Contextual Teaching and Learning Approach in Mathematics for Stem Students on Blended Learning Modality

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DOI: https://dx.doi.org/10.47772/IJRISS.2025.903SEDU0553

Received: 12 September 2025; Accepted: 18 September 2025; Published: 17 October 2025

ABSTRACT

The sudden shift to online and blended learning during the COVID-19 pandemic posed serious challenges for students, particularly in Mathematics—a subject that many already struggle with. Although several strategies have been introduced to improve performance, there's still limited research on how well the Contextual Teaching and Learning (CTL) approach works in blended settings. This study focused how CTL affects students' achievement in Basic Calculus among Grade 11 STEM students. A quasi-experimental design was used, involving 71 students from a private school in Cebu City. They were divided into two groups: 37 students were taught using conventional methods, while 34 received instruction through the CTL approach. After the intervention, a focus group discussion with the experimental group provided insights based on their experiences. Results showed that students taught with CTL had a much higher mean gain (10.176) compared to the control group (1.891), with a significant difference of 8.28 ($p = 0.011$). Despite this success, some challenges were noted—mainly poor internet access, which affected the delivery. To help address this, the researcher proposed an instructional design to support CTL in Mathematics classes. Overall, the findings suggest that CTL can be a helpful strategy for improving learning outcomes in STEM, especially in blended learning environments.

Keywords: CTL approach, blended learning modality, conventional lecture method, Basic Calculus

INTRODUCTION

Rationale

Many occupations, particularly science, technology, and engineering, rely heavily on Mathematics. However, because Mathematics is typically regarded as difficult, many students are discouraged by Science, Technology, Engineering, and Mathematics (STEM) courses, decreasing opportunities to employment in STEM (Li & Schoenfeld, 2019). This implies that learners' mastery of Mathematics' concepts at a young age might help them to thrive in today's technologically dependent economy.

According to de Vera (2021), the Philippines' education system especially in the field of Science and Mathematics, the country ranked second to the last of 79 countries. Wherein the country's students show dismal ranking in terms of literacy and proficiency in the subject compared to international learners.

Unfortunately, due to COVID-19 pandemic, the face-to-face physical classroom set-up of learning has been stopped to curtail the rise of infection. Consequently, blended learning was adapted to continue learning in a

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume IX Issue IIIS September 2025 | Special Issue on Education

remote manner. The term "blended learning" (BL) refers to the technique of combining online and in-person learning activities or the interfusing of both in-person and online instruction (Graham, 2013, as cited in Dziuban et al., 2018). However, one of the challenges of BL modality is that low performance may arise due to a lack of direct instructor monitoring. Moreover, the learners' different levels of ability to absorb and digest the lessons being provided to them might also lead to poor attainment of outcomes (Uy, 2020). These situations may exacerbate the already deteriorating quality of education of the country.

This study examined how well students could master mathematical concepts when taught and learned using a Contextual Teaching and Learning (CTL) approach. STEM Students from a private university in Cebu were observed to be less responsive and perform poorly when taught pure mathematics concepts, but when concepts and problems were connected to real-world practices and grounded in real-world realities, they performed well and produced exceptional outputs and performances. Unfortunately, there was a dearth of studies exploring the effectiveness of using CTL to improve students' Mathematics performance in a blended learning modality. Thus, this gap urged the researcher to study further. The researcher would comprehend the depth of students' proficiency of the subject and by then, the researcher would make relevant proposals to recommend on the use of this approach to Mathematics teachers as well as the tools and other materials that could aid the orchestration of the approach.

The Problem

Statement of the Problem

The study aimed to determine the effectiveness of the CTL in enhancing the academic performance in Mathematics-Basic Calculus of the Senior High School (SHS) Grade 11 STEM students in a blended learning modality. Specifically, it sought to answer the following questions:

1. What is the pretest Mathematics performance of the students in the:

1.1 control group (conventional lecture method) and

1.2 experimental group (with CTL)?

2. What is the posttest Mathematics performance of the students in the:

2.1 control group and

2.2 experimental group?

3. Is there a significant mean gain from the pretest to the posttest Mathematics performance of the students in the:z

3.1 control group and

3.2 experimental group?

4. Is there a significant difference in the mean gains in Mathematics academic performance between control and experimental group?

5. What are the feedbacks of the experimental group students towards CTL approach in learning Basic Calculus?

6. What instructional material can be developed from contextual teaching and learning approach in secondary schools as an integrated module for STEM students?

Statement of the Hypotheses

This study is action research on the use of Contextual Teaching and Learning approach as an intervention in Basic Calculus among grade 11 STEM students.

To answer the problem in the study, these are the null hypotheses:

H_{01}: There is no significant difference between the hypothetical and actual mean in the pretest and posttest performance in Mathematics of the students in the:

1.1 control group (exposed to CLM), and

1.2 experimental group (exposed to CTL).

H_{02}: There is no significant mean improvement from the pretest to the posttest performance in Mathematics of the students in the:

2.1 control group, and

2.2 experimental group.

H_{03}: There is no significant difference in the mean gains in Mathematics academic performance between control and experimental group.

Theoretical Background

Related Theories

The Direct Instruction Theory, developed by Engelmann, emphasizes that students learn best through clear, structured, and teacher-led instruction. Unlike more exploratory or student-driven methods, it promotes focused lessons with defined objectives and short, sequenced learning tasks (Engelmann, 1982).

In contrast, the Contextual Teaching and Learning (CTL) approach is grounded in Constructivist Theory, which views learning as an active process where individuals build knowledge through experience. Rooted in Piaget’s early work, constructivism highlights that learning is shaped by how students interpret and internalize information rather than passively receive it (Piaget, 1955; Xu & Shi, 2018). While not a teaching method itself, constructivism provides the theoretical basis for approaches like CTL, guiding how learners engage with and make meaning from content.

CTL was based on the constructivism idea, the origins of which may be traced back to Socrates' dialogues with his disciples, in which he asked pointed questions that encouraged his students to recognize the flaws in their thinking (Educational Broadcasting Corporation, 2004). Plato's Laws (approximately 1500) and Xenophone's Hiero (about 400 BC) are the oldest writings to contain Socrates' dialogues (Schofield, n.d; Bickers & Widger, 2008). Constructivist educators continue to utilize the Socratic discussion while assessing student learning and planning new learning opportunities. The Contextual Teaching and Learning method were based on the theory of Constructivists. It was based on the idea that individuals learn by following a series of steps. In 1955, Jean Piaget set the foundation for this idea. To understand constructivism, one must know that it is not a teaching method in and of itself.

When implementing a contextual teaching and learning strategy, there were seven components that can be used to develop a successful teaching and learning process (Selvianiresa and Prabawanto, 2017). First, Constructivism is a way of thinking about teaching and learning that was based on the context. The second component is the process of questioning. Teaching and learning strategies that were based on a contextual approach include questioning as the primary strategy. Third, when using a contextual teaching and learning approach, all teaching and learning activities revolve on inquiry. Students' knowledge and abilities are the consequence of more than just remembering a collection of facts, but they are also the result of their own exploration and discovery. Fourth, the term "learning community" refers to the outcome of teaching and learning that has been achieved through collaboration with others. Fifth, Student-imitated modeling is more effective in teaching a skill and acquiring specific knowledge than traditional modeling. The model provided an excellent opportunity for the teacher to demonstrate how something works before the students were required to complete the task. Sixth, reflection is a method of thinking on what you've just learned about, as well as thinking back on what we have done in the past when studying that subject matter. The seventh step is to conduct an authentic assessment. The assessment process was the collection of data that may be used to evaluate a student's academic progress.

RELATED LITERATURE

Contextualized Teaching and Learning, according to Johnson's book (2011), is a method of teaching and learning that aims to increase students' learning productivity. It was based on the belief that it will encourage professors and students alike to connect academic concepts to real-world contexts.

Contextual teaching and learning (CTL) have been shown to improve students' motivation and academic performance in the classroom (Laili, 2016). CTL also assists students in developing their critical thinking abilities (Tari & Rosana, 2019).

Students were encouraged to apply what they've learned in the classroom to their everyday lives by using a contextual approach to teaching. (Nurhadi et. al., 2009). He claims that Contextual Teaching and Learning (CTL) is educating and instructing in a real-world context. (Khotimah, 2014) The use of real-world problems or difficulties that students are likely to encounter on a daily basis as learning materials is a growing trend in education.

Related Studies

The CTL approach helps kids discover the purpose of learning by connecting what they've learned to real-world situations. This helps them retain the information they've learned for the rest of their lives. Rather than focusing on memorization, the CTL strategy aims to increase students' desire to put their newly acquired knowledge into practice by connecting it to their everyday activities and interactions (Ilhan et al., 2016). While students can discover contextual learning is a mechanism that stimulates the brain to develop patterns that embody meaning when they study and remember what they have learned (Johnson, 2014). Consequently, it is hoped that students will learn and retain what they have learned if they are able to discover meaning in their lectures. This will allow them to meet their learning objectives and achieve positive learning outcomes.

