

# Effects of two modes of Peer Tutoring and Gender on Secondary School Biology Students' Motivation

Obiageli Loretta Aniaku<sup>1</sup>, Ebere Ibe<sup>2\*</sup>, Assumpta Chinyere Aham<sup>3</sup>, Theresa Ukamaka Ugwu<sup>4</sup>, Uche Mariestella Nzewi<sup>5</sup>

## **Abstract**

*The study examined the effects of two modes of peer tutoring on secondary school Biology students' motivation. Aptitude Treatment Interaction (ATI) experimental design was used. Three research questions and three null hypotheses guided the study. The population consisted of 2, 636 senior secondary one (SSI) Biology students (10<sup>th</sup> graders), from 30 public secondary schools. A sample of 224 (109 males and 115 females) students was drawn from three different school types (single –sex male, female and mixed- sex) through simple random sampling. Two intact classes were randomly sampled from each of the three school types and were assigned randomly, to experimental groups I and II. Students in experimental group I were exposed to Reciprocal Peer Tutoring (RPT) while those in experimental group II were exposed to Peer Assisted Tutoring (PAT). Data were collected using Biology Motivation Inventory (BMI) with reliability index of .85 established using Cronbach alpha. Research questions were answered using mean and standard deviations while hypotheses were tested using ANCOVA at 0.05 level of significance. Results obtained indicated that RPT mode promoted students' motivation in Biology significantly better than PAT mode. The study revealed no significant gender influence and no significant interaction effect of modes of instruction and gender on students' motivation. The study authenticates Vygotsky's theory that through child-centered teaching and learning, learners attain their Zone of Proximal Development (ZPD) by problem-solving in collaboration with peers, specifically with more academically brighter peers within heterogenous groups. We recommend that teachers target learners ZPD through child centered teaching and learning such as RPT, in Science (Biology). The strategy supports Deci and Ryan Self-determination theory that striving together by all students' increases their motivation to learn and persistence in tasks.*

**Keywords:** Reciprocal Peer Tutoring, Peer Assisted Tutoring, Motivation, Biology

---

<sup>1</sup>Department of Science Education, University of Nigeria, Nsukka

<sup>2</sup>Department of Science Education, University of Nigeria, Nsukka

<sup>3</sup>Department of Science Education, University of Nigeria, Nsukka

<sup>4</sup>Department of Science Education, University of Nigeria, Nsukka

<sup>5</sup>Department of Science Education, University of Nigeria, Nsukka

## **I. Introduction**

Biology is one of the science subjects taught at senior secondary school level in Nigeria. It deals with the study of living things. Taylor, Green and Stout (2004) defined Biology as a subject devoted to the study of the structures, functions evolution, distribution and interrelationships that exist between living things and their environments. The study of Biology offers learners wide range of knowledge about living things and understanding of the environmental complexities. Besides, it is one of the prerequisite subjects for the study of Medicine, Pharmacy, Nursing, Teaching, and Biochemistry among other courses in tertiary institutions of learning. In Nigeria, for a candidate to enroll for any of these afore-mentioned courses in Institutions of Higher learning, the candidate must possess at least a credit pass (C<sub>6</sub>) in senior (High) school certificate examination or its equivalent. Regardless of these relevancies of Biology to humans, reports from researches (Araoye, 2013; Agboghoroma & Oyovwi, 2015) and West African Examination Council report (Chief Examiners, 2019 and 2020) indicate persistent students' poor achievement in Biology. Ogundiwin, Asaju, Adegoke and Ojo (2015) attributed students' poor achievement to the use of non-learner-centered method of teaching such as lecture method in delivering biological contents to students.

Lecture is a method of teaching where the teacher has great class control and delivers contents to students by dictating notes, writing out contents or use projector to display information with little or no students' contribution in the teaching and learning process (Ezenwosu and Nworgu, 2013). The unidirectional flow of information from the teacher to the learners in the teacher-centered method of teaching especially the lecture method encourages passivity of learners in the classroom. When learners are not actively involved in the learning process, they are disengaged and not motivated to learn.

Motivation as a psychological construct refers to an individual's impulses and motives for action. It is the force that energizes, directs and sustains individual towards setting and achieving a goal (Godera, Williams & Wright, 2015). It is the force that propels an individual into action to achieve a desired goal. Guerid (2015) see motivation as the desire to engage in an activity out of curiosity, interest and enjoyment. It includes all the forces acting on and within an individual which initiate and direct the individuals to engage in activity and aim towards achieving the set goals. There are two major types of motivation: external or extrinsic motivation and internal or intrinsic motivation. External/extrinsic motivation refers to the tendency to perform external activities for a known external reward such as money, praise or recognition. Extrinsic motivation is influenced by external factors that push an individual to engage in activities without interest but for external reward. Intrinsic /internal motivation on the other hand is self-directed. It is the type of motivation that comes from the pleasure one gets from task that gives satisfaction in completing. Guerid (2015) noted that intrinsic motivation enables students to engage in an activity with a full sense of volition. In the academic parlance, although intrinsic motivation controls learners' full sense of volition; Yukseloglu and Karagüven (2013) opined that both intrinsic and extrinsic motivation controls all other factors that affect learning outcomes of students. Hence, both types of motivation are required in promoting students' academic achievement.

