Effects of Peer-Dialogic Discourses on Science Students' Performance in Differential Calculus

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DOI: https://dx.doi.org/10.47772/IJRISS.2024.8120136

Received: 29 November 2024; Accepted: 04 December 2024; Published: 07 January 2025

ABSTRACT

Further Mathematics is essentially a subject, where solving problem is more prominent than reading. It was designed to provide means to worthwhile and challenging mathematical learning in a way that takes into accounts the necessity and aspirations of a wide range of learners. Science students' performance in Calculus has not been encouraging and has been concern to researchers. Factors that affect the performance of students include the fact that calculus involves abstract and complex ideas, inadequate understanding and interest on the part of students and teachers' inability to use innovative and differentiated instructions. Therefore, this study investigated the effects of peer-dialogic discourse on science students' performance in differential calculus. Specifically, the study investigatedt: (i) effects of the peer-dialogic and teacher- presentation discourses on students' performance in calculus; (ii) influence of gender on the performance of students when taught calculus using peer-dialogic discourse; (iii) influence of score levels on the performance of students when taught calculus using peer-dialogic discourse. This study adopted the pre-test post-test non-randomized non-equivalent control group design of the quasi-experimental research design. The pre-test post-test of 2x2x3 was used with experimental levels, that is discourse patterns, occurring at 2 levels (peer-dialogic and teacher-presentation discourses), gender at 2 levels (male and female) and the students' score levels also at 3 levels (high, medium and low scoring students). One hundred and thirty-one (131) science students that were selected from four purposively sampled schools participated in the study. The validated research instrument, Further Mathematics Performance Test on Calculus (FMPT-C) was used for the study. The reliability coefficient of the test was 0.87 and it was obtained using Pearson's Product-Moment Correlation. The research hypotheses were tested using the t-test and the Analysis of Co-variance .Findings from the study revealed that there is: (i) a significant difference in the performance of students taught using peer-dialogic and those taught using teacher-presentation discourse, $p< 0.05$, $t=8.77$ in favour of those taught peer-dialogic discourse; (ii) no significant difference in the performance of male and female science students when taught calculus using peer-dialogic and teacher-presentation discourses, (iii) no significant difference in the performance of high, medium and low scorers when taught using peer and peer-dialogic discourse but there is significant difference in the performance of high, medium and low scorers when taught using dialogic discourse, $p< 0.05$ $F_{(2, 58)}=7.40$ respectively. The study concluded that science students that were taught calculus using peer-dialogic discourses performed better than those taught using teacher-presentation discourse. This implies that the use of the various discourse patterns will go a long way in assisting teachers and students in the teaching and learning of calculus respectively. The study then recommended that teachers of further mathematics should adopt the use of peer-dialogic discourse in teaching calculus and all other concepts in further mathematics.

Keywords: Discourse, Peer-dialogic, Teacher-presentation, Differential calculus,

INTRODUCTION

Further Mathematics is an intermediate subject of study that bridged the gap between General Mathematics and Higher Mathematics. This encompasses all topics in General Mathematics and it is not standing alone as a course or subject at the tertiary level of Nigeria educational system but it is embedded in Mathematics courses. The focus of Further Mathematics curricula amongst other things include: helping the students to develop

conceptual and manipulative skills in Mathematics to prepare them for further studies in Mathematics and its applications (Amao & Bakare, 2020). A very crucial bonus for students taking Further Mathematics is that it usually improves their advance level Mathematics performance by reinforcing their core algebra and calculus skills. (Nina, Daron, Richard, Charlie & Peter; (2007))