Previous research using geoboard media in the CTL technique has been deemed successful. When compared to tangram, learning with Geoboard may improve students' learning achievement (Lastrijanah, 2017). (Masitoh, 2018) stated that the Geoboard produced increases pupils' conceptual knowledge of circumference and area. Further, The CTL is more efficient than the old way of teaching because it adheres to the properties of mathematics, making it easier for pupils to understand topics (Kistian, 2018).

According to the findings of Mauliana et al. (2018), on the rectangular subject, CTL learning strategies may be utilized to create mathematical relationships between them. In addition to rectangular topics, researchers can assist students in making connections between statistical material and real-world situations.

Contextual teaching and learning can help to improve students' mathematical connection skills and abilities. Teaching and learning in context (CTL) is a method of engaging students that are engaged in their learning and experiences, encouraging students to study on their own, developing their mathematical skills, and imparting the sense that mathematics can be used and valuable in everyday life (Selvianiresa and Prabawanto, 2017).

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume IX Issue IIIS September 2025 | Special Issue on Education

Theoretical and Conceptual Framework

Figure 1 Theoretical-Conceptual Framework of the Study in Schematic Diagram

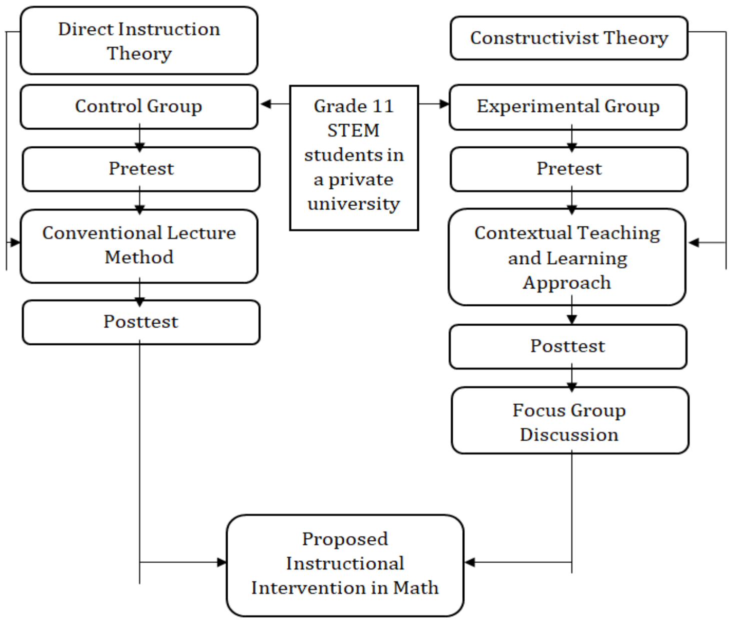


Figure 1 shows that this study is anchored to Engelmann's Direct Instruction Theory for the control group. CTL is grounded by Constructivist Theory for the experimental group.

Respondents to this study were Grade 11 STEM students at an independent, non-sectarian university. Students were divided into two groups, one for the control group and another for the experiment. The two groups were subjected to a pretest, which was followed by an experiment to determine their differences. In the control group, students were facilitated using the conventional lecture method, while in the experimental group, students were facilitated using the CTL method. After the implementation, both groups were given a posttest.

In addition, focus group discussion was administered to the experimental group. The data was analyzed, after which, an instructional intervention was proposed. Then the conclusion and recommendations were drawn.

Significance of the Study

The study would be significant in the instruction of Mathematics in Institutions. Furthermore, the results and findings of the study could be favorable to the following:

school administrators, the findings offer evidence-based interventions to enhance Mathematics instruction and support strategies that maximize the potential of Senior High School students in the subject.

teachers, the study provides a practical framework for designing more effective and relatable lessons. The contextualized instructional samples may serve as useful references for classroom application.

students, the approach encourages more engaging and meaningful learning experiences, promoting better mastery of Mathematics by connecting content to real-life contexts.

future researchers, the data contributed to the growing literature on CTL in Mathematics education and may guide further studies involving inquiry, collaboration, reflection, and authentic assessment.

Scope and Delimitation of the Study

This study focused on the application of the Contextual Teaching and Learning Approach in the teaching-learning of Basic Calculus to Senior High School students, with a particular emphasis on the topics of The Derivative as Slope of the Tangent Line, Derivative Rules, and Chain Rule. It was conducted to the Grade-11 students from a private university in Cebu City, who took Basic Calculus on their Fourth Mastery of the Second Semester for the School Year 2021-2022. Classes were conducted through an online class using a Learning Management System (LMS) and other online tools in both synchronous and asynchronous sessions. Students attended class on-site but only to a limited time (40 minutes per subject) for a day in a week.

Definition of Terms

This part provides the description of the said terms and how it was operationally and conceptually used in the study:

Academic performance. It refers to students' pretest and posttest scores in Mathematics on the questionnaire covering some of the topics of Derivatives.

Blended learning. It refers to the technique of combining online and in-person learning activities. In this study, it focuses more on online learning both synchronous and asynchronous session. Students attended classes on-site but only for a limited time (40 minutes per subject) for a day in a week.

Contextual Teaching and Learning (CTL) Approach. It refers to the approach that recognizes and addresses the fact that knowledge is context- or situation-based. It strives to make experience relevant and meaningful to students through linkages both in and beyond of the classroom. In the study, it mainly focused on Inquiry, Learning Community, Reflection and Authentic Assessment.

Conventional Lecture Method (CLM). It is an instructor-directed teaching strategy in which pupils are instructed to sit and listen (Tularam, 2018). In this study, the students in the control group were exposed to lectures in teaching Mathematics concepts.

RESEARCH METHODOLOGY

The study design, research setting, research subjects, data collection technique, and research instrument are all covered in this chapter.

Research Design

This study employed a quasi-experimental, pretest-posttest control group design. Group A (n=34) was taught using the CTL approach, and Group B (n=37) received traditional lecture-based instruction.

Research Setting and Participants

The study was conducted in the Senior High School Department of a private university in Cebu City. The study was conducted to two sections which were randomly selected from 11 sections of Grade-11 STEM students taking the Basic Calculus subject. For group A there were thirty-four (34) students and for group B there were thirty-seven (37) students. Group A were the experimental group and exposed to CTL approach, while Group B were the control group and exposed to conventional lecture method.

Data Gathering Procedure

1. Research permission was obtained from school authorities.
2. Students and parents signed consent forms.
3. A validated 45-item multiple-choice test was administered as pretest and posttest.
4. CTL was applied in the experimental group through activities incorporating real-world scenarios, inquiry-based learning, and collaborative tasks.
5. A post-intervention focus group discussion (FGD) was conducted with five experimental group students.

Research Ethics and Data Management Plan

The study was conducted with the agreement of the chosen school's principal via a request letter delivered prior to the start of the study. In conducting the study, the researcher had adhered to the school's norms, good behavior, and ethics.

Before the study was conducted, the students and their parents or guardians were asked to consent. The study included students who have received permission from their parents or guardians to participate. Before completing the consent form, students and parents were informed about the procedures for conducting the study.

The study's findings were shared with students, parents, and the school. The respondents' personal information was not disclosed. Only the responders' scores were gathered.

Pedagogical Approach

Two teaching strategies were used in the study: the experimental group received instruction using Contextual Teaching and Learning (CTL), while the control group received traditional lectures.

Control Group

Using Google Forms, students first finished a validated pretest. The school's LMS was used for both synchronous (ClassIn/Google Meet) and asynchronous sessions of instruction. Lessons took the form of lectures, starting with a question pertaining to the subject, followed by explanation, instruction, and an online posttest.

Experimental Group

Additionally, the experimental group finished a pretest. Through the integration of inquiry-based learning, group collaboration, reflection, and practical assessment tasks, the CTL approach was used to deliver instruction. After the last session, a posttest was administered. In addition, five students took part in a focus group discussion (FGD) to discuss their experiences with CTL; their answers were gathered online and verified in person.

Research Instrument

For the pretest and posttest, the researcher utilized a validated teacher-created questionnaire. The 45-item multiple-choice question tool includes questions on The Derivative as Tangent Line Slope, Differentiation Rules, and Chain Rule (See Appendix C). The questionnaire was validated by three (3) qualified Mathematics instructors (See Appendix D), then, the researcher did a pilot testing and analyzed the data.

Statistical Treatment of Data

Data were analyzed using descriptive statistics and inferential tests, including z-test, paired t-tests and independent sample t-tests. All tests were conducted at a 5% significance level using Minitab software.

Presentation, Analyses, And Interpretation Of Data

This chapter discusses the analyses, findings and interpretations of the data obtained to answer the problems of the study. This section addressed the specific research problems, and the discussion is arranged in the order of the research problems presented in the previous chapter.