Theoretically, this study on students motivation through peer tutoring, irrespective of their gender is anchored on the tenets of Deci and Ryan (1991) Self-determination Theory (SDT) which suggests that learners' function and grow optimally well only when three innate psychological needs: such as competence, relatedness and autonomy are met. Peer tutoring provides learners with the opportunity to attain competence;

relatedness and autonomy needed for self-determination and increased motivation. Mazumber (2014) noted that students with high level of motivation stay focused, overcome academic challenges and achieve highly unlike those with low motivation. Abdurrahman and Garba (2014) identified motivational orientation as an important learners' characteristic variable that influences academic achievement. Hence, promoting students' motivation could enhance academic achievement.

To promote students' motivation and enhance their achievement in Biology, there is need for teachers to adopt teaching strategies that could encourage active participation of learners in the classroom. Researchers such as (Pal, Roy & Gangopadyay, 2014) suggested learner-centered strategies of teaching such as inquiry-based learning, concept mapping, simulation and games and cooperative learning. Peer tutoring can encourage active engagement of learners and could promote students' motivation in the classroom. Hence, this study examined the effects of two modes of peer tutoring considered as learner-centered strategies of teaching and learning by the authors to see what knowledge can be added to existing knowledge as it relates to child centered learning. Peer tutoring is a type of cooperative learning that encourages learners to work in small groups. It involves brighter learners assisting the less bright ones to acquire knowledge or skills in a tutor/tutee relationship (Horvath, 2011; Yurt & Aktas, 2016). Peer tutoring encourages learners to help one another to learn by teaching and assisting one another. It involves learners teaching other learners in a tutor and tutee relationship whereby the peer that teaches is the tutor while the peer that is taught is the tutee. Peer tutoring goes by many other names such as: peer- led learning, partner learning, child- teach- child and learning through teaching (Kalkowski, 1995). In view of the meanings inherent in the names, many scholars (Hott, Walker & Sahni, 2012; Nguyen, 2013) defined it as a flexible peer- mediated strategy that involves students serving as academic tutors and tutees whereby a higher performing student trained and supervised by the class teacher is paired with a lower performing one to review critical academic concepts or skills.

The underlying principle of peer tutoring is that it involves a learner teaching another learner under the supervision of an experienced teacher. Thus, peer tutoring lends credence to the Socio-cultural theory of Vygotsky (1978) which states that knowledge is social in nature whereby the assistance provided by a more academically brighter one(peer), can scaffold other peers beyond their Zone of Proximal Development (ZPD). ZPD is the distance between the actual developmental level as determined by independent problem-solving and the level as determined through problem-solving under adult guidance or in collaboration with more academically brighter peers. The underlying philosophy of Vygotsky's theory is that social interaction provides essential role in the growth and development of cognition in learners as they interact with one another. Peer tutoring is a teaching strategy worth exploring because it creates favorable social environment that could promote motivation in learners. Quinn (2006) noted that students helping one another to learn in small heterogenous groups enable them to build a supportive community that raises the performance level of each member. Peer tutoring also encourages, learners' accountability to meaningful knowledge construction(Onwu, 2020). Learners' ability to construct meaningful knowledge may increase their motivation to learn and create greater opportunity for active learners' participation in the learning process. Deci and Ryan (2012) also emphasized that providing learners with the opportunity to participate actively in the learning process enable them to develop intrinsic motivation. Quinn (2006) observed that motivation often correlates with achievement. Han, Yin and Wang (2015) remarked that motivation correlates with teaching method to promote students' achievement.

There are many models of peer tutoring: Cross- Age Peer Tutoring (CAPT); Same- Age Peer Tutoring (SAPT); Reciprocal Peer Tutoring (RPT); Class wide peer tutoring (CWPT) and Peer Assisted Learning Strategy (PALS) otherwise referred to in this study as Peer Assisted Tutoring (PAT) (Hott, Walker & Sahni, 2012;Ogundola, 2017). Cross- Age Peer Tutoring (CAPT) is tutoring model involving peers of different ages whereby the older peer tutors the younger ones. Same- Age Peer Tutoring (SAPT)is a tutoring model that involves pairing of peers within the same age but with or without the same academic ability. The peer with brighter or less bright academic ability can act as a tutor; The Reciprocal Peer Tutoring (RPT) is a tutoring model that involves pairing of peers with differing academic ability, who at intervals swap their tutor roles. Class wide peer tutoring (CWPT) is a model based on reciprocal tutoring model except that it incorporates a game format whereby pairs of peers that tutor each other are grouped into two teams. Each pair win points for their team. The Peer Assisted Learning Strategy (PALS) referred to as Peer Assisted Tutoring (PAT) is a tutoring model that allows only the academically brighter students to serve as peer tutors over the less academically bright ones.