Harris (2015) mentioned that Further Mathematics is designed to develop in students wider and extensive mathematical knowledge and skills acquired when studying general mathematics. In comparism with the general mathematics, it is an advanced mathematics being studied by learners who intends to study mathematics related courses at the tertiary level of education. Concepts in Further mathematics include Geometry and topology, Calculus and Analysis, Number theory, Trigonometry and Logic. Among all of these topics, Calculus has been recognized by learners as one of the most difficult concepts in Further Mathematics (Eng, Li & Julaihi, 2013; Craig, 2014; Mokhtar, Tarmizi, Tarmizi & Ayub, 2010). Calculus, branch of mathematics concerned with the calculation of instantaneous rates of change (differential calculus) and the summation of infinitely many small factors to determine some whole (integral calculus) (Berggren, 2024). Calculus is concerned with two basic operations, differentiation and integration, and is a tool used by engineers to determine such quantities as rates of change and areas; in fact, calculus is the mathematical 'backbone' for dealing with problems where variables change with time or some other reference variable and a basic understanding of calculus is essential for further study and the development of confidence in solving practical engineering problems (Fox & Bolton, 2002). Calculus is a crucial tool that is used in various fields of science, engineering, economics, and other disciplines. Its applications are vast and essential in our daily lives, from designing buildings, predicting weather patterns, to understanding the spread of diseases (Kishore, 2023). Despite the importance of Calculus, and all the efforts by previous researchers, students still perceived it difficult, and this subsequently affects their performance when solving problems involving calculus. Several researches have been carried out to find a lasting solution to this problem, but still, students' performance has still not improved. Students seem to be less interested and do not enjoy learning differential calculus because it has been perceived as a tedious and boring concept. When students do not enjoy learning, they are more likely to show disinterest and will not work toward achievement, and eventually perform poorly and drop out of class. Students perform poorly due to lack of motivation, and it can lead to more serious problems in the future if this problem is not properly and adequately sorted out (Ryan, 1995). Teaching, a process of enabling pupils to acquire knowledge and skills, is an interactive process that involves the teacher, student and the environment which help in promoting learning through classroom activities (Aggarwal, 2002). Some classroom teaching/learning activities include: demonstration, questioning, experiments, reinforcement, reactions to teacher's teaching (Udeani, 1992). These classroom activities span through much of the activities of teacher-student interactions that involve various discourses. Student discourse, or the act of students engaging in discussions and conversations with their peers and teachers, is a crucial aspect of the learning process. When students are actively participating in discussions and sharing their thoughts and ideas, they are able to deepen their understanding of the subject matter and develop important critical thinking and communication skills (Rogers, 2022). There are many types of discourse, which peer and dialogic discourses are one of them. The Peer Discourse Pattern enables students talk with their peers (classmates).This discourse pattern involves the participation of every member of the group. The teacher, after teaching, divided the students into 4 or 5 students per group, each group with a peer leader, who was trained by the teacher to lead the group. The students discussed assignments given to them by their teacher in groups while the teacher coordinated them. The peer- dialogic discourse pattern involves exchange of ideas since students are given the opportunity to freely express their views or opinions on a given problem (Aggrawal, 2002). This discourse pattern is democratic in nature since it involves free dialogue. Peer- dialogic discourse is open to different perspectives, allowing the participants to become aware of any differences in points of view. Peer- dialogic discourse always gives room for the acknowledgement and understanding of other people's perspective. Through peer-dialogic discourse, the teacher attends to the students' points of view as well as to the school science view (Mortimer, 2005). In using peer- dialogic discourse pattern, the teacher teaches the topic to the students in order to prepare their thought prior to the classroom discussion. After which the students will be divided into groups for classroom discussion. The learners will go further to research and study extensively on areas to be discussed and they all return for the classroom discussion.

Peer-dialogic discourse is the combination of the peer discourse and the dialogic discourse. When using the

peer-dialogic discourse, the teacher teaches the topic to the students and initiates discussion in each group. The teacher accepts feelings, gives reinforcement such as praises and encouragement to good contributions. After which the teacher, divides the students into 4 or 5 students per group, each group with a peer leader, who is trained by the teacher to lead the group. The students discuss assignments given to them by their teacher in groups while the teacher coordinates them. Teacher-presentation Discourse is characterized by a straightforward instruction, a mini-lecture, with little or no student participation. This talk pattern is associated to the lecture method of teaching as both of them share similar characteristics. The pattern being teacher-centred or teacher-dominated involves verbal presentation of facts and principles to students. This discourse was used for the control group in this study.