Academic Performance of the Grade 11 STEM students in Basic Calculus

Two groups of Grade 11 STEM students in this study, control and experimental groups were subjected to pretest and posttest to evaluate their academic performance in Basic Calculus. The pretest and posttest shown in Table 1 and 2 evaluated the academic performance of Grade 11 STEM students in Basic Calculus.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume IX Issue IIIS September 2025 | Special Issue on Education

Table 1 Pretest Performance of the Control and Experimental Groups

Groups	**n**	**HM**	**AM**	**SD**	**Test Statistics**		**Qualitative Description**
					Computed z-value	**p-value**	
Control Group (*exposed to conventional lecture method*)	37	27	18.08	8.57	6.32	<0.000*	Below Average
Experimental Group (*exposed to CTL approach)*	34	27	20.03	7.78	5.22	<0.000*	Below Average
HM = 60% of the test items							
*significant at α = 0.05							

Table 1 shows the pre-test scores of the control and experimental groups. The actual mean of 18.08 (SD=8.57) of the control group and the actual mean of 20.03 (SD=7.78) of the experimental group were significantly less than the hypothetical mean. This significance was supported by the computed z-tests of 6.32 for the control group and 5.22 for the experimental group and p-values of 0.000 for both groups which are less than the significance level (α) set at 0.05. Hence, H_{01} was rejected for both groups. Since both values of the means were below the HM, the performance level of both groups in the pretest were Below Average, both groups did not reach the 60% passing standard of the school. This performance attributed the fact that both groups were heterogeneous groups of STEM students, and the concepts were not yet delivered, so students had little to no background about the topics covered on the pretest.

Table 2 Posttest Performance of the Control and Experimental Groups

Groups	**n**	**HM**	**AM**	**SD**	**Test Statistics**		**Qualitative Description**
					Computed z-value	**p-value**	
Control Group (*exposed to conventional lecture method*)	37	27	19.97	11.27	3.78	<0.000*	Below Average
Experimental Group (*exposed to CTL approach*)	34	27	30.20	8.35	2.23	<0.0127*	Above Average
HM = 60% of the test items							
*significant at α = 0.05							

Table 2 shows that the control group acquired an actual mean of 19.97 (SD=11.27) while the experimental group obtained an actual mean of 30.20 (SD=8.35). The computed z-test for the control and experimental group were 3.78 and 2.23 respectively. The p-value for the control group was 0.000 while the experimental group was 0.0127, both were less than the significance level (α) set at 0.05. The z-test and p-value for both groups were significant, thus, H_{01} was rejected. Since the actual mean was lower than the hypothetical mean in control group, the level of performance was still Below Average in the posttest. In the experimental group, since the actual mean was higher than the hypothetical mean, the level of performance of the experimental group was Above Average in the posttest. Based on the results of the posttest, the control group did not meet the 60% passing standard of the school while the experimental group met the 60% passing standard of the school.

The performance of the control group might be because of the lesser close monitoring during the conduct of online classes. Particularly in an online asynchronous class, students were reluctant to approach the teacher with questions and requests for clarification. For students who might have unstable connections in their area can't reach out to their teacher during the scheduled time for asking clarifications. Fabito, Trillanes, and Sarmiento (2021) conducted a study that identified two reasons: having a poor internet connection makes it difficult for students to participate in online activities, and it can be challenging to understand teacher discussions. The findings revealed that in some cases, teacher-student communication was weak due to limited resources such as the internet connection.

The performance on the experimental group might be because students were equipped with suitable gadgets, have a very stable connections on their areas and enjoy the lesson by connecting it to their real-life situations. During the focus group discussion, the student mentioned, "*By connecting the different concepts in real-life situations this makes it easier and more meaningful to students when it comes to mathematics.*" Another student also stated, "*It helps us connect to the real world.*" This result supported the study of Mauliana et al. (2018) which states that using a contextual teaching and learning strategy, students' performance can be enhanced. The Contextual Teaching and Learning (CTL) approach encourages students to learn from their own experiences and knowledge, allows them to learn on their own, increases their mathematical proficiency, and conveys the sense that mathematics is useful and valuable to student lives. It also supported the study of Pangemanan (2020) which indicates that the learning outcomes of students taught using the standard learning process are lower to those of students taught using the CTL technique, particularly when learning Mathematics. Thus, students in the experimental group exposed to CTL approach improved their performance in Basic Calculus.

Mean Gain between the Pretest and Posttest in Academic Performance

Table 3 shows the significant mean gain between the pretest and posttest in academic performance of the grade 11 STEM students in the controlled and experimental group.

Table 3 Mean Gain between the Pretest and Posttest in the Control and Experimental Group

Group	***n***	**Pretest Mean**	**Posttest Mean**	**Mean Gain**	***SD***	**Test Statistic**
						p-value
Control (*Exposed to conventional lecture method*)	37	18.08	19.97	1.89	14.05	0.419
Experimental (*Exposed to CTL approach*)	34	20.03	30.20	10.17	12.58	0.000*

*significant at $\alpha = 0.05$ (two-tailed test)

The table shows the difference between the performance of the students from pretest to posttest of both control and experimental groups. For the control group exposed to conventional lecture method, the p-value is 0.419 (mean gain of 1.89) which is greater that the $\alpha = 0.05$, this was not significant, hence, it failed to reject the H_{02}. Moreover, there is no significant difference in the mean gain between the pretest and posttest of control group. The control group showed no significant improvement in their performance in Basic Calculus which might be attributed to students' lack of interest in the topics and less concentration on the online synchronous discussion. Students might also attempt to open new tabs in their gadgets and might be doing something else at home because they were not required to open their cameras and microphone during the discussions. This result of the control group contradicted the claim of Saville et. al. (2006) that in many classroom settings, the traditional lecture technique is a useful teaching strategy that has been proved to improve students' performance. Also, the result also opposed the claim of Stockard (2010) that students' reading progress was considerably better, employing direct instruction, reading comprehension, and mathematics.

For the experimental group exposed to CTL approach, the p-value is 0.000 (mean difference of 10.18) which is lesser than the $\alpha = 0.05$, this was significant, hence, it rejected the H_{02}. Moreover, there was a significant difference in the mean gain between the pretest and posttest of the experimental group. It also implies that after the intervention, which is the CTL approach, students' academic performance in Basic Calculus improved. The significant mean gain of the experimental group could be attributed to the fact that students were able to perform better using the CTL approach. Students work collaboratively to finish their performance task and some assessments, reflect on each topic, and relate it to their real-life situations. This observation was supported by the statements coming from the students during the focus group discussion stating, "*It is an effective approach to guide students into learning basic calculus. By connecting the different concepts in real-life situations this makes it easier and more meaningful to students when it comes to mathematics*." Another student also mentioned, "*It helps us connect to the real world. Basic calculus is not just about solving problems, but it also helps us to understand deeply the answer*." This finding also supported the study of Syamsuddin and Istiyono (2018) that based on students' learning completion, participation in the learning process, and positive response to the learning activity, the Contextual Teaching and Learning approach for teaching mathematics to junior high school students is effective. Also, the study of Uslima et al. (2018) which has shown that students' mathematical understanding abilities improved with the use of CTL model. Results revealed an improvement in the students' understanding of the topics on derivatives.

Comparison between the Control and Experimental Group in terms of their Mean Gain

Table 4 indicates the significant mean difference between the control and experimental group in terms of their pretest and posttest academic performance.

Table 4 Comparison of the Experimental and Control Group in Terms of Their Mean Gains in Basic Calculus

Group	***n***	**Mean Gains**	***SD***	**Absolute Difference Between Means**	**Test Statistic** p-value
Control (*exposed to conventional lecture method*)	37	1.891	14.051	8.28	0.011*
Experimental (*exposed to CTL approach*)	34	10.176	12.582		

*significant at $\alpha = 0.05$ (two-tailed)

In table 4, the p-value 0.011(absolute difference between means = 8.28) is less than $\alpha = 0.05$, thus the result rejects H_{03}. Based on this, the mean score of the experimental group is higher than the controlled group, hence there is a significant difference between the mean gains of the control and experimental group. The performance of the grade 11 STEM students who were exposed to CTL approach has improved compared to the performance of those who are using the conventional approach.

For the control group exposed to Conventional Lecture Method show no significant difference in their pretest to posttest results. In the experimental group exposed to Contextual Teaching and Learning Approach, shows significant difference in their pretest to posttest results. The result supported the study of Selvianiresa and Prabawanto (2017) that it is evident from the posts of the students in both classrooms that there are variations in the mathematical connections that students who study through CTL technique and students who learn directly may make. The difference between the two classes' average test scores demonstrates that the average student grade in the experiment class is higher than the average student grade in the control class. Therefore, learning using a CTL approach is preferable compared to learning it directly. Also, it contradicts the study of Sadeghi, Sedaghat, and Shaahmadi (2014) evaluated the influence of lectures versus integrated learning (blended teaching methods) on student learning. Results, however, indicated that neither the pretest nor the posttest scores for the two groups were statistically significant. The result supported the study of Tamur et al. (2020) and Kadarsono et al. (2019) which states that CTL has a much greater favorable impact on pupils' mathematics understanding skills than the use of the traditional technique.