This study examined the effects of Reciprocal Peer Tutoring (RPT) and Peer Assisted Tutoring (PAT) on students' motivation in Biology. The choice of these two modes of student-centered learning was based on low motivation to learn science by students as a result of their passive roles in science classrooms; teachers' inability to provide activity oriented and child centered learning which have resulted to poor learning outcomes in Sciences (Biology).The differences in the position of the tutors and tutees during the tutoring sessions differentiates RPT and PAT modes. In the Reciprocal Peer Tutoring (RPT) for instance the role of tutor and those of the tutees is occasionally swapped among the group members within a specified time interval. Every member in the group is given the opportunity to act as a tutor and as a tutee within a tutoring session; whereas in the Peer Assisted Tutoring(PAT) mode, the peer tutor is fixed throughout the tutoring session. Every member is not given the opportunity to act as a tutor. Only the academically brightest students in the group can act as the peer tutors. The less academically bright students then act as the tutees. In this study we examined how the differences in alternating roles of tutors and that of fixing the roles of tutors within the groups could impact on students' motivation irrespective of their gender.

Gender is a broad analytical concept and socio-cultural attribute assigned to being male and female. It is a concept that is used to draw out women's roles and responsibilities in the society in relation to those of men. It therefore refers to the societal ideas, expectations, norms, economic, social, political, and cultural attributes and opportunities, associated to a male or a female (Erydice, 2010; Family Life Education, n.d). In Nigeria, the societal ideas and expectations of the male and female children vary across ethnic groups. Socio-culturally, the male child is viewed as the future bread winner and as such is expected to achieve higher by engaging in task demanding roles more than the girl child. To meet up with the societal expectations, the male child is provided with the opportunity to explore and achieve more than the girl child in stereotypic roles dimensions. These societal misconceptions hitherto influence learners' abilities in academic activities and tasks especially the sciences (Nzewi, 2010; Anderson, 2017). Girls start to believe gender stereotypes that could hold them back for life by the time they are six years old (Anderson, 2017). The gender stereotype beliefs are nurtured throughout their schooling years. This provides a chilly psychosocial environment that may hamper their motivation to learn sciences. In view of this, the researchers examined the influence of gender on Biology students' motivation to learn Biology when exposed to treatment conditions. Three (3) research questions were

answered using mean and standard deviation while their corresponding hypotheses were tested using ANCOVA at 0.05 level of significance.

1. What are the relative effects of two modes of peer tutoring on the mean motivation ratings of students?
2. What is the influence of gender on student' motivation?
3. What is the interaction effect of modes of peer tutoring and gender on Biology students' motivation?

The corresponding null hypotheses tested at 0.05 level of significance using ANCOVA were as follows:

1. There is no significant difference in the effects of the two modes of peer tutoring on Biology students' motivation.
2. There is no significant influence of gender on students' motivation.
3. There is no significant interaction effect of gender and mode of instruction on students' motivation.

## **II. Method**

The study employed Aptitude Treatment Interaction (ATI) research design using non-equivalent control groups quasi experimental design due to the use of intact classes. ATI is a research paradigm that attempts to examine how an outcome depends on the match between individuals' attitude and treatment received. It was deemed appropriate for this study because of its focus on examining how students' motivation will be affected by exposure to two modes of child centered learning (peer tutoring). The study involved pretesting to determine initial differences that existed between the two experimental groups, RPT and the PAT. Recently, Adene et al (2021), Offordile et al. (2021), Odo et al. (2021), Ejimonye et al. (2020a, b), Njoku et al. (2020) have adopted this same design. The study was carried out in Nsukka Local Government Area of Enugu State, Nigeria with a population of 2,636 senior secondary one (SS1) students in 30 public secondary schools in 2018/2019 academic session (Research and Statistical Unit, Enugu State Post Primary School Management Board Nsukka, Education Zone). Sample of 240 (109 males & 115 females) drawn through simple random sampling (balloting) from three different school types (73 students from mixed-sex school, 78 students from single-sex male school and 73 from single-sex female school). The three different school types were drawn because gender was considered in the study. Schools were similar in demographic characteristics such as school ownership and availability of infrastructures. Through simple random sampling, two intact classes were drawn from each of the three different school types. Each of the two intact classes were randomly assigned to experimental groups I & II and were exposed to RPT and PAT modes of peer tutoring respectively. The regular Biology teachers in the three schools were trained for two weeks using researcher developed peer tutoring instructional manual/guide and lesson plan on Biology content: Cell and its environment. These instructional guide and lesson plan for PRT and PAT were also validated. Training period for research assistants who were experienced regular teachers of the students lasted for two weeks while treatment lasted for five weeks and was monitored by the researchers.

