.

Dewey valued real-life contexts and problems in educative experiences. These experiences should involve what Dewey called 'transaction': an active phase, in which the students do something, as well as a phase of 'undergoing', where the student receives or observes the effect that their action has had. This inquiry to Dewey involves students reflecting intelligently on their experiences to adapt their habits of action [2].

Among the several active teaching approaches to learning in inquiry are Think-Pair-Share and Circle Chat. The Think-Pair-Share and Circle Chat learning strategies are cooperative learning techniques that allow students' active participation in the learning process. In the Think-Pair-Share strategy, a question or problem is presented to students to think about, answer, and respond to, and then tell the response (s) to a partner, then the teacher calls some of the students to share their responses with the whole class. In this learning strategy, the teacher is a facilitator of learning, moderator, and corrector of misconceptions. Think-Pair-Share allows the students to think and speak about a question or problem instead of just two or three responding to questions [3]. [4]'s findings showed Timed Think-Pair-Share and Timed Circle Chat to be more effective in improving students' learning of basic concepts in chemistry. The learning processes in Think-Pair-Share and Circle Chat were timed to moderate the students' discussions and not to overshoot the allotted time for the lesson.

[5] revealed a negative perception of the students of teachers' illustrations and demonstration of the hybridization concepts in chemistry. [6] indicated that chemistry teachers perceived chemistry practicals as difficult to handle and had a negative attitude towards chemistry practicals. [7] indicated that students did not find practical activities as fun and enjoyable and the students saw chemistry containing more abstract concepts and chemical formulae. However, [8] showed that teachers and students expressed positive perceptions and attitudes toward using practical work in chemistry lessons. The perception of students toward chemistry in senior secondary revealed that chemistry lessons were difficult due to inadequate resources for teaching and learning chemistry [9]. [10] found students' perception to be low interest in the ease of use of computer simulation learning strategy due to a lack of basic computer skills. [11] revealed that the teachers, students, and parents had good beliefs, attitudes, and perceptions toward chemistry education. The study also found a slight difference between male and female students' beliefs, attitudes, and perceptions towards chemistry. [12] showed that students preferred problem-based learning and small-group teaching as more effective for teaching and learning than the didactic lecture method. They perceived didactic lectures as lengthy and boring. [13] revealed a significant relationship between students' perception of teachers' classroom effectiveness and the student's academic achievement. [14 showed that classroom practices were perceived as the highest factors and studying practices as the lowest factors in learning. They also found age and gender as insignificant in determining students' perception of personal and institutional factors in learning. [15] indicated students' perception of teachers' questioning in open and closed questions in biology classrooms. The result indicated that students preferred scenario-based questions and supported students' engagement in knowledge construction as valuable by the students.

Researches are limited in chemistry that determines the effects of students' perceptions of learning strategies of Think-Pair-Share and Circle Chat with students' gender and mathematical ability.

What would likely be the perception of the chemistry students towards learning chemistry using Timed Think-Pair-Share, Timed Circle Chat, and the Conventional Lecture methods? Would students' perceptions of the learning strategies be influenced by students' gender and mathematical ability levels?

3. PURPOSE OF THE STUDY:

The study's main purpose was to determine chemistry students' perception of the Timed Think-Pair-Share and Timed Circle Chat on the students' learning of chemistry. The study also investigated the effects of students' gender and mathematical ability on students' perception of the learning strategies.

4. RESEARCH HYPOTHESIS:

The formulated null hypotheses for the study at 0.05 level of significance are:

1. There is no significant main effect of treatment on students' perception of Basic Chemistry concepts in secondary schools.
2. There is no significant main effect of gender on students' perception of Basic Chemistry concepts in secondary schools.
3. There is no significant main effect of mathematical ability on students' perception of Basic Chemistry concepts in secondary schools.
4. There is no significant interaction effect of treatment and gender on students' perception of Basic Chemistry concepts in secondary schools.
5. There is no significant interaction effect of treatment and mathematical ability on students' perception of Basic Chemistry concepts in secondary schools.