To sum it up, the mean gain of the experimental group is statistically higher than the mean gain of the control group. This result showed that there was difference between the performance of the pretest to posttest of two groups. The CTL approach was more comparable than Conventional Lecture Method in teaching and learning Basic Calculus.

Perspectives of the Grade 11 STEM students exposed to CTL approach

FGD responses revealed students found CTL helpful and engaging. They appreciated the real-world relevance and collaborative nature of the activities. However, some students preferred individual work due to group dynamics. Technical issues like poor internet access were also noted.

On question number one (1), five students agreed that learning Basic Calculus through CTL approach is a helpful and effective approach. Furthermore, three students mentioned that CTL approach helps them connect the topic to real-world. Then one student said, *"It helps them connect to the real world and another student infer that it motivates and unleash their adventurous side, they were able to help each other especially when the teacher assigned group activities".*

As students learned better if they apply and connect the topic to their real-life situations and the teacher allowed them to collaborate and work on their group based on the given group task.

For question number two (2), three out of five students from the FGD stated that CTL approach is hard. As one student said that "*It is somewhat hard, naay time time nga dili same ang extend effort sa members sa group."* Also, two students stated that they prefer to do the task alone or by themselves. One commented that, *"For me sir, I rather do the activities on my own because I don't want to wait and rely on my groupmates…"*

Students were exposed to one category of CTL approach which is Learning Community. They need to collaborate and work with their group on the given task.

On question number three (3), three out of five students mentioned that the Performance Task about song parody is what they liked the most. The song parody is a group activity where the group must create a lyric based on the given topic and used an old song for it. One student said that *"I like the performance task because it was fun to fully enhanced and correlate a song to the topic. Me, together with my groupmates were having fun while having a virtual meeting for the making of the parody song…"*

Otherwise, there was one negative comment about the parody song and said that *"Naglisud mi sa song part sir."* Moreover, one student stated that *"I particularly liked the performance task 4.2. Where we must solve for the code and find out the message."*

For question number four (4), two out of five mentioned that Inquiry Method is the most beneficial. These are the reasons: (1) *"where we can solve the answer or write on the white board" and* (2) *"ara mi maka determine kinsa ang naminaw, maka kuan dayun mi sac hatbox and ma on ang mic."* In addition, two of them said that Authentic Assessment was the most beneficial. The reasons were: (1) *"this approach tests our knowledge and skills when the things we have learned are applied to the real-world problems. This can also help us spot our shortcomings and learn from our mistakes with this approach."* (2) *"because it teaches the students how to apply their learning into the real world…"* Lastly, one out of 5 talked about the song parody that *"naglisud mi sa song part sir".*

On the other hand, for the least beneficial, two students stated that reflection was the least beneficial. One of the reasons was opinionated. Moreover, three out of five said that inquiry base was the least beneficial. One of them reason out that *"sometimes, it can't be executed as it requires a good internet connection."* Thus, the majority of them did not like the inquiry method of teaching because it required internet all the time and not all students had a good internet connection all the time.

Lastly for question five (5), five of them agreed that they prefer the CTL approach compared to the traditional approach. The reasons were: *"nindut sha kay students can explore. More engagement enhances talent and skills. It also helps us through life, ma apply ang learnings as we move forward."*, *"enhances talent skills*", "because there are a lot of things to be done", *"it is more engaging and improves thinking and solving skills"* and *"…since it's not only fun and interactive but also it can encourage the students to listen and learn things they did…"* Hence, the majority chose CTL approach to be implemented in their future classes because they think that the categories used in the CTL approach might be effective in learning Basic Calculus.

Proposed Instructional Material using CTL Approach

Based on the findings, the researcher developed instructional materials integrating CTL principles in Basic Calculus lessons. These include modules for teaching Derivatives as Tangents, Differentiation Rules, and Chain Rule, incorporating inquiry, collaboration, reflection, and real-world assessments. The Instructional Design created will serve as a scheme on how to work with the topics (see Figure 2, 3 and 4).

Figure 2 Instructional Design for Basic Calculus (Derivative as Slope of the Tangent) using CTL Approach

An Instructional Design in STEM 11 SHS

Subject Name: Math 4

Subject Descriptive Title: *Basic Calculus*

I. LEARNING OUTCOMES

At the end of the session, you should be able to:

- Illustrate the tangent line to their graph of a function at a given point;
- Apply the definition of the derivative of a function at a given number; and
- Relate the derivative of a function to the slope of the tangent line.

II. SUBJECT MATTER

A. Topic: The Derivative as the Slope of the Tangent Line

B. Materials:

- ✓ E-book (LMS)
- ✓ Laptop/Mobile phones
- ✓ Calculator
- ✓ ClassIn app
- ✓ LMS

C. References:

- ✓ Basic Calculus book Published by the Commission on Higher Education, 2016
- ✓ Mercado, J.P. (2016). Next Century Basic Calculus. Phoenix Publishing House, Inc. Quezon City, Philippines.
- ✓ Egarguin, N.A., Fontanil, L.L., & Lawas, V.M. (2017). Basic Calculus for Senior HighSchool. C & E Publishing, Inc. Quezon City, Philippines.
- ✓ Pagala R.C. & Valderama, M.S. (2018). Basic Calculus for Senior High School.Mindshapers Co., Inc. Intramuros Corporate Plaza Bldg, Recoletos St., Manila.
- ✓ Alegre, H.C. (2016). Basic Calculus. Anvil Publishing, Inc. Mandaluyong City,Philippines

III. PROCEDURE

A. Preparation

- Preliminaries
  - ➢ Prayer
  - ➢ Attendance
  - ➢ Checking virtual environment

B. Motivation

- Recall first by asking students on how they define a tangent line.
- Teacher will show an illustration depicting the tangent and will ask questions about illustration then relate to the current topic.

C. Presentation

- The teacher will show to the class the detailed Slide Presentation or PowerPoint. Slide presentations including all the content about the derivatives as the slope of thetangent line. The teacher will read the learning objectives.

D. Discussion (

-**WHAT IS A TANGENT LINE?**

A ***Tangent Line*** is a line which locally touches a curve at one and only one point.

- ❖ The slope-intercept formula for a line is y = mx + b, where m is the slopeof the line and b is the y-intercept.
- ❖ Among all the lines through a point (c, (c)), the one which best approximates the curve = () near the point (c, (c)), is the tangentline to the curve at that point.
- ❖ Another way of qualitatively understanding the tangent line is to visualize the curve as a roller coaster (refer to the figure below). The tangent lineto the curve at a point is the point of tangency of that curve.

THE TANGENT LINE DEFINED MORE FORMALLY

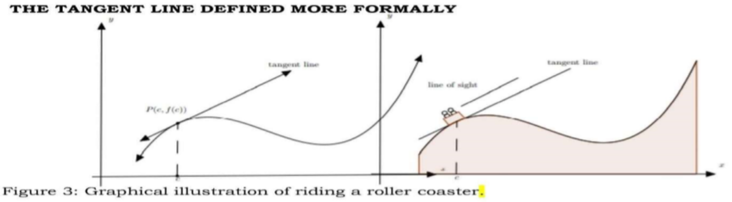
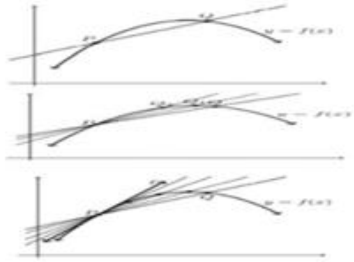


Figure 3: Graphical illustration of riding a roller coaster.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume IX Issue IIIS September 2025 | Special Issue on Education

- The precise definitions of a tangent line rely on the notion of a secant line. Let C be the graph of a continuous function y=f(x) and let P be a point on C.



A secant line to $y = f(x)$ through P is any line connecting P and another point Q on C. In the figure at the left, the line $\overline{PQ}$ is a secant line of $y = f(x)$ through P.

Next is we choose another point Q_1 in between P and Q, then connect the two points P and Q_1 to construct a secant line $\overline{PQ_1}$. Then choose another point Q_2 in between P and Q_1 and construct the secant line $\overline{PQ_2}$ as shown on the figure at the left.

If the sequence of secant lines to the graph of $y = f(x)$ through P approaches one limiting position (in consideration of points Q to the left and form the right of P), then we define this line to be the tangent line to $y = f(x)$ at P (as shown at the figure at the left.

So, we can summarize the definition of the secant line through a point, and the tangent line at a point of thegraph of $y = f(x)$

Definition

Let C be the graph of a continuous function y = $f(x)$ and let P be a point on C.