Before the treatment, all the students in the sampled intact classes were assigned to groups of five students per group (dyad). The grouping was heterogeneous such that each group had students with differing academic abilities: high, average and low academically achieving students. In group I, each student was assigned to a sub-topic which he/she taught for one week. Whereas in experimental group II, sub-topics were assigned to academically brightest students whose roles as tutors were fixed. The fixed peer tutors taught throughout the five weeks. The teaching activities were as shown on table 1 below:

**Table 1: Instructional procedure**

Weeks	Content	Expt. group 1 (RPT): Tutoring roles swapped	Expt. group II (PAT): Tutoring roles fixed	Teacher's Activity.
1.	<i>Diffusion:</i> Definition of terms, processes of diffusion, factors that affect diffusion, importance and experiments on diffusion.	Peer tutors for week 1, in each group defines diffusion, explains processes, factors that affect diffusion and carried out experiments with other students in their various groups. Did the evaluation. Students exchanged views through dialogue, negotiations of meanings of ideas contributed by group members and through questioning.	The fixed tutors in each group defines diffusion, explains process, factors that affect diffusion and importance, carried out experiments with students in their various groups and did evaluation both formative and summative. Students exchanged views through dialogue, negotiations of meanings of ideas contributed by group members and through questioning.	Teacher's role was guidance oriented and identification of learners' difficulties such as in setting up experiment on diffusion and provided assistance.
2.	<i>Osmosis:</i> Definition, processes, types of solution, importance and experiments on osmosis.	Tutors in groups for week II taught osmosis, types of solutions, processes, importance, carried out experiments and evaluated peers.	Fixed tutors taught osmosis, types of solution, importance, carried out experiments and evaluated peers	Monitored students' activities and gave assistance where necessary.
3.	Plasmolysis and crenation; factors that influence both, effects of plasmolysis and crenation, simple experiments on both processes.	Peer tutors for week III, taught plasmolysis and crenation, outlined factors that influence both and carried out simple experiments on the two phenomena and evaluated peers.	Fixed peer tutors, taught plasmolysis and crenation, outlined factors that influence both, carried out simple experiments on both and evaluated their groups.	Moderated teaching, gave assistance where necessary.
4.	Turgidity and Haemolysis.	Peer tutors for week IV, taught	Fixed peer tutors taught	Supervised the groups

	Process, importance and experiments.	turgidity and hemolysis ,explained processes and importance. Then evaluated members in the group.	turgidity and hemolysis, explain the processes and importance and evaluated peers.	during each tutoring session and clarified issues where necessary.
5.	Active transport; definition, processes, factors affecting processes and the importance of Active transport.	Peer tutors for week V in each of the groups taught active transport, processes, factors affecting active transport, importance and then evaluated peers.	Fixed peer tutors in each of the groups, taught active transport, its processes, factors that affect active transport, importance and then evaluated peers	Facilitated learning, assisted and clarified students on difficult issues they raised amongst themselves. Teachers probing questions elicited meaningful responses in the groups.

Data were collected using 23 item statements Biology Motivation Inventory (BMI) developed by researchers. The instrument was an adaptation of Biology motivation item statements by (Glynn & Koballa, 2005). The items were initially forty (40) Biology motivation statements but were reduced to 23 item statements through factor analysis. The 23 item- statements consisted of both positive and negative items rated on a 4- point scale. Each of the response corresponds to a point value that ranged from 4-1. The stability co-efficient of .86 was established through Pearson's product moment correlation while the internal consistency coefficient index of .82 was determined using Cronbach's alpha

Data were analyzed using mean, standard deviations for answering research questions and Analysis of Covariance (ANCOVA) for testing the hypotheses at 0.05 level of significance.

### III. Results

**Table 2:** Mean and standard deviation of motivation rating of Biology students taught using Reciprocal Peer Tutoring (RPT) and those taught using Peer Assisted Tutoring (PAT)

Groups	Pretest			Posttest		Mean Scores	Gain	Mean Difference
	N	$\bar{X}$	SD	$\bar{X}$	SD			
RPT	114	52.44	5.82	64.49	8.36	12.05		3.75
PAT	110	52.46	5.82	60.76	7.25	8.30		

On table 2 above, the mean gain of 12.05 and 8.30 for RPT and PAT respectively indicated that the students who were exposed to RPT had higher posttest mean motivation rating than those exposed to PAT.

**Table 3:** Mean and Standard Deviation on motivation ratings of male and female students

Gender	Pretest			Posttest		Mean Gain Score	Mean Gain Difference
	N	$\bar{X}$	SD	$\bar{X}$	SD		
Male	109	52.30	5.72	62.03	8.21	9.73	.94
Female	115	52.59	5.91	63.26	7.86	10.67	

On table 3 above, the obtained mean gain of 9.73 and 10.67 for male and female students respectively indicate that the female students had higher posttest mean motivation rating than their male counterparts. The posttest standard deviations of 8.21 and 7.86 for the male and female students indicate that the variation in the individual motivation ratings clustered around the mean for both gender. However, the ANCOVA table 4 below show that the difference was not significant (.209).