METHODS

The target population for the study comprised all the students in Senior School II in offering Further Mathematics as a subject. The sample comprised science school II students from two (2) schools that were purposively selected. They were purposively selected because only few schools offer Further Mathematics as a subject due to insufficient supply of further mathematics teacher. Further mathematics is an optional subject; therefore, a few numbers of students offer and register for the subject probably because they believe that it is more abstract and difficult than General Mathematics (Amao & Bakare, 2020). The senior school II students were considered appropriate because they have not been taught differential calculus and at the same time were expected to have learnt some aspect of calculus which served as their entry behaviour for the teaching of differential calculus. Two (2) intact classes were involved in the study. The schools included one (1) experimental group and one (1) control group. The two groups were labelled group A and B. Students in group A were exposed to peer-dialogic discourse; Students in group B were exposed to teacher-presentation discourse. In order to ensure that the schools selected are equivalent the researcher selected schools that are co-educational and also the Further-mathematics teachers holds at least B. (Ed.) or B.Sc. with PGDE and have at least five (5) years teaching experience. Eighty-four (84) students in School A (peer-dialogic discourse group) participated in the study and their further mathematics teacher holds B.Sc. (Ed.) Mathematics and has been teaching for the past 20 years. Meanwhile, forty-seven (47) students in school B (teacher-presentation group) participated in the study and their further mathematics teacher holds B.Sc. (Ed) Mathematics and has been teaching for the past 12 years. Schools were sampled into group using simple random sampling technique, that is, the researcher asked the teachers to pick ballot. The discourse pattern each of the teachers picked from the ballot is what their students were exposed to. The students in each group were later categorized on the basis of score levels after been exposed to pre-test. The Further Mathematics Performance Test on Differential Calculus (FMPT-DC) was used for this study. The test consisted of two (2) sections. Section I provided information (Age, Name of school, Sex) about the respondents while section II consisted four essay item tests which were constructed by the researcher. Each item was awarded five (5) marks making a total of 20 marks. The Table of Specification for the preparation of the test items covering areas of Knowledge, Comprehension and Application was drawn. The scores obtained were analysed according to the research hypotheses stated. The discrimination index and difficulty index of each item test were obtained and the lesson plans for the two instructional discourses were drawn. The researcher personally trained the Further Mathematics teachers from school A on how to carry out the instruction using peer-dialogic discourses respectively. For the validation of FMPT-DC which was constructed by the researcher, the researcher submitted the essay item test to be subjected for check and scrutiny to two (2) lecturers of Mathematics and two (2) lecturers of Mathematics education. For reliability of the test items, the researcher adopted the test-retest reliability method. The test was administered to two (2) co-educational public schools that did not participate in the research. The same test was re-administered to the same group of students after a period of two (2) weeks. The coefficient of the two (2) sets of scores was 0.87 which was obtained using Pearson's Product-Moment Correlation. The researcher gave consent forms to school authorities, teachers and parents of the students to seek their consent to participate in the research. In conformity with the ethics of research, the respondents were allowed to participate voluntarily and they were taught at the exact periods for further mathematics to avoid disrupting other lesson periods. The identities of the respondents, research assistants and that of the schools that participated were not disclosed at any point in this research. Also, all related data were handled with utmost confidentiality and were used exclusively for the purpose of the research. The respondents, teachers and sampled schools were not exposed to any risk during and after the

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue XII December 2024

research. Meanwhile, analyses of all the results were carried out using SPSS version 20.

Research questions

1. Is there any difference in the performance of students when taught differential calculus using peer-dialogic and teacher-presentation discourse (conventional method)?

2. What is the difference in the performance of male and female science students when taught differential calculus using peer-dialogic discourse?

3. What is the difference in the performance of male and female science students when taught differential calculus using teacher-presentation (conventional method)?

4. Is there any difference in the performance of high, medium and low scorers when taught differential calculus using peer-dialogic discourse?

5. Is there any interaction effect among peer-dialogic discourse and gender on the performance of students in differential calculus?

Research hypotheses

Ho_1: There will be no significant difference in the performance of science students when taught differential calculus using peer-dialogic discourse and teacher-presentation discourse (conventional method).

Ho_2: There will be no significant difference in the performance of male and female science students when taught differential calculus using peer-dialogic discourse.

Ho_3: There will be no significant difference in the performance of male and female students when taught differential calculus using discourse teacher presentation (conventional method).

Ho_4: There will be no significant difference in the performance of high, medium and low scorers when taught differential calculus using peer-dialogic discourse.