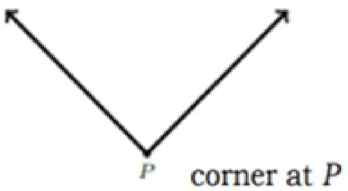
1. A secant line to y = $f(x)$ through P is any line connecting P and another point Q on C.
2. The tangent line to y = $f(x)$ at P is the limiting position of all secant lines $\overline{PQ}$ as $Q \to P$

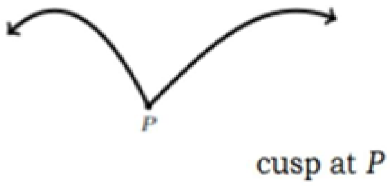
CURVES THAT DO NOT HAVE TANGENT LINES

Only two cases when tangent line to the graph of a function at a point does not exist:

1. The case when the function is not continuous at x_0: It is clear from the definition of the tangent line thatthe function must be continuous.

2. The case when the function has a sharp corner/cusp at P. This case produces different limiting positionsof the secant lines PQ depending on whether Q is to the left or the right of P.





THE EQUATION OF THE TANGENT LINE AT A POINT ON A CURVE

Given a function $y = f(x)$, how do we find the equation of the tangent line at a point $P(x_0, y_0)$?

Consider the graph of a function $y = f(x)$ whose graph is given below and let $P(x_0, y_0)$ be a point on the graph. Our objective is to find the equation of the tangent line (TL) to the graph at the point $P(x_0 - y_0)$ as shown below.

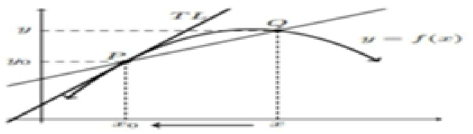


Figure 4: Tangent line (TL) to the graph at the point $P(x_0, y_0)$

Observe that **letting Q approach** P is **equivalent to letting x approaches x_0**. Since the tangent line is the limiting position of the secant lines as Q approaches P, it follows that the slope of the tangent line (TL) at the point P is the limit of the slopes of the secant line $\overline{PQ}$ as x approaches x_0. In symbols,

$$m_{TL} = \lim_{x \to x_0} \frac{y - y_0}{x - x_0} = \lim_{x \to x_0} \frac{f(x) - f(x_0)}{x - x_0}$$

And its tangent line passes through $P(x_0 - y_0)$, then its equation is given by:

$$y - y_0 = m_{TL}(x - x_0)$$

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Example 1: Find the slope of a tangent line to the curve $y=x^2$ at x=2

Given: $x_0=2$ y= f(x) = x^2 $y_0= f(x_0)= x^2$

$y_0= f(2)= x^2= 2^2$

$y_0= 4$

$m=\lim_{x\to x_0}\frac{y-y_0}{x-x_0}$	Slope of a tangent line formula
$m=\lim_{x\to 2}\frac{x^2-4}{x-2}$	Substitute the given
$m=\lim_{x\to 2}\frac{(x-2)(x+2)}{(x-2)}$	Factor of -4 is equal to (x-2)(x+2) then cancel both x-2
$m=\lim_{x\to 2} x+2$	Substitute x with 2
m= 2+2	
m=4	Thus, slope is equal to 4

The teacher will show examples to fully understand the topic.

Example 2: Find the slope of a tangent line to the curve f(x) =$\sqrt{x}$ at x=4.

Given: x_0=4   **y= f(x) =$\sqrt{x}$**   **y_0= f(x_0)=$\sqrt{x}$**

y_0=f(4)=$\sqrt{x}$

y_0= $\sqrt{4}$

y_0=2

SOLUTION:

$m=\lim_{x\to x_0}\frac{y-y_0}{x-x_0}$	Slope of a tangent line formula
$m=\lim_{x\to 4}\frac{\sqrt{x}-2}{x-4}$	Substitute the given
$m=\lim_{x\to 4}\frac{\sqrt{x}-2}{x-4}\cdot\frac{\sqrt{x}+2}{\sqrt{x}+2}$	Multiply numerator and denominator by √x+ 2, the conjugate of the numerator, √x-2
$m=\lim_{x\to 4}\frac{x-4}{(x-4)(\sqrt{x}+2)}$	Cancel both x-4 in the numerator and denominator
$m=\lim_{x\to 4}\frac{1}{(\sqrt{x}+2)}$	Substitute 4 to the x
$m=\frac{1}{(\sqrt{4}+2)}$	
$m=\frac{1}{4}$	Thus, the slope of tangent line is ¼

Example 3: Find the slope of a tangent line to the curve y= $3x^2$-12x+1 at the point (2,-11)

Given: x_0=2   **y= f(x) =$3x^2-12x+1$**   **y_0= f(x_0)=-11**

SOLUTIONS

$m=\lim_{x\to x_0}\frac{y-y_0}{x-x_0}$	Slope of a tangent formula
$m=\lim_{x\to 2}\frac{3x^2-12x+1-(-11)}{x-2}$	Substitute the given
$m=\lim_{x\to 2}\frac{3x^2-12x+1+12}{x-2}$	Combine like terms in the numerator
$m=\lim_{x\to 2}\frac{3(x^2-4x+4)}{x-2}$	Get the common factor in the numerator
$m=\lim_{x\to 2}\frac{3(x-2)(x-2)}{x-2}$	Factor of x^2-4x+4 is (x-2)(x-2) then cancel x-2
$m=\lim_{x\to 2}3(x-2)$	Substitute 2 to your x
m= 3(0)	
m= 3	Thus, 3 is the slope

Formal Definition of Derivative

Definition of the Derivative

Let f be a function defined on an open interval $I \subseteq \mathbb{R}$, and let $x_0 \in I$. The derivative of f at x_0 is defined to be

$$f'(x_0) = \lim_{x\to x_0}\frac{f(x)-f(x_0)}{x-x_0}$$

if this limit exists. That is, the derivative of f at x_0 is the slope of the tangent line at $(x_0, f(x_0))$, if it exists.

Notations: If $y = f(x)$, the derivative of f is commonly denoted by

$$f'(x),\ D_x[f(x)],\ \frac{d}{dx}[f(x)],\ \frac{d}{dx}[y],\ \frac{dy}{dx}.$$

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Illustrative example 1: Derivative of a function at a point

Compute $f'(1)$ for each of the following functions:

a) $f(x) = \frac{2x}{x+1}$ b) $f(x) = \sqrt{x+8}$

Solution:

a) $f' = \lim_{x \to 1} \frac{f(x) - f(1)}{x - 1}$

$= \lim_{x \to 1} \frac{\frac{2x}{x+1} - 1}{x - 1} \cdot \frac{x+1}{x+1}$ Multiply numerator and denominator by x + 1, the conjugate of the denominator, x – 1

$= \lim_{x \to 1} \frac{2x - (x+1)}{(x-1)(x+1)}$ Combine like terms in the numerator

$= \lim_{x \to 1} \frac{x-1}{(x-1)(x+1)}$ Cancel x – 1

$f' = \lim_{x \to 1} \frac{1}{x+1} = \frac{1}{2}$ The derivative of $f(x) = \frac{2x}{x+1}$ at x = 1 is $\frac{1}{2}$.

FINDING DERIVATIVE OF FUNCTION USING THE ALTERNATIVE FORMULA

Illustrative example 3:

Find the derivative of $f(x) = 5x^2 + 3x - 1$ at x = 2

Solution:

$f(2) = \lim_{h \to 0} \frac{f(x_0 + h) - f(x_0)}{h}$

$= \lim_{h \to 0} \frac{f(2+h) - f(2)}{h}$

$= \lim_{h \to 0} \frac{[5(2+h)^2 + 3(2+h) - 1] - [5(2^2) + 3(2) - 1]}{h}$

You need to substitute (2 + h) in every x's in the given function and then simplify the numerator.

$= \lim_{h \to 0} \frac{[5(4 + 4h + h^2) + 6 + 3h - 1] - [20 + 6 - 1]}{h}$

$= \lim_{h \to 0} \frac{20 + 20h + 5h^2 + 5 + 3h - 25}{h}$

Combine like terms in the numerator and factor out common monomial in the numerator, thus $5h^2 + 23h = h(5h + 23)$ and cancel h

$= \lim_{h \to 0} \frac{5h^2 + 23h}{h}$

$= \lim_{h \to 0} 5h + 23 = 23$ The derivative of $f(x) = 5x^2 + 3x - 1$ at x = 2 is 23.

E. Activities

- The teacher will give an activity for the students to practice.

1. Let us try finding the tangent line of $f(x) = \frac{3}{x}$ *at point* $(3, 1)$.

F. Application

- The teacher will give a performance task related to the topic and students will givetheir reflection on how the topics relate in real life experiences.