**Table 4:** ANCOVA on the effect of mode of peer tutoring on students' motivation by treatment and by gender.

Source	Type III Squares	Sum of Df	Mean Square	F	Sig.	Partial Squared	Eta
Corrected Model	901.107 <sup>a</sup>	4	225.277	3.655	.007	.063	
Intercept	9658.182	1	9658.182	156.688	.000	.417	
Pre- Motivation	20.781	1	20.781	.337	.562	.002	
Treatment	794.671	1	794.671	12.892	.000	.056	
Gender	98.035	1	98.035	1.590	.209	.007	
Treatment * Gender	2.236	1	2.236	.036	.849	.000	
Error	13499.107	219	61.640				
Total	893906.000	224					
Corrected Total	14400.214	223					

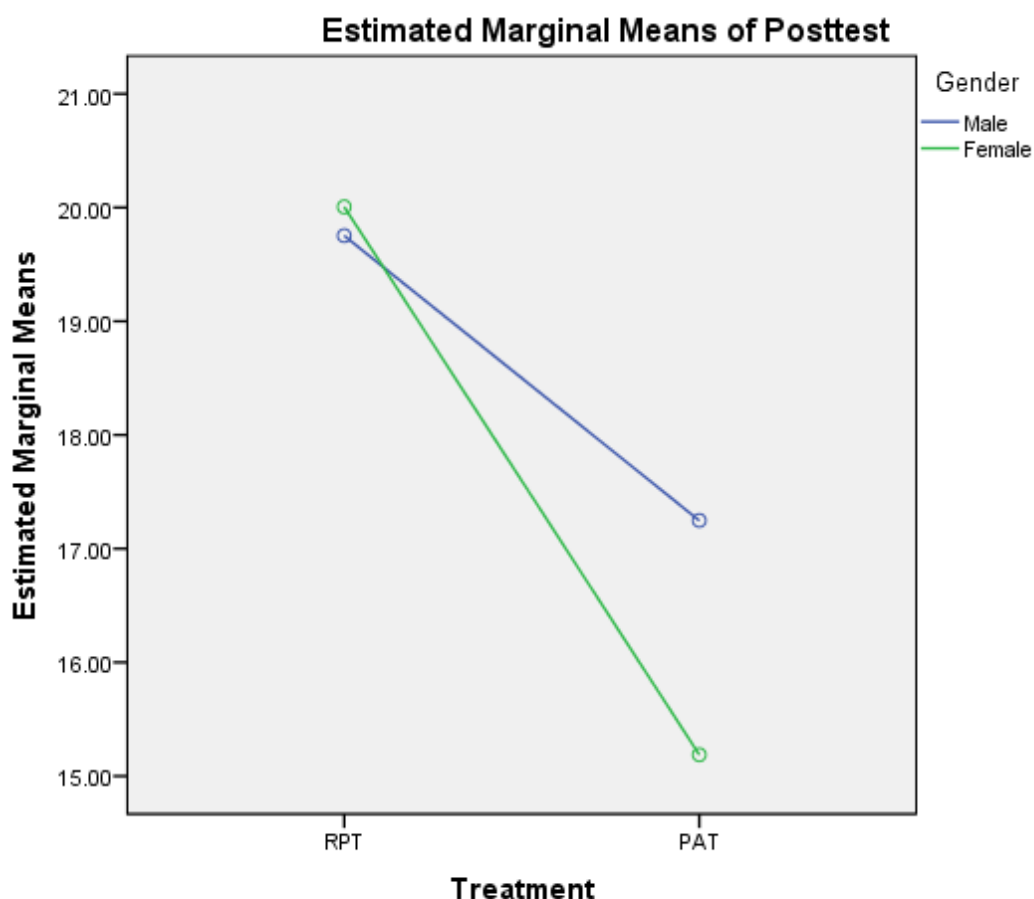


Table 4 reveal that the probability value associated with the calculated value of F (12.892) for treatment and students' motivation is significant at 0.000. Thus, the null hypothesis of no significant difference is rejected. This is because the exact probability value of .000 is less than the level of significance set at 0.05. There is therefore a significant difference in the effect of modes of peer tutoring on Biology students' motivation in favor of the students exposed to RPT.

Table 4 also show that the probability value associated with the calculated value of F (1.590) for gender and students' motivation is .209. Since the exact probability value of .209 is greater than the 0.05 level of significance set ab initio, the null hypothesis of no significant difference is accepted.

Table 4 reveal that the probability value associated with the calculated value of F (.036) for interaction effect of methods and gender on students' motivation is .849. Since the exact probability value of .849 is greater than the already set 0.05 level of significance, the null hypothesis of no significant interaction effect of gender and method of instruction is accepted.