Ho_5: There will be no significant interaction effect between peer-dialogic discourse and students' gender on the performance of students in differential calculus.

Hypothesis testing

Demographic information of the independent variable (i.e. peer-dialogic and teacher-presentation discourses) and the intervening variables (i.e. gender and score levels) were presented in this table.

Table 1: Descriptive statistics of Students Sampled Based on Gender (N=131)

Groups	Gender	Frequency	Sub-total
Experimental Group A (*Peer-dialogic discourse Group*)	Male	52 (39.69%)	84 (64.12%)
	Female	32(24.43%)	
Control Group (*teacher-presentation group*)	Male	28 (21.37%)	47(35.88%)
	Female	19 (14.50%)	
Total			131(100%)

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As shown on Table 1, a total of 131 (100%) students were sampled for the study, out of which 84(64.12%) of the respondents formed the experimental group A (peer-dialogic group) and 47(35.88%) remaining formed the control group. Also, experimental group A consists of 52(39.69%) males and 32(24.43%) females. Furthermore, in the control group, there were 28(21.37%) males and 19(14.50%) females.

Table 2: Descriptive statistics of Students Based on Score Levels (N=131)

Groups	Score Level	Frequency	Percentage	Sub-total
Experimental Group A (peer-dialogic discourse group)	Low	16	19.05%	
	Medium	42	50.0%	
	High	26	31.0%	84(64.12%)
Control Group B (teacher-presentation group)	Low	13	27.66%	
	Medium	24	51.06%	
	High	10	21.28%	47(35.88%)
Total				131(100%)

Table 2 above shows out of the 84 (100%) students that formed the experimental group A, 16 (19.05%) of them were low scorers; 42 (50.0%) were medium scorers while 26 (30.95%) were high scorers. Furthermore, 47 (35.88%) students formed the control group B, out of which 13 (27.66%) were low scorers; 24 (51.06%) of them were medium scorers while 10 (21.28%) were high scorers.

Research Question 1: Is there any difference in the performance of students when taught differential calculus using peer-dialogic and teacher-presentation discourse (conventional method)?

Table 3: Descriptive analysis of t-test Showing the Performance of Students in Group A and B

Groups	N	Mean	S.D	t	Df	Sig. Level	Remark
A	84	13.11	3.540	8.769	46	0.000	Significant
B	47	6.04	4.070				

Table 3 shows the mean gain score of 84 respondents exposed to peer-dialogic discourse and that of the 47 respondents exposed to teacher-presentation discourse (conventional method). The table revealed a mean gain score of 13.11 for the respondent in group A against a mean gain score of 6.04. Also the group exposed to peer-dialogic discourse and teacher-presentation had a standard deviation of 3.54 and 4.07 respectively. This shows that the score of each student in the groups is close to the average score since the groups had a low standard deviation. Therefore, this illustrates that students exposed to peer-dialogic discourse performed better than students exposed to the teacher-presentation discourse (conventional method).

Ho_1: There is no significant difference in the performance of students when taught differential calculus using peer-dialogic discourse and teacher presentation discourse (conventional method).

In order to test if there exist statistically significant difference in the performance of students that were exposed to peer-dialogic discourse and those that were exposed to teacher-presentation discourse (conventional method), their score were analyzed using t-test. Table 3 reveals that the t-value= 8.77 is obtained with a p-value of 0.00 computed at 46 degree of freedom and 0.05 alpha level. Since p-value (0.00) is less than alpha

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level (0.05), the null hypothesis is rejected. Therefore, there is significant difference in the performance of students taught calculus using peer-dialogic discourse and teacher-presentation discourse (conventional method). The result favours peer-dialogic discourse group as reflected in their higher mean score.

Research Question 2: What is the difference in the performance of male and female science students when taught differential calculus using peer-dialogic discourse?

Table 4: Descriptive analysis of t-test showing the Performance of Male and Female Students in Group A

Gender	N	Mean	S.D	t	df	Sig. Level	Remark
Male	52	14.12	3.949	1.093	82	0.277	Not significant
Female	32	13.13	4.164				

The descriptive statistics of student performance in peer-dialogic group as shown on table 4 reveals the number 52 male and 32 female and their mean gain scores. The male respondents had a mean gain score of 14.12 while female respondent had a mean gain score of 13.13. The mean score of male students which is 14.12 is greater than the mean score of the female students of 13.13. Also, the male and female had a standard deviation of 3.95 and 4.16 respectively. This implies each of their score is very close to the mean since they had a low standard deviation. This means that male students performed better than the female students.