INSTRUCTION: Think about how you can relate derivatives as a slope on a tangent line in real life experiences. Put it in a document and submit it in a PDF file. Make the content concise, organized, and creative. The content of your reflection will be evaluated with these criteria:

Criteria	1	2	3	4
Depth of Reflection	Demonstrates little or no understanding of the writing task and subject matter. Needs serious revision.	Demonstrates a limited understanding of the writing task. Needs revision	Demonstrates a thoughtful understanding of the writing task and subject matter	Demonstrates a thorough and conscious understanding of the writing task and subject matter.
Development of examples and evidence	None or very few specific examples used to support claims.	Uses some vaguely developed examples to support claims.	Uses relevant examples from experience to support claims. Makes applicable connections between ideas	Uses specific and convincing examples to support ideas and makes insightful connections.
Language use/style	Uses language that is unsuitable for the audience and purpose with little or no awareness of sentence structure.	Uses some imprecise language with little sense of voice and limited awareness of how to vary sentence structure.	Uses language that is usually fresh and original with a sense of awareness of audience and purpose. Able to vary sentence structure	Uses stylistically sophisticated language that is precis and engaging with a good sense of voice and awareness of audience and purpose. Skillful sentence structure.
Grammar/conventions	Demonstrates little or no control of	Demonstrates partial control of grammar	Demonstrates control of grammar and	Demonstrates total control of

	grammar and conventions, making comprehensions difficult	and conventions with occasional errors that do not hinder comprehension.	conventions with only slight errors when using sophisticated language.	grammar and conventions with essentially no errors, even with sophisticated language.

G. Generalization

The teacher will ask the following questions:

- How can we say that the curve has a tangent line?
- How important are derivatives in our everyday life?

IV. ASSESSMENT

Find the slope (m) of the tangent line of the curve;

1. F(x) = $x^2 + 5x + 6$, at x=1
2. F(x)= $2x^2 - 10x$, at x=2
3. F(x)= $x^2 - 6x + 9$, at x=3
4. F(x) $= 3x^2 + 5$, at x=2
5. y= 3x+4 at (1,7)
6. 5x+y+13 = 0 at (-4,7)
7. -3x+y+4 = 0 at (3, 5)

Figure 3 Instructional Design for Basic Calculus (Differentiation Rules) using CTL Approach

An Instructional Design in STEM 11 SHS

Subject Name: Math 4

Subject Descriptive Title: Basic Calculus

I. LEARNING OUTCOMES

At the end of the lesson, the learner shall be able to:

1. Determine the relationship between differentiability and continuity;
2. Derive the differentiation rules; and
3. Apply the differentiation rules in computing the derivatives of algebraic, exponential, and trigonometric functions.

II. SUBJECT MATTER

A. **Topic: Differentiation Rules**

B. **Materials:**

- ✓ E-book (Basic Calculus)
- ✓ Laptop/Mobile phones
- ✓ Calculator
- ✓ ClassIn app
- ✓ LMS

C. **References:**

- ✓ Basic Calculus book Published by the Commission on Higher Education, 2016
- ✓ Egarguin, N.A., Fontanil, L.L., & Lawas, V.M. (2017). Basic Calculus for Senior High School. C & E Publishing, Inc. Quezon City, Philippines.
- ✓ The Organic Chemistry Tutor. (2018, February 27). Derivatives of Exponential Functions. Retrieved April 2022, from https://www.youtube.com/watch?v=yg_497u6JnA
- ✓ The Organic Chemistry Tutor. (2016, September 11). Derivatives of Trigonometric Functions - Product Rule Quotient & Chain Rule - Calculus Tutorial. Retrieved April 2022, from https://www.youtube.com/watch?v=_niP0JaOgHY&t=436s
- ✓ Teacher Franz. (2021, March 17). Differentiation Formula. Retrieved April 2022, from https://www.youtube.com/watch?v=vc2YFSSzkEQ

III. PROCEDURE

A. Preparation

- Preliminaries
    - Prayer
    - Attendance
    - Checking virtual environment

B. Motivation

- The teacher will show a video applying differentiation in real life situations. Then ask some follow up questions about the video.

C. Presentation

- The teacher will show to the class the detailed Slide Presentation or PowerPoint. Slide presentations including all the content about the Rules of Differentiation. The teacher will read the learning objectives.

D. Discussion

The teacher will first recall the different definitions:

Definition 1. (Continuity at a Number). A function *f* is *continuous* at a number *c* if all of the following are satisfied.

i. *f(c) is defined:*

ii. $\lim\limits_{x\to c} f(x)$ *exists; and*

iii. $\lim\limits_{x\to c} f(x) = f(c)$

If at least one of these conditions is not satisfied, the function is said to be ***discontinuous***.

Definition 2. (Continuity on **R**). A function *f* is said to be continuous everywhere if *f* is continuous at every real number.

Definition 3. A function *f* is ***differentiable*** at a number *c* if $f'(c) = \lim\limits_{h\to 0} \frac{f(c+h)-f(c)}{h}$ exists.

After recalling the previous topic and connecting it with the new topic. The teacher will now present examples.

EXAMPLE:

Determine whether the function $f(x) = x^3 + x^2 - 2$ is continuous or differentiable at $x = 1$.

1. if $f(x) = x^3 + x^2 - 2$ at $x = 1$.

   $f(1) = (1)^3 + (1)^2 - 2$

   $f(1) = \underline{\mathbf{0}}$

2. $\lim\limits_{x\to 1} f(x) = x^3 + x^2 - 2$

   $\lim\limits_{x\to 1} f(1) = (1)^3 + (1)^2 - 2$

   $\lim\limits_{x\to 1} f(1) = \underline{\mathbf{0}}$

3. $\lim\limits_{x\to 1} f(x) = f(x)$

Thus, the $f(x) = xt + x^2 - 2$ is continuous at $x = 1$.

$f'(1) = x^3 + x^2 - 2$

$$f'(x) = \lim_{h\to 0} \frac{f(x+h)-f(x_0)}{h}$$

$$f'(1) = \lim_{h\to 0} \frac{f(1+h)-f(1)}{h} \quad\longrightarrow\quad \boxed{\text{Replace c with 1}}$$

$$f'(1) = \lim_{h\to 0} \frac{(1+h)^3+(1+h)^2-2-(1^3+2^2-2)}{h} \quad\longrightarrow\quad \boxed{\text{All x in the given function will be replaced by (1+h) and 1 respectively}}$$

$$f'(1) = \lim_{h\to 0} \frac{1+3h+3h^2+h^3+1+2h+h^2-2-0}{h} \quad\longrightarrow\quad \boxed{\text{Combine like terms, get the common factor, and cancel out both h in numerator and denominator}}$$

$$f'(1) = \lim_{h\to 0} \frac{h^3+4h^2+5h}{h} \quad\longrightarrow\quad \boxed{\text{Factor out}}$$

$$f'(1) = \lim_{h\to 0} \frac{h(h^2+4h+5}{h} \quad\longrightarrow\quad \boxed{\text{Cancel h}}$$

$$f'(1) = \lim_{h\to 0} h^2+4h+5$$

$$f'(1) = \lim_{h\to 0} (0)^2+4(0)+5 \quad\longrightarrow\quad \boxed{\text{Replace h with 0}}$$

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$f'(1) = 5$

Thus, this example is continuous at the same time it is differentiable because its derivatives exist.

Next, solving a piecewise function. The following example will show that the function is continuous but not differentiable.

The function defined by

$$f(x) = \begin{cases} 5x & \text{if} \quad x < 1 \\ 2x + 3 & \text{if} \quad x \geq 1 \end{cases}$$

is continuous at $x = 1$ but is not differentiable at $x = 1$. Indeed, $f(1) = 2(1) + 3 = 5$. Now,

- If $x < 1$, then $f(x) = 5x$ and so $\lim_{x \to 1^-} 5x = 5$.
- If $x > 1$, then $f(x) = 2x + 3$ and so $\lim_{x \to 1^+} (2x + 3) = 5$.

Since the one-sided limits exist and are equal to each other, the limit exists and equals 5. So,

$$\lim_{x \to 1} f(x) = 5 = f(1).$$

This shows that f is continuous at $x = 1$. On the other hand, computing for the derivative,

- For $x < 1$, $f(x) = 5x$ and $\lim_{h \to 0^-} \dfrac{5(x + h) - (5x)}{h} = 5$.
- For $x > 1$, $f(x) = 2x + 3$ and $\lim_{h \to 0^+} \dfrac{(2(x + h) + 3) - (2x + 3)}{h} = 2$.

Since the one-sided limits at $x = 1$ do not coincide, the limit at $x = 1$ does not exist. Since this limit is the definition of the derivative at $x = 1$, we conclude that f is not differentiable at $x = 1$.