6. There is no significant interaction effect of gender and mathematical ability on students' perception of Basic Chemistry concepts in secondary schools.
7. There is no significant interaction effect of treatment, gender and mathematical ability on students' perception of Basic Chemistry concepts in secondary schools.

5. METHODOLOGY:

The quasi-experimental research design of a 3x3x2 factorial matrix was the research design. Twelve public secondary schools were randomly sampled in the Oyo Educational Zone in Oyo State, Nigeria. The senior secondary school chemistry students in class two were the population for the study. Four hundred and twenty-one (421) chemistry students consisting of 194 males and 227 females were samples for the study. The sampled schools were randomly assigned to the three learning groups of Timed Think-Pair-Share (TTPS), Timed Circle Chat (TCC) and the Conventional Lecture Method (CLM). The main difference between TTPS and TCC was the levels of interactions of the students in sharing their thoughts with their peers. The level of interaction of information sharing was higher in TCC than in TTPS. The discussions of the students were timed to avoid rowdiness, maintain orderliness and keeping to the time allotted for the lesson.

The research instruments were the learning package, mathematical ability and students' perception of the learning strategies on Basic Chemistry concepts. The learning package had six structured learning activities that were hands-on and mind-on in nature on physical and chemical changes, mixture and compound, solution, and atomic structure. The learning package was adapted to the learning strategies of TTPS, TCC, and CLM. The learning package was used to train the chemistry teachers on the assigned learning strategies. The mathematical ability test measured students' basic mathematics knowledge necessary to perform quantitative problems and logical reasoning in chemistry. The students' scores in mathematical ability test were used to categorised the students into mathematical ability levels of high, medium, and low. Students' perception of the learning strategies was structured on a 4-point scale of strongly agree, agree, disagree, and strongly disagree on items such as students' active participation, communication of ideas, interaction among peers, interest in learning, student confidence, reflection on the learning processes and understanding of chemistry concepts. The instruments were validated by three chemistry educators for content and construct validation. The instruments were pilot-tested and the reliability coefficient value for MAT was 0.88 while the rating scale for students' perception was 0.90 using Kuder-Richardson Formula 20, (KR-20) and Cronbach Alpha, respectively.

The validated and reliable instruments of the mathematical ability test and the student's perception rating scale were pre-administered to the sampled students before the six weeks of treatment with the learning package. The students' perception rating scale was post-administered after the learning engagement by the trained chemistry teachers.

6. RESULTS:

The testing of hypotheses and the presentation of the results

1. There is no significant main effect of treatment on students' perception of Basic Chemistry concepts in secondary schools.

Table 1.1

Analysis of Covariance of Main Effect of Treatment on Students' Perception of Basic Chemistry Concepts

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	439.380	3	146.460	6.702	.000	.046
Intercept	13338.351	1	13338.351	610.340	.000	.594
Pre-test	79.045	1	79.045	3.617	.058	.009
Treatment	315.025	2	157.512	7.207	.001*	.033
Error	9113.105	417	21.854			
Total	673825.000	421				
Corrected Total	9552.485	420				

Source: Field Survey, 2024

Table 1.1 shows a significant main effect of treatment on students' perception of Basic Chemistry concepts in secondary schools ($F_{(2,417)} = 7.207$, $p < 0.05$, $\eta^2 = 0.033$). The null hypothesis was therefore rejected. The eta square value of 0.033 shows the contributing effect size of 3.3%.

Table 1.2

Estimated Marginal Means of Treatment on Students' Perception of Basic Chemistry Concepts

Treatment Group	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
TTPS	40.389	0.376	39.650	41.129
TCC	40.293	0.422	39.463	41.122
CLM	38.508	0.393	37.736	39.280

Source: Field Survey, 2024

Table 1.2 shows that participants exposed to TTPS had the highest mean ($\bar{x}$) score of 40.389 on perception towards basic Chemistry concepts in secondary schools in Oyo Zone of Oyo State, followed by TCC with a mean score of 40.293, while the CLM group had the least mean score of 38.508.