**Figure 1. Graph on Interaction effects of modes of instruction and gender on students' motivation**



Covariates appearing in the model are evaluated at the following values: Pretest = 11.1696

Figure 1 above, further explains the ANCOVA result on interaction effects of method and gender. The two graph lines of males and females on figure 1 do not intersect along PAT. The minor intersection of lines towards RPT is not substantial. The null hypothesis of no significant interaction of methods and gender set for the study is accepted.

#### **IV. Discussion of results**

Results on table2, indicate that students exposed to RPT mode had higher mean motivation scores than their counterparts exposed to PAT. This was revealed by the mean gain difference of 3.75 in favor of the group exposed to RPT mode. The higher effect of the RPT mode over the PAT mode on students' motivation could be attributed to the degree of students' participation (peer interaction) in the teaching and learning process. Every student in RPT mode participated actively as they alternated the tutor/tutee roles as against those in the PAT mode with fixed peer tutors. The active participation of the RPT group promoted their enthusiasm to act and learn. These enhanced their motivation more than those in the PAT group. This validates the findings of (Quinn, 2006; Alotebi, 2016) that active participation of learners in learning process promotes motivation. The finding agrees with (Miller, et. al., 2010; John, et. al., 2014) that cooperative learning such as peer to peer tutoring involving swapping of roles amongst learners significantly promotes students' motivation.

Finding of the present study further authenticates Deci and Ryan (1991) theory that psychological needs such as competence, relatedness and autonomy are enhanced when students learn from each other in a Reciprocal Peer Tutoring than Peer Assisted Tutoring where only a single peer (the brightest) in the class takes all. RPT which has proven to be more efficacious in this study than PAT promoted self-determination which has strong relationship with students' motivation to learn. Students that were exposed to RPT mode developed competence, relatedness and autonomy that promoted their motivation due to the individualized responsibility accorded to each of the peers through role swapping. The finding agrees with Horvath (2011) that providing learners with learning autonomy promotes motivation. However, this finding does not agree with that of Tella (2013) who found that there was no significant effect of peer tutoring on primary school pupils' attitude towards Mathematics. The insignificant effect could be attributed to the age of the pupils who were not old enough to teach one another.

Although table 3 reveal a slightly higher mean motivation rating in favor of the females which Chung and Chang (3017) attributed to method of teaching; that led to their submission that females prefer cooperative method of learning to individual learning. ANCOVA analysis table 4 show that the slight difference recoded on table 3 in favor of females was not significant. This indicates that both male and female students were equally motivated in the use of PRT. The finding of the present study that indicated no significant gender influence on Biology students' motivation may be due to increased academic engagement provided by peer tutoring mode which encouraged all the students irrespective of gender to be actively involved in the learning process.

The finding agrees with Singh, Singh and Singh (2013) who reported no significant gender influence in the motivation level of male and female Indian undergraduate student enrolled in traditional and open learning education. Similarly, the finding corroborates with John, Barchok and Ngeno(2014) who reported no gender influence on students' motivation in Chemistry using cooperative mastery learning.

The finding disagrees with the findings of Yong (2009) who reported a significant gender influence in students' motivational orientations in Biology in favor of female students. Yukselogu and Karaguvun (2013) also reported a significant gender influence in the motivation levels of Technical high school students in favor of the males. The finding of the present study also disagrees with Becirovic (2017) who

reported a significant gender influence in the motivation levels of students in learning English as a foreign Language in favor of females. What results to influence of gender in favor of females in some topics/subjects while in favor of males in some is an inconclusive research perspective.

The interaction effect of method and gender was not significant in this study. Rather the instructional method continually exerted influence on male and female students' motivation. This is because, when learners as novices come together in a collaborative posture, each member 'contribute something to, and take something away from the interaction they learn from one another in a manner that enhances and sustains motivation. The mutual giving and taking facilitates the layering and building of ideas and enacts the co-construction of knowledge. More importantly, Reciprocal Peer Tutoring teaching emphasizes the need to collaborate by actively listening to one another, contributing to ideas and viewpoints through scrutinizing and questioning the basis of arguments in terms of reasons and evidence, and by building upon one another's ideas and inputs.

## V. Conclusion

From the findings of the study these conclusions were made:

- RPT mode of peer tutoring promotes students' motivation than PAT mode;
- The influence of gender on students' motivation was not significant;
- There was no significant interaction effect of modes of peer tutoring and gender on Biology students' motivation

## VI. Recommendations

1. Students should be actively involved in the teaching process through the use of activity-oriented methods such as (RPT) mode, to promote their motivation in Sciences(Biology).
2. Teachers should adopt the use of RPT in the teaching of Sciences(Biology) to address the problem of students' poor motivation to learn Biology.
3. Biology teachers should be encouraged through incentives by their employers to attend conferences, seminars and workshops where student centered innovative teaching methods such as (RPT) are taught to update their teaching strategies and skills for effective teaching and learning outcomes.
4. Science educators should regularly organize seminars, workshops and conferences on the use of innovative methods of teaching such as (RPT) for serving teachers for better classroom performance.
5. Curriculum planning and development agencies should infuse child centered teaching and learning strategies such as RPT into Science (Biology) curricular for use at high schools and tertiary institutions.