Ho_2: There will be no significant difference in the performance of male and female students when taught differential calculus using peer-dialogic discourse.

To determine if there exist significant difference in the performance of male and female students that were exposed to peer-dialogic discourse, their scores were analyzed using the t-test analysis. The table 4 shows that the t-value (1.093) is obtained with a p-value of 0.277 computed at 0.05 alpha level. Since p-value (0.277) is greater than alpha level (0.05), the null hypothesis is not rejected. Therefore, there is no significant difference in the performance of male and female students when taught calculus using peer-dialogic discourse.

Research Question 3: What is the difference in the performance of male and female science students when taught differential calculus using teacher-presentation (conventional method)?

Table 5: Descriptive analysis of t-test Showing the Performance of Male and Female Students in Group B

Gender	N	Mean	S.D	t	Df	Sig Level	Remark
Male	28	5.54	3.920	-1.037	45	0.305	Not significant
Female	19	6.79	4.276				

Table 5 reveals that 28 male respondents with a mean gain score of 5.54 and 19 female respondents with a mean gain score of 6.79 were exposed to teacher-presentation discourse (conventional method). The average mean score of male respondent is greater than the average mean gain score of female respondent. Also, the male and female had a standard deviation of 3.92 and 4.28 respectively. This implies each of their score is very close to the mean since they had a low standard deviation. Therefore male respondent performed better than the female respondents.

Ho_3: There will be no significant difference in the performance of male and female students when taught differential calculus using teacher presentation discourse (conventional method).

To determine if there exist significant difference in the performance of male and female students that were exposed to teacher-presentation discourse, their scores were analyzed using the t-test analysis. Table 5 above

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reveals a higher mean gain score (6.79) of 19 female students against the mean gain score (5.54) of 28 male students that were exposed to teacher-presentation discourse (conventional method). The table also shows that the t-value (-1.037) is obtained with a p-value of (0.305) computed at 45 degree of freedom and 0.05 alpha level. Since p-value (0.305) is greater than alpha level (0.05), the null hypothesis is not rejected. Therefore, there is no significant difference in the performance of male and female students when taught calculus using teacher-presentation discourse (conventional method).

Research Question 4: Is there any difference in the performance of high, medium and low scorers when taught differential calculus using peer dialogic discourse?

Table 6: Descriptive statistics of Mean Gain Scores of Students in the Different Score Levels in Group A

Score Levels C	N	Mean	Std. Deviation
1	16	15.44	3.425
2	42	13.55	3.927
3	26	13.00	4.391
Total	84	13.74	4.036

Table 6 reveals the descriptive analysis of the respondents. I6 high scorers with mean of 15.44, 42 medium scorers with the mean score of 13.55 and 26 low scorers with mean score of 13.00 were exposed to peer-dialogic discourse. From the description, it is obvious that high scorers performed best, followed by the medium scorers and then the low scorers.

Ho_4: There will be no significant difference in the performance of high, medium and low scorers when taught differential calculus using peer dialogic discourse.

Table 7: ANCOVA Showing the Performance of High, Medium and Low Scorers in Group A.

Source	Type III Sum of Squares	df	Mean Square	F	Sig
Corrected Model	71.195a	3	23.732	1.482	0.226
Intercept	828.765	1	828.765	51.756	0.000
Pretest A	9.299	1	9.299	0.581	0.448
Score Level A	38.507	2	19.254	1.202	0.306
Error	1281.043	80	16.013		
Total	17206.000	84			
Corrected Total	1352.238	83			

R Squared = 0.053 (Adjusted R Squared = 0.017), P>0.05

To test if there exist a significant difference, the scores of respondents in the three score levels were subjected to Analysis of Covariance. As shown on table 7, the F-value (1.202) is obtained with a p-value of 0.306 computed at 0.05 alpha level. Since p-value is greater than the alpha level (0.05), the null hypothesis is not rejected. Therefore, there is no significant difference between the performance of high, medium and low scorers when taught differential calculus using peer-dialogic discourse.