2. There is no significant main effect of gender on students' perception of Basic Chemistry concepts in secondary schools.

Table 2.1

Analysis of Covariance of Main Effect of Gender on Students' Perception of Basic Chemistry Concepts

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	128.362	2	64.181	2.847	0.059	0.013
Intercept	14046.980	1	14046.980	623.043	0.000	0.598
Pre-test	124.942	1	124.942	5.542	0.019	0.013
Gender	4.007	1	4.007	0.178	0.674	0.001
Error	9424.122	418	22.546			
Total	673825.000	421				
Corrected Total	9552.485	420				

Source: Field Survey, 2024

Table 2.1 shows no significant main effect of gender on students' perception of Basic Chemistry concepts in secondary schools ($F_{(1,418)} = 0.178$, $p > 0.05$, $\eta^2 = 0.001$). The null hypothesis was therefore accepted. The eta square value of 0.001 shows the contributing effect size of 0.1%.

Table 2.2

Estimated Marginal Means of Gender on Students' Perception of Basic Chemistry Concepts

Gender	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Male	39.828	0.341	39.158	40.498
Female	39.632	0.315	39.012	40.251

Source: Field Survey, 2024

Table 2.2 shows that male participants had a higher mean score (39.828) than their female (39.632) counterparts. This implies that gender had a better effect on students' perception of Basic Chemistry concepts in secondary schools among male participants than their female counterparts.

3. There is no significant main effect of mathematical ability on students' perception of Basic Chemistry concepts in secondary schools.

Table 3.1

Analysis of Covariance of Main Effect of Mathematical Ability on Students' Perception towards Basic Chemistry Concepts

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	548.430	3	182.810	8.466	0.000	0.057
Intercept	12955.670	1	12955.670	600.009	0.000	0.590
Pre-test	66.330	1	66.330	3.072	0.080	0.007
Mathematical Ability	424.076	2	212.038	9.820	0.000	0.045
Error	9004.054	417	21.592			

Total	673825.000	421				
Corrected Total	9552.485	420				

Source: Field Survey, 2024

Table 3.1 shows a significant main effect of mathematical ability on students' perception of Basic Chemistry concepts in secondary schools ($F_{(2,417)} = 9.820$, $p < 0.05$, $\eta^2 = 0.045$). The null hypothesis was therefore rejected. The eta square value of 0.045 shows the contributing effect size of 4.5%.

Table 3.2

Estimated Marginal Means of Mathematical Ability on Students' Perception of Basic Chemistry Concepts

Mathematical Ability	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Low	38.210	0.414	37.397	39.023
Medium	40.075	0.493	39.106	41.043
High	40.517	0.326	39.876	41.158

Source: Field Survey, 2024

Table 3.2 shows that participants with high mathematical ability had the highest mean score (40.517), followed by those with medium ability (40.075), while the participants with low mathematical ability (38.210) had the least mean score.

4. There is no significant interaction effect of treatment and gender on students' perception of Basic Chemistry concepts in secondary schools.

Table 4.1

Analysis of Covariance of Interaction Effect of Treatment and Gender on Students' Perception towards Basic Chemistry Concepts

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	553.269	6	92.211	4.242	0.000	0.058
Intercept	13334.423	1	13334.423	613.437	0.000	0.597
Pre-test	80.226	1	80.226	3.691	0.055	0.009
Treatment	335.844	2	167.922	7.725	0.001	0.036
Gender	20.974	1	20.974	.965	0.327	0.002
2-way Interaction Treatment*Gender	95.049	2	47.524	2.186	0.114	0.010
Error	8999.216	414	21.737			
Total	673825.000	421				
Corrected Total	9552.485	420				

Source: Field Survey, 2024

Table 4.1 shows no significant interaction effect of treatment and gender on students' perception of Basic Chemistry concepts in secondary schools ($F_{(2,414)} = 2.186$, $p > 0.05$, $\eta^2 = 0.010$). The null hypothesis was therefore accepted. The eta square value of 0.010 shows the contributing effect size of 1.0%.