After the discussion the teacher will now move on to **"The Differentiation Rules and Examples Involving Algebraic, Exponential, and Trigonometric Functions"**

The derivative of the function f the function f' whose value at a number x in the domain of f is given by $f'(x) = \lim_{h \to 0} \frac{f(x + h) - f(x)}{h}$ **exist.**

For example, let us compute the derivative of the first function $f(x) = 3x^2+4$. Let us first compute the numerator of the quotient in (2, 3).

$$\begin{aligned} f(x + h) - f(x) &= (3(x + h)^2+4) - (3x^2+4) \\ &= (3x^2+6xh+3h^2+4) - 3x^2 - 4 \\ &= 6xh+3h^2 \\ &= h(6x+3h) \end{aligned}$$

$$\begin{aligned} f'(x) &= \lim_{h \to 0} \frac{f(x + h) - f(x)}{h} \\ &= \lim_{h \to 0} \frac{3(x + h)^2 + 4 - (3x^2 + 4)}{h} \\ &= \lim_{h \to 0} \frac{h(6x + 3h)}{h} \\ &= \lim_{h \to 0} (6x + 3h) \\ &= 6x. \end{aligned}$$

We see that computing the derivative using the definition of even a simple polynomial is a lengthy process. What follows next are rules that will enable us to find derivatives easily. We call them **DIFFERENTIATION RULES.**

DIFFERENTIATING CONSTANT FUNCTIONS

The graph of a constant function is a horizontal line, and a horizontal liner has a zero slope. The derivative measures the slope pf the tangent, and so the derivative is zero.

RULE 1: <u>The Constant Rule</u>

If $f(x) = c$ where c is a constant, then $f'(x) = 0$. The derivative of a constant6 is equal to zero.

Example 1: Find the derivative of $y = 8 + \pi$.

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y' = $8 + \pi$

y' = 0 + 0

y' = 0

Example 2: Find the derivative of y= 2.

y' = 2

y' = 0

RULE 2: The Power Rule

If $f(x) = x^n$ where $n \epsilon \mathbf{N}$, then $f'(x) = nx^{n-1}$.

The derivative of the nth power of a variable is the product of the n and the (n-1)st power of the variable. Or, to differentiate x to a positive integer power, take the power and multiply it by x to the lower integer power.

Ex. 1 Find the derivative of y = x

y' = x

y' = x^{1-1}

y' = x^0

y' = 1

Ex. 2 Find the derivative of y = x^4

y' = x^4

y' = $4x^{4-1}$

y' = $4x^3$

RULE 3: The Constant Multiple Rule

If $f(x) = k\,h(x)$ where k is a constant, then $f'(x) = k\,h'(x)$.

Example 1: Find the derivative of y = $3x^6$

y' =$3x^6$

y' = $\mathbf{6\,.\,3x^{6-1}}$

y' = $18x^5$

Example 2: Find the derivative of y = $4x^5$.

y' = $4x^5$

y' = $5\,.\,4x^{5-1}$

y' = $20x^4$

RULE 4. The Sum Rule

If $f(x) = g(x) + h(x)$ where g and h are differentiable functions, then $f'(x) = g'(x) + h'(x)$.

The derivative of a sum of a finite number of differentiable functions is a sum of the derivatives.

Example 1: Find the derivative of y = $3x^2 + 2x - 1$.

y' = $3x^2 + 2x - 1$

y' = $2\,.\,3x^{2-1} + \mathbf{1}\,.\,2x^{1-1} - 0$

y' = 6x + 2

Example 2: Find the derivative of y = $(⅔)w^3 - 4w + 86$.

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y = $(2/3)w^3 - 4w + 86$

y' = $3(2/3)w^{3-1} - 1 \cdot 4w^{1-1} + 0$

y' = $2w^2 - 4$

RULE 5. <u>The Product Rule</u>

If *f* and *g* are differentiable functions, $D_x[f(x)\,g(x)] = f(x)\,g'(x) + g(x)\,f'(x)$.

The derivative of a product of two functions is the first function times the derivative of the second plus the second functiontimes the derivative of the first.

Example 1: Find the derivative of y = $(x^3 + 2x)(2x - 1)$.

y = $(x^3 + 2x)(2x - 1)$

y' = $(x^3 + 2x)(2) + (2x - 1)(3x^2 + 2$

y' = $(8x^3 - 3x^2 + 8x - 2$

Example 1: Find the derivative of y = $(x^3 - 3x^2)(x^2 + 4x + 2)$.

y = $(x^3 - 3x^2)(x^2 + 4x + 2)$

y' = $(x^3 - 3x^2)(2x + 4) + (x^2 + 4x + 2)(2x^2 - 6x)$

y' = $2x^4 - 2x^3 - 12x^2 + 3x^4 + 6x^3 - 18x^2 - 12x$

y' = $5x^4 + 4x^3 - 30x^2 - 12x$

RULE 6. <u>The Quotient Rule</u>

Let *f(x)* and *g(x)* be two differentiable functions with $g(x) \neq 0$.

Then, $D_x\left[\frac{f(x)}{g(x)}\right] = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2}$

The derivative of a quotient of two functions is the denominator times the derivative of the numerator minus the numerator times the derivative of the denominator, all divided by the denominator squared.

Example 1: Find the derivative of y = $\frac{x^2+1}{x^3-1}$.

y = $\frac{x^2+1}{x^3-1}$

y' = $\frac{(x^3-1)(2X)-(x^2+1)(3x^2)}{(x^3-1)^2}$

y' = $\frac{2x^4-2x-3x^4-3x^2}{(x^3-1)^2}$

y' = $\frac{-x^4-3x^2-2x}{(x^3-1)^2}$

y' = $\frac{-x^4-3x^2-2x}{(x^3-1)^2}$

Example 2: Find the derivative of y = $\frac{x+2}{X-1}$.

y = $\frac{x+2}{X-1}$

y' = $\frac{(X-1)(1)-(X+2)(1)}{(X-1)^2}$

y' = $\frac{(X-1)-(X+2)}{(X-1)^2}$

y' = $\frac{X-1-X-2}{(X-1)^2}$

y' = $\frac{-3}{(x-1)^2}$

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume IX Issue IIIS September 2025 | Special Issue on Education

RULE 7: **Derivatives of Trigonometric Functions**

(a) $D_x(\sin x) = \cos x$

(b) $D_x(\cos x) = -\sin x$

(c) $D_x(\tan x) = \sec^2 x$

(d) $D_x(\cot x) = -\csc^2 x$

(e) $D_x(\sec x) = \sec x \tan x$

(f) $D_x(\csc x) = -\csc x \cot x$

Example 1: Find the derivative of $y = x^3 + \sin x + 4 \cos x$.

$y = x^3 + \sin x + 4 \cos x$

$y' = 3x^2 + \cos x + 4 (-\sin x)$

$\boldsymbol{y' = 3x^2 + \cos x - 4 \sin x}$

Example 2: Find the derivative of $y = x^2 \sin x$.

$y = x^2 \sin x$

$y' = 2x (\sin x) + x^2 (\cos x)$

$\boldsymbol{y' = 2x \sin x + x^2 \cos x}$

RULE 8: **Derivative of an Exponential Function**

If $f(x) = e^x$, the $f'(x) = e^x$.

Example 1: Find the derivative of $y = e^{5x+3}$.

$y = e^{5x+3}$

$y = e^{5x+3} . 5$

$\boldsymbol{y = 5e^{5x+3}}$

Example 2. Find the derivative of $y = e^{x^2}$.

$y = e^{x^2}$

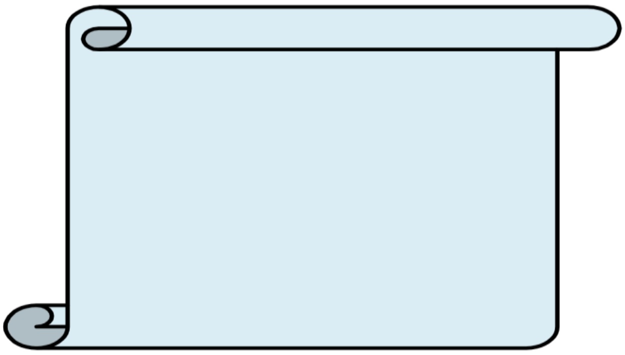
$\boldsymbol{y = e^{x^2} . 2x}$

E. Activities

- The teacher will give a practice activity for the students.
  Find the derivatives of the following:
  1. If $f(x) = x^3 + 2x^2 + 4x - 1$
  2. If $f(x) = 9$
  3. If $f(x) = (x - 1)(x + 1)$
  4. If $y = x^3(x^2 - 4x + 3)$
  5. If $(3t^2 + 2)(3t^2 - 2t + 1)$

F. Application

Create a word problem involving derivatives as the slope of a tangent line. Theproblem must be related in real life scenario/situation and solve it. Show your solution using short or long method and box the final answer. Criteria will follow.



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Criteria	1	2	3	4
Depth of the Content	Demonstrates little or no understanding of the task and subject matter. Needs serious revision.	Demonstrates a limited understanding of the task. Needs revision	Demonstrates a thoughtful understanding of the task and subject matter	Demonstrates a thorough and conscious understanding of the writing task and subject matter.
Development of examples and evidence	None or very few specific examples used to support claims.	Uses some vaguely developed examples to support claims.	Uses relevant examples from experience to support claims. Makes applicable connections between ideas	Uses specific and convincing examples to support ideas and makes insightful connections.
Language use/style	Uses language that is unsuitable for the audience and purpose with little or no awareness of sentence structure.	Uses some imprecise language with little sense of voice and limited awareness of how to vary sentence structure.	Uses language that is usually fresh and original with a sense of awareness of audience and purpose. Able to vary sentence structure	Uses stylistically sophisticated language that is precis and engaging with a good sense of voice and awareness of audience and purpose. Skillful sentence structure.
Grammar/conventions	Demonstrates little or no control of grammar and conventions, making comprehensions difficult	Demonstrates partial control of grammar and conventions with occasional errors that do not hinder comprehension.	Demonstrates control of grammar and conventions with only slight errors when using sophisticated language.	Demonstrates total control of grammar and conventions with essentially no errors, even with sophisticated language.

