IMPROVING STUDENTS LEARNING OUTCOME IN BASIC BIOLOGY USING GOOGLE CLASSROOM AND WHATSAPP INSTRUCTIONS IN UNIVERSITIES

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ABSTRACT
The study investigated improving students learning outcome in basic Biology using Google classroom and WhatsApp instructions in universities. Two research questions and three null hypotheses guided the study. Quasi experimental design, specifically, non-randomize, pre-test, post-test compare group design was employed. The population consisted of 252-year one undergraduate Biology education students from federal universities in South-East, Nigeria, out of which 118 students were purposively sampled from two universities. Basic Biology Achievement Test (BBAT) served as the instrument for data collection and was thoroughly validated by three experts. The internal consistency of BBAT was determined using Kude-Richardson formula (K-R 20) and it yielded a reliability coefficient value of 0.86. Mean and standard deviation were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses at 0.05 level of significance. The result revealed that students taught using Google Classroom instruction had higher achievement than their counterpart taught using WhatsApp instruction. The female students were found to achieve slightly higher than male however, gender was found not to have a significant influence on students' achievement. Furthermore, there was no significant interaction effect of teaching strategies and gender on students' academic achievement in basic Biology. The implication of the findings suggest that Google classroom was more effective, as such universities should provide training programs for faculty members to enhance their competencies, gives students access to learning materials and encouraging self-paced learning.
Keywords: Academic achievement, Biology education, Google classroom instruction, Learning outcome, WhatsApp instruction

INTRODUCTION

In recent time, the integration of digital platforms into higher education has become increasingly prevalent, with educators exploring these tools to enhance teaching and learning processes. The proliferation of digital technology in the 21st century has significantly transformed the landscape of education. This transformation was accelerated by factors, such as advancement in information and communication technologies (ICT) and the global COVID-19 pandemic, which forced many educational institutions to adopt remote learning strategies. With the advent of various online platforms, teaching and learning processes have become more flexible, interactive, and accessible. Among these platforms, Google Classroom and WhatsApp have emerged as prominent tools in educational settings, particularly

in higher education. These online instructional tools help ensures that students continue to achieve academic success despite the challenges posed by remote education.

Google Classroom is a free learning management system (LMS) developed by Google and launch in 2014. Google Classroom is designed to assist students and teachers in connecting, working together, organizing, and creating assignments (Iliyasu et al., 2022). As a Digital Tool, Google Classroom is only accessible to users with Google Applications for Education (GAFE). According to Virgilio (2021) GAFE is a powerful cloud-computing solution that works regardless of students' location, time, and even the type of device being used. Google Classroom has gained widespread adoption due to its ease of use, accessibility, and integration with other Google services; such as Google Docs, Google Drive, and Gmail. It allows instructors to create classes, distribute assignments, grade, and send feedback all in a paperless manner.

Several studies have explored the impact of Google Classroom on students' academic achievement, revealing its potential to enhance engagement, facilitate communication, and improve organizational skills and performance among students. For instance, research by Shaharanee et al. (2016) suggests that Google Classroom positively influences students' learning experiences by offering an interactive and user-friendly platform for collaboration and information sharing. Google Classroom facilitates collaborative learning between teachers and students, positively affects students' performance, and increases students' perception positively (Albashtawi & Bataineh 2020). Despite the positive findings and the importance of Google Classroom, studies also shows that lecturers still use the traditional face-to-face method in teaching and learning sciences especially Biology (Yelamali & Beelagi, 2021). Similarly, Gupta and Pathania (2021) adduced that the adoption of Google Classroom among university lecturers as pedagogy is still very low.

WhatsApp is one of the social media messaging applications commonly used in Nigeria that allows users to send text messages and voice messages, make voice and video calls, and share images, documents, user locations, and links using either smartphones, laptops or Personal Computers (PCs). It was initially developed for personal communication; however, WhatsApp has been repurposed for educational use. WhatsApp in the context of this study is an instant messaging App and a learning tool that enables students to learn and socialise by sharing knowledge, ideas and emotions. Due to its wide acceptance, it was reported that about 83% of internet users globally were WhatsApp users as of late 2019 (Kominfo, 2019). The simplicity, and real-time communication features make it a valuable tool for educators and students alike to adopt it as an instructional tool. WhatsApp allows for the creation of group chats where teachers can share learning materials, post announcements, and initiate and facilitate discussions.