Table 4.2

Estimated Marginal Means Effect of Treatment and Gender on Students' Perception of Basic Chemistry Concepts

Treatment	Gender	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
TTPS	Male	40.014	0.570	38.893	41.135
	Female	40.675	0.497	39.697	41.653
TCC	Male	40.541	0.673	39.218	41.865
	Female	40.133	0.539	39.074	41.192
CLM	Male	39.232	0.526	38.198	40.267
	Female	37.615	0.584	36.468	38.763

Source: Field Survey, 2024

Table 4.2 shows that female participants in the TTPS and TCC groups had higher mean scores than their male counterparts while the males in the CLM had the highest score than their female counterparts.

5. There is no significant interaction effect of treatment and mathematical ability on students' perception of Basic Chemistry concepts in secondary schools.

Table 5.1

Analysis of Covariance of Interaction Effect of Treatment and Mathematical Ability on Students' Perception towards Basic Chemistry Concepts

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	500.320	9	55.591	2.524	0.008	0.052
Intercept	12266.540	1	12266.540	556.944	0.000	0.575
Pre-test	73.446	1	73.446	3.335	0.069	0.008
Treatment	84.083	2	42.042	1.909	0.150	0.009
Mathematical Ability	16.451	2	8.225	0.373	0.689	0.002
2-way Interaction: Treatment*Mathematical Ability	41.411	4	10.353	0.470	0.758	0.005
Error	9052.164	411	22.025			
Total	673825.000	421				
Corrected Total	9552.485	420				

Source: Field Survey, 2024

Table 5.1 shows no significant interaction effect of treatment and mathematical ability on students' perception of Basic Chemistry concepts in secondary schools ($F_{(4,411)} = 0.470$, $p > 0.05$, $\eta^2 = 0.005$). The null hypothesis was therefore accepted. The eta square value of 0.005 shows the contributing effect size of 1.5%.

Table 5.2

Estimated Marginal Means Interaction Effect of Treatment and Mathematical Ability on Students' Perception towards Basic Chemistry Concepts

Treatment	Mathematical Ability	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
TTPS	Low	39.219	1.486	36.299	42.140
	Medium	40.416	0.402	39.626	41.207
	High	41.417	1.659	38.155	44.678
TCC	Low	39.960	0.592	38.797	41.123
	Medium	40.464	2.710	35.136	45.792
	High	40.653	0.622	39.431	41.876
CLM	Low	38.036	1.486	35.115	40.957
	Medium	38.380	0.440	37.516	39.244
	High	39.567	1.106	37.393	41.742

Source: Field Survey, 2024

Table 5.2 shows the overall comparison that participants with high mathematical ability in the TTPS, TCC, and CLM had the highest mean scores (41.417), (40.653), and 39.567 respectively than medium and low mathematical ability in the learning groups.

6. There is no significant interaction effect of gender and mathematical ability on students' perception of Basic Chemistry concepts in secondary schools.

Table 6.1

Analysis of Covariance of Interaction Effect of Gender and Mathematical Ability on Students' Perception of Basic Chemistry Concepts

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	596.765	6	99.461	4.598	0.000	0.062
Intercept	13280.800	1	13280.800	613.937	0.000	0.597
Pre-test	90.927	1	90.927	4.203	0.041	0.010
Gender	13.572	1	13.572	0.627	0.429	0.002
Mathematical Ability	297.080	2	148.540	6.867	0.001	0.032

2-way Interaction: Gender *Mathematical Ability	178.063	2	89.032	4.116	0.017	0.019
Error	8955.720	414	21.632			
Total	673825.000	421				
Corrected Total	9552.485	420				

Source: Field Survey, 2024

Table 6.1 shows a significant interaction effect of gender and mathematical ability on students' perception of Basic Chemistry concepts in secondary schools $F_{(2,414)} = 4.116$, $p < 0.05$, $\eta^2 = 0.019$). The null hypothesis was therefore rejected. The eta square value of 0.019 shows the contributing effect size of 1.9%.