## References

1. Adene, F.M., Umeano, E.C., Adimora, D.E., Ugwuanyi, C.S., Okeke, C.I.O., Offordile, E.E., Amaeze, F.E., Uzodinma, U.E., Abdullahi, Y., Ejiofor, J.N. &Ishiwu, E.N. (2021). Effectiveness of Peer

- Collaborative Learning Strategy on Self-Esteem of Pupils with Behaviour Problems in Nsukka Education Authority. *Journal of Critical Reviews*, 8(1), 1055-1069. <http://www.jcreview.com/fulltext/197-1615692041.pdf?1615708380>
2. Agboghoroma, T. E. &Oyovwi, E. (2015). Evaluating effects of students' academic achievement on identified difficult concepts in senior secondary school Biology in Delta state. *Journal of Educational Practice* 6(30), 2222-2288.
  3. Araoye, M. I. (2013). Redressing students' motivation and academic achievement in Biology Education. *Unpublished thesis*, Federal College of Education (special) Oyo, Oyo state.
  4. Becirovic, S. (2017). The relationship between gender, motivation and achievement in learning English as a foreign language. *European Journal of Contemporary Education* 16 (2), 210
  5. Christiana, I. O. (2009). Influence of Motivation on students' academic performance. *Social Sciences* 4(1): 30-36
  6. Chung, L.Y & Chang, R.C. (2017). The effect of gender on motivation and students' achievement in digital Game –based Learning: A case study of a content-based classroom. *Eurasia journal of Mathematics Science and Technology Education*13(6) 2309-2327.
  7. Deci, E.L. & Ryan, R.M. (1991). A motivational approach to self-integration in personality. In Dienstbier (Ed), *Nebraska symposium on motivation* 38:237-288.
  8. Deci, E. I & Ryan, R. M. (2012). Self-determination theory. In Van Lange P.A.M, Kruglanski, A.W. and Hygine E.T. (Eds.) *Handbook of Theories of Social psychology*: Thousand Oaks, C.A: Sage.
  9. Ejimonye, J.C., Onuoha, J.C., Ugwuanyi, C.S., Eneogu, N.D., Ugwuanyi, B.E &Ogbuehu, S.N (2020a). Effectiveness of Two-Dimensional Animation Technique in Enhancing Students' Motivation in Quantitative Economics Concepts. *International Journal of Future Generation Communication and Networking (IJFGCN)*, 13(1):27-38.
  10. Ejimonye, J.C., Ugwuanyi, C.S., Okeke, C.I.O. & Nwoye, M.N. (2020b). Two-Dimensional Animation and Students' Achievement in Mathematical Economics: Implications for Science Teaching. *International Journal of Engineering Research and Technology*, 13(6), 1220-1230. [http://www.irphouse.com/ijert20/ijertv13n6\\_20.pdf](http://www.irphouse.com/ijert20/ijertv13n6_20.pdf)
  11. Eurydice, (2010). Gender differences in educational outcomes: Study on the measures taken and the current situation in Europe[<http://www.envydice.org>]. On 05/04/12.
  12. Ezenwosu, S.U. &Nworgu, L.N. (2013). Efficacy of peer tutoring and gender on students' achievement in Biology. *International Journal of Scientific & Engineering Research*, 4(12), 944-949. Retrieved @ <http://www.jiser.org> 24/08/16.
  13. Family Life Education, (n.d). *Reproductive Health and Right of Young People*. Africa, WACOL, YORDELE, NAWOJ and SWAAN, Peer Health Educators.
  14. Godera, D. Williams, J. & Wright, N. (2015). Identifying factors influencing students' motivation and engagement in online courses: *Springer Science + Business Media Singapore* Retrieved 5/10/2018.
  15. Glynn, M. &Koballa, T. R. (2008). Attitudes and motivation in Science:In J.J Mintzes and W.H. Leonard, (Eds), *Handbook of College Science teaching*: National Science Teachers Association.
  16. Guerid, F. (2015). Enhancing students' level of motivation in learning English: The case of 1<sup>st</sup> Year's Economic Students. Retrieved online from e-mail [gueridfethi@yahoo.fr](mailto:gueridfethi@yahoo.fr) Retrieved on 25/10 2018.