Despite its informal origins, WhatsApp has been recognized for its potential in educational contexts, particularly in fostering communication and collaboration among students (Rachmawaty, 2021). It is an instructional tool with stimulating elements, such as visual, auditory, and interactive aspects (Magde *et al.,*2019), it is free and very easy to use (Hidayawati, 2020), it enables multimedia sharing among group members (Anjarwati & Sa'adah, 2022) and an unlimited messaging using either smartphone and or laptops (Fauzi 2021)

Studies shows that WhatsApp supports the creation of a community of learners, enhances student participation, and provides a platform for continuous feedback (Bouhnik & Deshen, 2014). According to Denker *et al.* (2018) WhatsApp improves students learning by using messages linked to images,

promoting collaboration between instructors and students (Sivakumar, 2020) and help teachers better understand students' personalities, interests and improves students' participation (Pimmer *et al.,* 2021). In spite of the numerous advantages of the use WhatsApp as an instructional strategy globally, it is worrisome to note that little or nothing can be said of its status in Nigeria.

Although, the use of Google Classroom and WhatsApp in education have gained significant attention for their potential to facilitate instruction, communication, and collaboration among students and instructors. However, there is a lack of comprehensive research comparing the effectiveness of these platforms in terms of their impact on students' academic achievement, particularly in the context of university education. While both platforms offer unique features and advantages, it remains unclear which one better supports student's academic achievement. Google Classroom, as a comprehensive learning management system (LMS), provides structured course management, seamless integration with other Google tools, and centralized communication. In contrast, WhatsApp, a widely-used messaging app, offers real-time communication, ease of access, and familiarity to students.

It is believed that with the multisensory nature of both platforms, if applied in Biology classroom, they would stimulate students' senses and allow interaction between students and teachers (Hussaini *et al.,* 2020). They would make the teaching and learning of basic Biology (SED III) more attractive and interesting and consequently enhance their academic achievement, engagement, and understanding irrespective of gender (Khan et al., 2022). Basic Biology is a compulsory course for year one Biology education students and all other members of the university who wish to take the course. It empowers the students with the basic knowledge of Biology as a subject. The relevance of basic biology is multidisciplinary. It prepares preservice science teacher for their profession after school, as well as other. Similarly, medical students especially physiotherapy students who wish to offer it as an elective course stand a chance of gaining content and pedagogical knowledge in science education.

Science education provides the foundational knowledge and critical thinking skills essential for the practice of physiotherapy, a profession deeply rooted in the principles of biology, physics, and chemistry. Physiotherapy relies on an understanding of human anatomy, biomechanics, neurophysiology, and exercise science, all of which are core components of science education. Through scientific inquiry and evidence-based practice, physiotherapists assess, diagnose, and treat movement disorders, applying principles of physics in modalities like ultrasound therapy and hydrotherapy, and integrating biological sciences to understand tissue healing and rehabilitation. As a result, science education plays a crucial role in shaping competent physiotherapists irrespective of gender, who can effectively apply scientific knowledge to promote health, prevent injury, and enhance physical function in diverse populations.

Gender is a socio-cultural construct developed by society to ascribe characters, and mental and emotional roles to sex. Ukala (2018) defined gender to simply mean the character or characteristics of being male or female, man or woman, boy or girl. Leghara (2021) see gender as a behavioural difference between male and female that are culturally based and socially learned. Due to a strong culture and religion affiliations in Nigeria, issues of gender have remained at the front burner of academic discussion (Nzewi, 2010).

Researchers such as; Ukala (2018); Ugwu and Nwagbo (2019) and Leghara (2021) agreed that gender discrimination stifles the growth and actualization of students' potential especially among women. In earlier study, Nwagbo and Ibekwe (2010) found that female students have poor achievement and low interest in Biology. Similarly, the finding of Okoro as cited in Leghara (2021) showed that males

show more interest in science than their female counterparts. In addition, Kang and Keinonen (2018) agreed with Nzewi (2010) that when both genders are subjected to the same teaching condition and environment, they tend to show more interest in sciences and have the same level of academic engagement and achievement. This suggests that adopting a strategy that could solve the problem of gender differences is all that matters to ensure equal academic achievement, engagement, and interest among students.