Table 6.2

Estimated Marginal Means Interaction Effect of Gender and Mathematical Ability on Students' Perception of Basic Chemistry Concepts

Gender	Mathematical Ability	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Male	Low	39.508	0.745	38.043	40.973
	Medium	39.560	0.559	38.461	40.658
	High	40.192	0.505	39.199	41.185
Female	Low	37.229	0.611	36.027	38.430
	Medium	40.482	0.427	39.643	41.321
	High	40.400	0.658	39.107	41.693

Source: Field Survey, 2024

Table 6.2 shows that male participants with high mathematical ability had the highest mean score (40.192) while female participants with medium mathematical ability had the highest mean score.

7. There is no significant interaction effect of treatment, gender, and mathematical ability on students' perception of Basic Chemistry concepts in secondary schools.

Table 7.1

Analysis of Covariance of Interaction Effect of Treatment, Gender and Mathematical Ability on Students' Perception of Basic Chemistry Concepts

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	784.028	18	43.557	1.997	0.009	0.082
Intercept	12237.625	1	12237.625	561.048	0.000	0.583
Pre-test	88.123	1	88.123	4.040	0.045	0.010
Treatment	103.607	2	51.804	2.375	0.094	0.012
Gender	3.026	1	3.026	0.139	0.710	0.000
Mathematical Ability	6.497	2	3.249	0.149	0.862	0.001
Treatment*Gender	27.340	2	13.670	0.627	0.535	0.003
Treatment*Mathematical Ability	47.466	4	11.866	0.544	0.703	0.005
Gender *Mathematical Ability	63.521	2	31.761	1.456	0.234	0.007
3-way Interaction: Treatment*Gender* Mathematical Ability	7.531	4	1.883	0.086	0.987	0.001
Error	8768.456	402	21.812			
Total	673825.000	421				
Corrected Total	9552.485	420				

Source: Field Survey, 2024

Table 7.1 shows no significant interaction effect of treatment, gender and mathematical ability on students' perception of Basic Chemistry concepts in secondary schools ($F_{(4,402)} = 0.086$, $p > 0.05$, $\eta^2 = 0.019$). The null hypothesis was therefore accepted. The eta square value of 0.001 shows the contributing effect size of 0.1%.

Table 7.2

Estimated Marginal Means Interaction Effect of Treatment, Gender and Mathematical Ability on Students' Perception of Basic Chemistry Concepts

Treatment	Gender	Mathematical Ability	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Think-Pair-Share	Male	Low	40.002	0.604	38.814	41.190
		Medium	39.962	2.700	34.653	45.270
		High	40.182	2.337	35.588	44.776
	Female	Low	40.728	0.533	39.681	41.776
		Medium	38.919	1.765	35.448	42.390
		High	42.660	2.336	38.068	47.252
Circle Chat	Male	Low	41.664	1.072	39.558	43.771
		Medium	43.842	4.671	34.659	53.025
		High	39.657	0.884	37.919	41.394
	Female	Low	40.143	0.758	38.652	41.634
		Medium	38.795	3.306	32.296	45.294
		High	40.195	0.789	38.643	41.747
Control	Male	Low	37.433	1.907	33.684	41.182
		Medium	39.476	0.578	38.341	40.612
		High	38.530	1.765	35.060	42.000
	Female	Low	38.976	2.347	34.362	43.590
		Medium	36.923	0.668	35.611	38.235
		High	40.230	1.408	37.461	42.998

Source: Field Survey, 2024

Table 7.2 shows that female participants with high mathematical ability in the TTPS had the highest mean score (42.660), followed by females with low ability (40.728). while female participants with medium ability had the lowest mean score (38.919). Table 7.2 further shows that male participants with medium mathematical ability in the TCC had the highest mean score (43.842), followed by males with low ability (41.664); while female participants with medium ability had the lowest mean score (38.795). In the CLM, the female participants with high mathematical ability had the highest mean score (40.230), followed by males with medium ability (39.476); while female participants with medium ability had the lowest mean score (36.923).