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Research Question 5: Is there any interaction effect among peer-dialogic discourse and gender on the performance of students in differential calculus?

Table 8: Descriptive statistics of Mean Gain Scores of Male and Female Students in Group A

Gender A	N	Mean	Std. Deviation
Male	52	14.12	3.949
Female	32	13.12	4.164
Total	84	13.74	4.036

Table 8 shows that each of the 52 male respondents with an average mean score of 14.12 and each of the 32 female respondents with an average mean score of 13.12 were exposed to peer-dialogic discourse. The average mean score of each of the male respondents is greater than the average mean score of each of the female respondent. This indicates that the male respondent performed better than the female respondent.

Ho_5: There will be no significant interaction effect between peer-dialogic discourse and students' gender on the performance of students in differential calculus.

Table 9: ANCOVA of the Interaction Effect between Peer-dialogic Discourse and Gender

Source	Type III Sum of Squares	df	Mean Squares	F	Sig
Corrected Model	46.916a	2	23.458	1.456	0.239
Intercept	3922.526	1	3922.526	243.407	0.000
Pre-test A	27.485	1	27.485	1.706	0.195
GenderA	14.228	1	14.228	0.883	0.350
Error	1305.322	81	16.115		
Total	17206.000	84			
Corrected Total	1352.238	83			

R Squared = 0.350 (Adjusted R Squared = 0.11), P>0.05

To test for significant interaction between male and female students exposed to peer-dialogic discourse, Analysis of Covariance was used and the result is presented on table 9. As shown on the table, the F-value (0.883) is obtained with a p-value of (0.350) computed at 0.05 alpha level. Since p-value is greater than the alpha level (0.05), the null hypothesis is not rejected. Therefore, there is no significant interaction effect between peer-dialogic discourse and students' gender on the performance of students in differential calculus.

SUMMARY OF MAJOR FINDINGS

1. Students taught using peer-dialogic discourse pattern performed significantly better than those taught using teacher-presentation discourse.

2. There was no significant difference in the performance of male and female students taught differential calculus using peer-dialogic discourse.

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3. There was no significant difference in the performance of male and female students taught differential calculus using teacher-presentation discourse.

4. There was no significant difference in the performance of high, medium and low scorers taught differential calculus using peer-dialogic discourse.

5. There was no significant interaction effect between peer-dialogic discourse and gender on the performance of students in differential discourse.

CONCLUSIONS

This study was conducted in order to find lasting solutions to the problems faced by students in learning differential calculus. From previous studies, it was reported that students perform poorly when solving problems in differential calculus. Science school II students participated in the study to find out if using the discourse patterns to teach will encourage and motivate them to learn differential calculus and also enhance their learning outcomes. The result revealed that peer-dialogic discourse enhanced students' performance better than the teacher-presentation discourse. This outcome is in agreement with the researcher's assumption that peer-dialogic discourse will give the best result out of the three discourse patterns. The results obtained from the study also revealed that peer-dialogic discourse patterns improve the performance of students in solving differential calculus problems than the teacher-presentation discourse used for the control group. It is obvious that the control group recorded the least mean gain score when compared to the treatment groups. Therefore, this implies that for students to learn meaningfully in the classroom, there is need for teachers to use appropriate and adequate instructional strategies that involve discourse patterns for teaching in the classroom. The outcome of the study also indicated that gender has no influence on the performance of students when taught using the discourse patterns. Although the descriptive statistics showed differences in the performance of male and female students but the differences are not significant. This implies that gender is not a barrier in the performance of students in differential calculus if they are taught using peer-dialogic discourse patterns. Furthermore, the outcome of the study showed that score levels does not influence the performance of students in differential calculus. The discourse patterns are very helpful to the different level of scorers involved. Although, all the different scorers benefitted in the peer-dialogic discourse group but high scorers performed significantly better than the medium and low scorers. This result indicates that score level is not also a barrier as far as performance in differential calculus is concerned with discourse patterns.