Given the diverse educational needs and learning styles of university students, especially year one biology education students, understanding the best strategy to meet their educational needs is crucial for educators to make informed decisions about integrating technology into their method of instructional delivery. To fill this gap in literature, the study examines relative effectiveness of Google Classroom and WhatsApp instructions on students' achievement in basic biology in universities. This is to provide empirical evidence on which platform better supports student learning and achievement and ultimately guide educators in selecting the most effective tools for enhancing educational outcomes among students in universities in south-east Nigeria. The researchers investigated the effectiveness of google classroom and WhatsApp instructional platforms on academic achievement of undergraduate biology students in Nigerian Universities. The following issues were addressed;

1. What are the mean achievement scores of undergraduate students taught basic Biology using Google Classroom instruction and those taught using WhatsApp instruction?
2. What is the influence of gender on mean achievement scores of undergraduate students?

Theoretical framework

Multimedia learning theory by Richard Mayer (1997)

The study was supported by Richard Mayer's theory of multimedia learning theory (MMLT) propounded in 1997. The theory states that students learn better when information is presented in two channels (that is visually and auditorily or images and words) rather than just through words or just graphics. Through visually channel, the instructions are represented in form of pictures, videos, charts, or printed words while through auditorily channel, the instruction is represented in form of spoken words in a narration and other non-verbal sounds. Supporting the theory, Khawlah and Mujo (2019) stated that the process of transferring knowledge from two channels (audio and visual) could be more successful when new information is linked with the existing knowledge. This is to help students actively process incoming information, while using their existing knowledge to fast-track the process. This theory is therefore related to the study in that both Google Classroom and WhatsApp instructions allow both lecturers and students to use both visual and audio channel in teaching and learning process to improve students' academic outcome.

Studies like Ercan (2014), Yue et al., (2013) and Chang et al., (2010) support multimedia learning theory. Chang et al., (2010) found that students taught with multimedia learned more successfully than the groups taught with traditional methods. Ercan (2014) found that multimedia has an important role for students' achievement. Yue et al., (2013, p.192) theorized "that by combining information from the two channels, the information is transferred from short-term to working memory to be processed in-depth with the help of prior knowledge, and that processing helps the information stay in the learners' long-term memory".

Hypotheses

The following null hypotheses guided the study and was tested at 0.05 level of significance;

1. There is no significant difference in the mean achievement scores of undergraduate students taught basic Biology using Google Classroom instruction and those taught using WhatsApp instruction.
2. There is no significant influence of gender on undergraduate students' mean achievement score in basic Biology
3. There is no significant interaction effect of instructional strategies and gender on students' achievement in basic Biology

MATERIALS AND METHODS

The study employed Quasi-experimental research design, specifically, non-randomized pretest, post-test comparison group design. A quasi-experimental design is considered appropriate for the study because random assignment of participants into experimental groups is not permitted (Nworgu, 2015). This implies that it allows for the use of intact classes to avoid the disruption of normal class periods and activities. The study was carried out in South-East, specifically, Federal Universities in South-East Nigeria. The area was considered appropriate for the study because due to huge commerce and several money-making opportunities, students show lack interest in learning and prefer activities that bring fast money instead of academic. Also, the consistent report of poor academic achievement and dwindling interest among undergraduate students in the area necessitate this study.

The population of the study comprised 252 (70 male and 182 female) first year undergraduate biology education students for 2023/2024 academic session in Federal Universities in South-East Nigeria offering basic Biology for education students. Purposive sampling techniques were used to sample 118 (36 male and 82 female) first year undergraduate biology education students from two out of the five Federal Universities in Southeast Nigeria. The criteria for purposively selecting the two federal universities for the study was because, they offer the course and they have the learning management system environments that permit online learning for both lecturers and students and also have other ICT resources such as; e-learning tools, free Wi-Fi, interactive whiteboards, standby generator plants, computer laboratories, overhead projectors and skilled personnel which is lacking in others.