7. DISCUSSION OF THE FINDINGS:

The treatment had a significant effect on students' perception of basic chemistry concepts in secondary schools. This implies that the treatment effectively affected students' perception of Basic Chemistry concepts in secondary schools. This means that participants who were exposed to TTPS perceived the teaching as more appropriate in fostering their confidence in learning, reflection on learning processes, interaction among their peers, active involvement in learning chemistry concepts, being comfortable in listening to other students' discussions and sharing their thoughts, improved their oral communication than TCC and CLM. It implies that TTPS was more potent as a learning strategy in improving students' perception towards learning Basic Chemistry concepts in secondary schools than TCC and CLM. This finding is in support of [16] and [17] who found that students perceived the Think-Pair-Share strategy as effective in motivating, engaging, providing immediate feedback developing social and physical interactions, increasing students' interest and confidence in learning, and improving teamwork and critical thinking skill. However, their findings were in Biology and English language not in Chemistry.

The study also showed no significant main effect of gender on students' perception of the learning strategies toward Basic Chemistry concepts. This implies that gender has no significant effect on students' perception of learning strategies toward Basic Chemistry concepts. This is in support of [14] who found that age and gender were not effective in determining students' perception of either personal or institutional factors in learning. However, the study showed a significant main effect of mathematical ability on students' perception of Basic Chemistry concepts in secondary schools. This implies that the mathematical ability of the students had a significant effect on students' perception of Basic Chemistry concepts. The students with high mathematical ability had a better perception to chemistry learning than their counterparts with medium and low mathematical abilities. This implies that students' knowledge of

mathematics contributes to their learning of the chemistry concepts which in turn promotes their positive perceptions to learning of the Basic Chemistry concepts. This finding is in support of [4] who also found a significant main effect of students' mathematical ability on students' achievement in Basic Chemistry concepts.

There were no significant interaction effects of treatment and gender, treatment and mathematical ability and 3-way interaction of treatment, gender and mathematical ability on students' perception on Basic Chemistry concepts. However, there was a significant interaction effect of gender and mathematical ability on students' perception of Basic Chemistry concepts in secondary schools. The overall comparison of the effect of gender and mathematical ability shows female participants with high mathematical ability in the TTPS had the highest mean score followed by females with low ability while female participants with medium ability in CLM had the lowest mean score. This implies that the interaction effect of gender and mathematical ability had a better effect on students' perception towards Basic Chemistry concepts among female participants with high mathematical ability who were exposed to TTPS learning strategy than their male counterparts in TCC and CLM, respectively. These findings are in support of [18] who found that there were no 2-way and 3-way interaction effects of learning strategies, gender and mathematical ability on conceptual knowledge, attitude, cognitive operation and skills acquisition in chemistry but found interaction effect of treatment and mathematical ability of the students on computational knowledge in chemistry.

8. RECOMMENDATIONS

The study recommends the use of the Timed Think-Pair-Share and Timed Circle Chat in promoting students' active engagement, social interactions, sharing and reflection of students' thoughts and overall positive perception of students in the learning of chemistry. The learning strategies can also be applied in science to evaluate students' conceptions, attitudes and interests in other aspects of chemistry concepts and other science fields of learning.

Training and retraining of the in-service science teachers are pertinent in engaging students in active learning processes. Provision of enriching learning environments and adequate learning organisation to foster meaningful and active engagement of students in teaching and learning.