17. Han, J, Yin, H & Wang, W. (2015). Exploring the relationship between goal orientations for teaching of tertiary teachers and their approach in China. *Asia Pac Educ* 16: 1-11
18. Horvath, K. (2011). Effects of peer tutoring on students' achievement. *Unpublished thesis* Faculty of the Patton College of Education and Human Services, Ohio University.
19. John, K. K, Barchok H. K. & Ngeno, J. O. K. (2014). Effect of cooperative mastery learning approach on students' motivation to learn Chemistry by gender. *Journal of Education and Practice*, 5(8): 91-97.
20. Kalkowski, P. (1995). Peer and cross-age tutoring: *School improvement research series*. .
21. Mazumder, Q. (2014). Students' motivation and learning strategies of students from USA, China and Bangladesh. *International Journal of Evaluation and Research in Education (IJERE)* 3(4): 205-210.
22. Meece, J. L., Gluenke, B.B. & Burg, S. (2006). Gender and motivation. *Journal of School Psychology*, 44 351-373 retrieved [<http://dx.doi.org/10.1016/j.jsp.04.004>].26/4/18.
23. Miller, K. R. & Levine. J. S. (2002). *Prentice Hall Biology*. New Jersey, USA. Pearson Education Inc.
24. Miller, D; Topping K & Thurston, A. (2010). Peer tutoring in reading: The effects of role and organization on two dimensions of self-esteem. *Research Gate*.
25. Abdurrahman, S. M&Garba, I. M. (2014). The impact of motivation on students' academic achievement in Kebbi State Junior Secondary School Mathematics. *International journal of Advance Research (IJOAR)* 2 (12) <http://www.ijoar.org>ISSN2320-9143
26. Njoku, M.I.A., Nwagbo, C.R., & Ugwuanyi, C.S. (2020). Effect of Peer Tutoring and Peer-Led Team Learning on Students' Achievement in Biology. *International Journal of Database Theory and Application (IJDTA)*, 13(1),1-10. <https://doi.org/10.33832/ijdt.2020.13.1.01>
27. Nzewi, U. M. (2010). *It's all in the brain: Gender and achievement in Science and Technology Education*. 51<sup>st</sup>Inaugural lecture of the University of Nigeria, Nsukka.
28. Nyuyen, M. (2013). Peer tutoring as a strategy to promote academic success. *Research Brief*. Duke University, North Carolina West
29. Odo, I.O., Agwagah, U.N.V., Ugwuanyi, C.C., Shiaki, O.B., Nwoye, M.N., Emeji, E.I., Okeke, A.M., Osakwe, I.J., Okeke, C.I.O., & Ugwuanyi, C.S.(2021). Effectiveness of First Principles of Instruction in Promoting high Achievement of students in Mathematics: Implications for physics teaching. *Journal of Critical Reviews*, 8(2), 119-128.
30. Offordile, E.E., Umeano, E.C., Adene, F.M., Obi, M.C., Ugwuanyi, C.S., Okeke, C.I.O., Adimora, D.E. (2021). Improving the academic achievement of low achieving secondary school students in physics using peer tutoring learning strategy: Implications for Engineering Career. *International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)*, 11(3), 201–212.
31. Ogundiwin, O.A., Asaaju, O.A., Adegoke, A.I. & Ojo A.T. (2015). Effect of group investigative laboratory strategies on students' achievement in Biology. *Pyrex Journal of Research in Environmental Studies*, 2(4): 035-041.
32. Ogundola, P.I. (2017). Effect of peer tutoring strategy on academic achievement of senior secondary school students in Technical Drawing in Nigeria. *British Journal of Education, Society and Behavioral Sciences*, 19(1): 1-10.
33. Okeke, Eunice. A.C. (2007). *Making Science Education Accessible to all*. 23<sup>rd</sup> Inaugural Lecture of the University of Nigeria, Nsukka.

34. Onwu, A. O. (2020). Effect of peer-assisted learning strategy on students' locus of control and academic achievement in reading comprehension in Enugu East Local Government Area of Enugu State *Unpublished Ph.D thesis* University of Nigeria, Nsukka.
35. Pal, S., Roy, S.C & Ganpopadhyay, S. (2014). Effectiveness of activity – based method of teaching life science over chalk and talk method. *Indian journal of Educational Research*. III: 91-104.
36. Quinn, P. (2006). Cooperative learning and students' motivation. *Unpublished thesis* Department of Education and Human Development of the State University of New York at Brockport. Retrieved from <http://www.brockport.edu/ehd/>
37. Singh, S., Singh, A & Singh, K. (2012). Motivation levels among Traditional and Open learning undergraduate Students in India. *The International Review of Research in open and Distance Learning*. <http://www.irrodl.org/index.php/irrodl/article/view/1050/2196>.
38. Tella, A. (2013). The effect of peer tutoring and explicit instructional strategies on primary school pupil's learning outcome in Mathematics. *Bulgarian Journal of Science and Education Policy*, 7 (1): 5-25. Retrieved 25/4/18.
39. Vygotsky, L., S. (1978). *Mind in society: The development of higher psychological processes*. London, England: Harvard University press.
40. West African Examination Council (2018) Biology chief examiners' reports (Nigeria) @ <http://waeconline.org.ng/e-learning/biology/biomain.html>
41. Yurt, S. U & Aktas, E. (2016). The effect of peer tutoring on university students' success, speaking skills and speech self-efficacy in the effective and good speech course. *Educational Research and Reviews*, 11(11), 1035-1042.