The instrument for data collection is Basic Biology Achievement Test (BBAT). BBAT is a 30 items researchers developed using SED III past questions, WAEC (West African Examination Council) and NECO (National Examination Council) question papers, biology textbooks and reviewed literatures. BBAT was thoroughly validated by three experts after which only 27 items survived. It was then trial tested using a sample of 20 students and yielded a reliability coefficient value of 0.86 using Kuder-Richardson formula 20 ($KR\text{-}_{20}$). The choice of $KR\text{-}_{20}$ for BBAT was because the items were dichotomously scored and the value of 0.86 shows that the instrument is reliable.

Before the commencement of the experiment, four lecturers (two from each institution) were trained (Research assistants) for two weeks on how to teach basic biology concepts using Google Classroom and WhatsApp instructions. The two trained lecturers for each group, one taught while the other was there as back up in case of unforeseen circumstance. This is to ensure that there is no break during the treatment period for both groups. Measures were adopted to ensure extraneous variables were

properly controlled. The experiment was conducted during the normal school lesson periods and the regular class timetable were used.

Data generated from this study were analyzed using SPSS. The research questions were answered using mean and standard deviation, while hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significant.

RESULTS

Table 1 showed that students taught with Google Classroom instruction had a pre-test achievement mean score of 30.92 with standard deviation score of 15.19, and a post-test achievement mean score of 67.02 with standard deviation score of 7.60, while their counterpart taught using WhatsApp instruction had a pre-test achievement mean score of 30.91 with standard deviation score of 16.65, and a post-test achievement mean score of 63.13 with standard deviation score of 9.35. Mean gain scores of 36.1 and 32.22 were recorded for the two groups respectively, indicating that the students taught with Google Classroom instruction had higher score than their counterpart taught with WhatsApp instruction.

Table 1. Mean and Standard Deviation of achievement score of students taught with the platforms

Treatment	N	Pre-test		Post-test		Mean gain
		Mean	SD	Mean	SD	
Google Classroom instruction	76	30.92	15.19	67.02	7.60	36.1
WhatsApp instruction	36	30.91	16.65	63.13	9.35	32.22

The analysis in table 2 shows that the probability value associated with the calculated value of F (6.90) for the effect of Google Classroom and WhatsApp instructions on students' achievement mean scores is (0.02). Since the p-value (0.02) is less than (0.05) level of significance, the null hypothesis is therefore rejected. Implying that there was a significant difference in the mean achievement scores of year one undergraduate student taught basic Biology using Google Classroom instruction and those taught using WhatsApp instruction in favour of those taught using Google Classroom instruction.

Table 2: ANCOVA for significant difference in the mean achievement scores of students taught basic Biology using the platforms

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	949.685[a]	2	474.843	7.592	0.001
Intercept	77521.308	1	77521.308	1239.389	0.000
Pretest_Ach	580.518	1	580.518	9.281	0.003
Treatment_Group	369.042	1	369.042	5.900	0.017
Error	6817.735	109	62.548		
Total	492345.000	112			
Corrected Total	7767.420	111			

a. R Squared = .122 (Adjusted R Squared = .106)

Table 3 showed male students pretest achievement mean score of 35.11 with standard deviation score of 13.09, and a post-test achievement mean score of 67.82 with standard deviation score of 7.22, while their female counterpart had pretest achievement mean score of 29.01 with standard deviation score of 15.88, and a post-test achievement mean score of 64.84 with standard deviation score of 8.71. The mean gain

scores for male and female were 32.71 and 35.88 respectively. Indicating that female students had higher achievement than their male counterpart.

Table 3. Influence of gender on achievement score of students taught basic biology using Google Classroom instruction and those taught using WhatsApp instruction

Gender	N	Pre-test		Post-test		Mean gain
		Mean	SD	Mean	SD	
Male	35	35.11	13.09	67.82	7.22	32.71
Female	77	29.01	15.88	64.84	8.71	35.88

Table 4 shows that the probability value associated with the calculated value of F (1.65) for the influence of gender on year one undergraduate students' mean achievement scores is (0.20). Since the p-value (0.20) is greater than (0.05) level of significance, the null hypothesis is therefore not rejected. Thus, there is therefore no statistically significant influence of gender on year one undergraduate students' mean achievement scores in basic Biology for education students.