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REFERENCES :

1. Dewey, J. (1980). Democracy and education. In J. A. Boydston (Ed.), *John Dewey: The middle works 1899-1924*: 15 (1923-1924), 180-189. Carbondale: Southern Illinois University Press.
2. Hargraves, Vicki (2021, January 18). *Dewey's educational philosophy*. https://www.theeducationhub.org.nz
3. Echevarria, J. Vogt, M. E., and Short, D. (2014). *Making content comprehensible for Elementary English Language learners: The SIOP model*. Boston, MA: Allyn & Bacon.
4. Adeoye, I. F. (2024). Effects of timed think-pair-share and circle chat on students' academic achievement in basic chemistry concepts. *International Journal of Novel Research in Education and Learning*, 11(5), 77-87.
5. Marifa, H. A., Abukari, M. A. Samari, J. A. & Dorsan, P. (2023). Students' perceptions of the pedagogical content knowledge of chemistry teachers on the concept of hybridization. *Science Journal of Education*, 11(2), 61-76.
6. Cheruiyot, R. O. (2020). Effect of student perception to chemistry practicals on performance in chemistry. *International Journal of Research in Education Humanities and Commerce*, 01(03), 139-150.
7. Nidup, Y. Zangmo, S., Rinzim, Y., Yuden, S., Subba, H. R. and Rai, J. (2021). The perception of class X students Phuentsholing higher Secondary school towards chemistry. *Anato lian Journal of Education*, 6(1), 56-66.
8. Mukaniyonsenga, E., Uwizeyimana, D., Iyamuremye, A. Nsabayezu, E. and Niyonzima, F. N. (2023). Teachers' and students' experiences of chemistry practical in selected day secondary schools in Nyarugenge District, Rwanda. *African Journal of Educational Studies in Mathematics and Sciences*, 19(1), 109-122.

9. Shoge, M.O. and Dauda, K. (2024). Perception of students toward chemistry in senior secondary school. A case study of Kaduna South Local Government Area, Kaduna State, Nigeria. *International Journal of Research and Innovation in Social Science (IJRISS),* VIII (IIIS), 1919-1923.
10. Batamuliza, J., Habinshuti, G. & Nkurunziza, J. B. (2023). Students' perceptions towards the use of computer simulations in teaching and learning of chemistry in lower secondary schools. *Journal of Chemistry Teacher International*, https://doi.org/10.1515/cti-2023-oo64
11. Irakoze, E., Gakuba, E., and Karegeya, C. (2021). Effect of gender perceptive towards performance of chemistry education in secondary: case study of three selected schools of Gicumbi District in North-East of Rwanda. *JRIIE Journal of Research Innovation and Implications in Education*, 5(3), 15-25.
12. Oluwole, L. O., Adetunji, O. and Olasehinde, T. (2024). Students' perceptions of teaching methods in a Nigerian medical school. *Sierra Leone Journal of Medicine*, 1(2), 118-122.
13. Khavere, S., Ogutu, J. P. and Bota, K. (2023). Students' perception of teacher classroom effectiveness and academic achievement: A case of secondary school students in Hamisi Sub-county, Kenya. *African Journal of Empirical Research,* 4(2), 54-61.
14. Tlali, T. V. and Baliyan, S. P. (2021). Gender, age and faculty differences in learning practices among undergraduates at the National University of Lesotho: Way forward to improve learning. *Creative Education*,12(10), DOI: https://www.10.4236/ce.2021.1210171
15. Zhang, Z. and Chen, X. (2024). An analysis of students' perceptions of teachers' questioning in secondary biology classroom. *Disciplinary and Interdisciplinary Science Education Research*, 6(5), 851-867.
16. Parker, J. and Asare, J. (2021). Teacher trainees' perceptions of Think-Pair-Share technique in teaching classification of living organisms in colleges of education-Ghana. *Science Educational International*, 32(4), 368-373.
17. Darmawan, Y. R. R. and Lestariningsih, F. E. (2023). Students' views towards the TPS strategy on students' oral communication skill in an EFL context. *JOLLT Journal of Languages and Language Teaching*, 11(4), 798-809.
18. I. F. Adeoye (2016). *Effects of inquiry-based learning strategies on students' learning outcomes on chemistry*. PhD Thesis, School of Postgraduate Studies, University of Lagos, Lagos State, Nigeria.