Recommendation were made that, further mathematics teachers should use peer-dialogic discourse in teaching differential calculus to students in the classroom. An extra period will be needed when using peer-dialogic discourse for adequate interaction so as to give excellent result. The discourse pattern may be used to teach students irrespective of their gender. The discourse pattern is gender-friendly, so it is appropriate for both genders.Teachers of further mathematics should often encourage classroom discussion among students as this will help in achieving meaningful learning outcome. In order for teachers to be able to adequately explore the use of discourse patterns in the classroom, there is need to increase the 2-period duration of teaching further mathematics in a week. The teachers will need up to at least three periods to teach all the sub-topic of differential calculus adequately using the discourse pattern.

Suggestions for Further Studies

Based on the findings from this study, suggestions were made that further researches should be carried out in the following areas.

1. Studies to find out the effects of peer-dialogic discourses on other topics like integral calculus could be conducted.

2. Studies to compare the effects of peer-dialogic discourse to other discourses like teacher-guided discourse could be carried out

3. Mixed research could be conducted to include students' or teachers' factors like their attitude and

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue XII December 2024

social-economic background.

4. Researches could be conducted to find out the effects of the discourse pattern on the performance of tertiary institution students in differential calculus or other difficult concepts.

5. Retention level of students may be added to their performance as another dependent variable to determine the effects of the discourse patterns on the students' retenti**on.**

REFERENCES

1. Amao D.O & Bakare A.B (2020) Influence of Gender on Senior School Students' Belief about the Nature of Further Mathematics in North Central, Nigeria Kwara State College of Education Journal for Professional Teachers (Kwacoed - Joproteach), 2 (1) 98-110, May 2020.
2. Aggarwal, J. C. (2002). Essentials of educational technology: Teaching-learning Innovations in Education. Delhi: Vikas Publishing House PVT Ltd.
3. Berggren, John L.(2024). "Calculus" *Encyclopedia Britannica*, 20 Feb. 2024, https://www.britannica.com/science/calculus-mathematics. Accessed 25 May 2024
4. Craig, T. S. (2014). Factors affecting students' perception of difficulty in calculus word problems. (An Unpublished Masters' dissertation), Department of Mathematics and Applied Mathematics, University of Cape Town, Rondebosch, Cape Town.
5. Eng, T. H., Li, V. L., & Julaihi, N. H. (2013). Lecturers' perceptions, students' problems and solutions for handling high-failure rate mathematics courses. Social and Behavioural Science, 90(2013), 853-861.
6. Fox, H., & Bolton, B. (2002). Mathematics for engineers and technologists. IIE Core Textbooks Series. https://doi.org/10.1016/B978-075065544-6/50005-9
7. Harris, A. (2015). Further mathematics (6360): AQA realising potentials. Retrieved from http://www.aqa.org.uk/subjects/mathematics/as-and-alevel/further mathematics-6360.
8. Kishore, S. (2023). Calculus in everyday life. Retrieved online on 25th May 2023 from https://www.linkedin.com/pulse/calculus-everyday-life-shila-kishore/
9. Mokhtar, M. Z., Tarmizi, M. A., Tarmizi, R. A., & Ayub, A. M. (2010) Problem-based learning in calculus courses: Perception, engagement and performance. Engineering Education (Pp. 21-26)
10. Mortimer, F. E. (2005). Dialogic and authoritative discourse: A constitutive tension of science classroom. Retrieved from http://icar.univ- lyon2.fr/ecole-thematique/analyse-video/documents/Dialogic-and-authoritative-discourse
11. Nina, S; Daron, O; Richard, P; Charlie, S; & Peter, H.(2007). Attracting the best students of Mathematics into Engineering Report of the MEI/IET Joint Conference at Savoy place London
12. Rogers, G. (2022). The Importance of student discourse in the classroom. Grant Wood AreaEducation Agency. Retrieved online on 25th May 2024 from https://www.gwaea.org/2022/12/19/the-importance-of-student-discourse-in-the classroom/#:~:text=Student%20discourse%2C%20or%20the%20act, aspect%20of%20the%20learning%20process.
13. Ryan, R. M. (1995). Psychological needs and the facilitation of integrative processes. Journal of Personality, 63(3), 397-427.
14. Udeani, U. N. (1992). Learning outcomes in integrated science as related to teacher and student characteristics and classroom interaction pattern (Unpublished Ph.D. thesis), University of Nigeria, Nsukka.