Table 4. ANCOVA for the influence of gender on year one undergraduate students' mean achievement scores in basic Biology

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	687.533[a]	2	343.766	5.293	0.006
Intercept	74453.725	1	74453.725	1146.269	0.000
Pretest_Ach	473.215	1	473.215	7.285	0.008
Gender	106.890	1	106.890	1.646	0.202
Error	7079.887	109	64.953		
Total	492345.000	112			
Corrected Total	7767.420	111			

a. R Squared = .089 (Adjusted R Squared = .072)

Table 5 shows that the probability value associated with the calculated value of F (0.15) for the interaction effect of teaching strategies and gender on year one undergraduate students' mean achievement scores is (0.69). Since the p-value (0.69) is greater than (0.05) level of significance, the null hypothesis is therefore not rejected. Thus, therefore was no statistically significant interaction effect of teaching strategies and gender on year one undergraduate students' mean achievement scores in basic Biology for education students.

Table 5. ANCOVA Interaction effect of instructional strategies and gender on students mean achievement score in basic Biology

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1098.021[a]	4	274.505	4.404	0.002
Intercept	69187.764	1	69187.764	1110.009	0.000
Pretest_Ach	469.984	1	469.984	7.540	0.007
Treatment_Group	396.798	1	396.798	6.366	0.013
Gender	101.424	1	101.424	1.627	0.205
Treatment_Group * Gender	9.513	1	9.513	0.153	0.697
Error	6669.398	107	62.331		
Total	492345.000	112			

Corrected Total	7767.420	111

a. R Squared = .141 (Adjusted R Squared = .109)

Figure 1 shows that there is no interaction effect of teaching strategies and gender on students' mean achievement scores in basic Biology for education students. This was revealed by the separate lines for the male and female students' achievement as seen in figure 1.

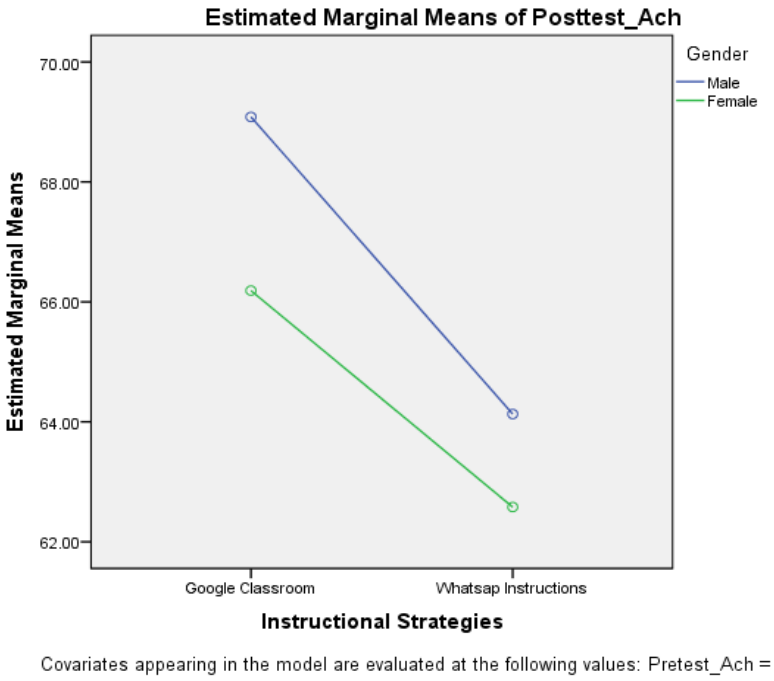

Figure 1. Interaction Effect of Instructional Strategies and Gender on Students Mean Achievement Score in Basic Biology

DISCUSSION

The findings revealed that year one undergraduate biology education students taught basic biology with Google Classroom instruction had higher achievement score than their counterpart taught with WhatsApp instruction. Similarly, on the test of significance the findings revealed further in Table 2 that there was a statistically significant difference in the mean achievement scores of students taught using Google Classroom instruction and those taught using WhatsApp instruction, in favour of Google Classroom instruction, in favour of Google Classroom instruction leading to the rejection of the null hypothesis. The superiority of Google Classroom instruction over WhatsApp instruction could be due to the innovative nature and novelty of the instruction strategy. This finding is in agreement with the findings of Sihombing and Ambarita (2022) who also found in their study that Google classroom was effective in improving undergraduate students' academic achievement. Similarly, Rilwan and Umoru (2021) and Omeh, *et al.* (2022) found that Google classroom enhance academic achievement of students in the treatment group better than control group. In another study, Ekpo-Eloma*, et al.* (2022) finding revealed that there was a significant difference in undergraduates students' scores in educational technology taught with the Google Classroom Application and those taught using expository method in

favour of those taught with Google Classroom. The finding of the study established thus: that Google Classroom is more effective than WhatsApp instructions.

The findings further revealed that year one undergraduate biology education female students taught basic biology with Google Classroom and WhatsApp instructions had higher mean achievement score than their male counterpart. The higher mean achievement score recorded by female students could be attributed to sampling error. As, Njoku (2019) theorize that Biology is a gender-neutral subject which student performance may not be link to their gender. Furthermore, the finding in Table 4 revealed that although female students achieved higher than their male counterpart but the difference was not statistically significant. The null hypothesis was therefore not rejected. This finding shows that both instructions are gender friendly and encourages active participation students. The finding is consistent with the findings of Rilwan and Umoru (2021), and Bataineh, Al-Hamad and Al-Jamal (2018) who also found in their studies that there was gender difference in students' performance in favour of females. However, in a contradictory finding, Manzano-Sánchez et al. (2020) and Murphy, Edulje et al., (2018) found that male students performed better than their female counterparts. The findings also agree with the finding of the study, Akanwa, *et al.* (2018), Agu and Samuel (2019), Rilwan and Umoru (2021) who found that there was no significant difference in the achievement of male and female biology students. However, the finding of the study disagrees with Ekpo-Eloma, *et al.* (2022) who found significant difference in academic achievement scores between male and female students taught using Google Classroom.

We found out that the interaction effect of instruction strategies (Google Classroom and WhatsApp instructions) and gender on students' mean achievement scores was not statistically significant. Therefore, the null hypothesis was not rejected. This it could be attributed to the fact that both strategies are innovative mode of instruction that was able to hold students' attention and active participation in the teaching and learning process. This finding is in agreement with Ugwu (2021) and Omeh et al. (2022) who found no significant interaction effect of teaching methods and gender on mean achievement score of undergraduate students. However, in a contradictory finding Onu, *et al.* (2020) and Ugwu (2024) found a statistically significant interaction effect of gender and instructional method on achievement. Based on these contradictory findings, the study recommended that gender sensitive instructional strategy or strategies (such as Google Classroom, CAI, animation and simulations) should be employed to bridge the gap in students' academic achievement.

CONCLUSION

Innovation in digital technologies have literarily influenced virtually every aspect of human endeavours including classroom instructional modes. The use of both Google Classroom and WhatsApp instruction improves students' academic achievement, but Google Classroom instruction is relatively more effective. Although slight differences seem to exist in the mean achievement scores between male and female in favour of female students. However, gender was found not to have a significant influence on students' mean achievement scores. No interaction effect of teaching strategies and gender on students' academic achievement in basic biology for education students when exposed to Google Classroom and WhatsApp instruction. The efficacy of Google Classroom instruction over WhatsApp instruction on students' academic achievement toward basic biology for education students irrespective of gender. Lecturers should therefore be encouraged to use Google Classroom instruction in instruction delivery since it has

been proven to enhance students' academic achievement irrespective of gender. Based on the findings of this study, the following recommendations were made:

1. Universities should consider adopting a structured teaching platform like Google Classroom for effective instruction delivery in their classroom.
2. Biology education lecturers should make use of Google Classroom as a strategy for instruction delivery in classroom, as it has been proven to be gender friendly in biology learning.
3. Sensitization workshops and seminars should be organized regularly by government through the Nigeria University Commission and Science Teachers' Association of Nigeria (STAN) to train science (Biology) lecturers on the development and utilization of Google Classroom instructional strategy.

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Conflict of Interest

The authors declare that they have no competing/conflict of interests

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Author's Contributions

We declare that the authors contributed actively from sourcing of materials, through brainstorming period to analysis and interpretation of result for the success of this study.

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