G. Generalization

The teacher will ask the following questions:

- ➢ How can we solve a given function applying the rules of differentiation?
- ➢ How important are derivatives in our everyday life?

IV. ASSESSMENT

- The teacher will give a performance related to the topic by group.

Find the Hidden Message!

I. Write the letter that corresponds to the answer in each blank to reveal the message. Use the letter bank at the bottom to decode the message. Arrange your solutions and make sure that is visible, clear, and organized.

CODE

A	W	A	I	K	U	M	T	O	H	Y	E	R
0	$-\frac{3}{(x-2)^2}$	$\sec x \tan x$	$\cos x$	1	$3e^{3x}$	2	-4	-2	$3e^{3x+2}$	$\frac{x(x-10)}{(x-5)^2}$	e^x	$8x^3$

- Find the derivative: $y = \frac{x^2}{x-5}$
- Find the derivative of $g(x) = e^{3x}$
- Given $y = \frac{x}{x^2+1}$ find the instantaneous velocity at which y changes with x at a point x=2.
- Derivative of y= -2x
- Derivative of f(x) = $2x^4$
- Simplify: $4x^3\sqrt{4}$
- Derivative of $y = e^{3x+2}$
- g(x)= sec x
- Find the derivative: $y = \frac{x+2}{x-1}$
- $f(x) = e^x$
- Find the derivative of sin x
- Evaluate: $\lim_{x \to -2} \frac{x^2-4}{x+2}$
- Given the slope intercept form y= -4x+3, what is the slope?

$\frac{x(x-10)}{(x-5)^2}$	-2	$3e^{3x}$

$\sec x \tan x$	$8x^3$	e^x

$-\frac{3}{(x-2)^2}$	-2	$8x^3$	-4	$3e^{3x+2}$

$\cos x$	-4

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume IX Issue IIIS September 2025 | Special Issue on Education

Figure 4 Instructional Design for Basic Calculus (Chain Rule) using CTL Approach

An Instructional Design in STEM 11 SHS

Subject Name: Math 4

Subject Descriptive Title: *Basic Calculus*

I. LEARNING OUTCOMES

At the end of the session, you should be able to:

- Illustrate the chain rule of differentiation; and
- Solve problems using the Chain Rule.

II. SUBJECT MATTER

A. **Topic: The Chain Rule**

B. **Materials:**

- ✓ E-book (LMS)
- ✓ Laptop/Mobile phones
- ✓ Calculator
- ✓ ClassIn app
- ✓ LMS

C. **References:**

- ✓ Basic Calculus book Published by the Commission on Higher Education, 2016
- ✓ Mercado, J.P. (2016). Next Century Basic Calculus. Phoenix Publishing House, Inc. Quezon City, Philippines.
- ✓ Egarguin, N.A., Fontanil, L.L., & Lawas, V.M. (2017). Basic Calculus for Senior HighSchool. C & E Publishing, Inc. Quezon City, Philippines.
- ✓ Pagala R.C. & Valderama, M.S. (2018). Basic Calculus for Senior High School. Mindshapers Co., Inc. Intramuros Corporate Plaza Bldg, Recoletos St., Manila.
- ✓ Alegre, H.C. (2016). Basic Calculus. Anvil Publishing, Inc. Mandaluyong City, Philippines

III. PROCEDURE

A. Preparation

- Preliminaries
  - ➢ Prayer
  - ➢ Attendance
  - ➢ Checking virtual environment

B. Motivation

- Teacher will start with a matching type of activity where they need to pair up the corresponding derivatives. Teacher will ask the answer from the students per item.

Matching type: Match the function in Column A with their corresponding derivativesin Column B.

Column A
$f(x) = (3x^2 - 2x + 4)^2$
$f(x) = sin^2 x$
$f(x) = \sqrt{sin\ x}$
$f(x) = (3x^4 - 3)(5x^2 + 1)$
$f(x) = xe^x$

Column B
$f'(x) = xe^x + e^x$
$f'(x) = 90x^5 + 12x^3 - 30x$
$f'(x) = 2\ sin\ x\ cos\ x$
$f'(x) = xe^x + ex$
$f'(x) = \frac{2\ sin\ x}{\sqrt{cos\ x}}$
$f'(x) = \frac{cos\ x}{2\sqrt{sin\ x}}$
$f'(x) = 36x^3 - 36x^2 + 56x - 16$

C. Presentation

- The teacher will show to the class the detailed Slide Presentation or PowerPoint. Slide presentations including all the content about the Chain Rule. The teacher will read the learning objectives.

D. Discussion

- The Chain Rule deals with the idea of composite functions and it is helpful tothink about an outside and an inside function when using The Chain Rule.
- In other words: The derivative when using the Chain Rule is the derivative ofthe outside leaving the inside unchanged times the derivative of the inside.

The Chain Rule below provides for a formula for the derivative of a composition of functions.

Theorem: (Chain Rule). *Let f be a function differentiable at at c and let g be a function differentiable at f(c). Then the composition* $g \circ f$ *is differentiable at c and*

$$D_x(g \circ f)(c) = g'(f(c)) \cdot f'(c).$$

Remark 1: Another way to state the Chain Rule is the following: If y is a differentiable function of u defined by $y = f(u)$ and u is a differentiable function of x defined by $u = g(x)$, then y is a differentiable function of x, and the derivative of y with respect to x is given by

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

In words, the derivative of a composition of functions is the derivative of the outer function evaluated at the inner function, times the derivative of the inner function.

$$y = f(g(x)),$$

Outer function Inner Function

$$\frac{dy}{dx} = (derivative\ of the\ outer\ function) \cdot (derivative\ of\ the\ inner\ function)$$

Examples:

a) Recall our first illustration $f(x) = (3x^2 - 2x + 4)^2$. Find $f'(x)$ using the Chain Rule.

Solution. We can rewrite $y = f(x) = (3x^2 - 2x + 4)^2$ *as* $y = f(u) = u^2$ where $u = 3x^2 - 2x + 4$, a differentiable function of x. Using the rule, we have;

$$f'(x) = y' = \frac{dy}{du} \cdot \frac{du}{dx}$$

$$= (2u)(6x - 2)$$

$$= 2(3x^2 - 2x + 4)(6x - 2)$$

derivative of outer function derivative of inner function

$$= 36x^3 - 36x^2 + 56x - 16$$

b. For the second illustration, we have $y = \sin(2x)$. Find y' using the Chain Rule.Solution: We can rewrite $y = \sin(2x)$ *as* $y = f(u)$ *where* $f(u) = \sin u$ *and* $u = 2x$

$$y' = \frac{dy}{du} \cdot \frac{du}{dx}$$

$$= \cos u \cdot 2$$

$$= 2\cos(2x)$$

c. Differentiate: $f(x) = (6x^4 - 2x^2 + 3)^{\frac{1}{3}}$.

$$f'(x) = \frac{1}{3}(6x^4 - 2x^2 + 3)^{-\frac{2}{3}}(24x^3 - 4x)$$

$$f'(x) = \frac{4}{3}x(6x^4 - 2x^2 + 3)^{-\frac{2}{3}}(6x^2 - 1)$$

$$f'(x) = \frac{4x(6x^2-1)}{3(6x^4-2x^2+3)^{\frac{2}{3}}}$$

d. What is the derivative of $y = (3x^2 + 4x - 5)^5$?

Solution:

$$D_x(3x^2 + 4x - 5)^5 = 5 \cdot (3x^2 + 4x - 5)^{5-1} \cdot D_x(3x^2 + 4x - 5)$$

$$= \mathbf{5(3x^2 + 4x - 5)^4(6x + 4)}$$

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume IX Issue IIIS September 2025 | Special Issue on Education

E. Activities

- The teacher will give a written activity for the students to practice.

Find the derivative of the following function using the Chain Rule.

1. $y = (3x - 5x^2)^7$
2. $y = \frac{7}{(2x-3)^2}$
3. $y = (4x^2 + 2x)^4$
4. $f(x) = \tan(x^2 - 2)$
5. $f(x) = \sqrt[3]{(x^2 - 1)^2}$

F. Application

- The teacher will show some real-life scenarios to where the topic Chain Rule can apply. (Video/Illustrations) The teacher will ask questions about the presentation and ask question to how they appreciate it.
- The teacher will give a performance task related to the topic and students will givetheir reflection on how the topics relate in real life experiences.

INSTRUCTION: Think about how you can relate The Chain Rule in real life experiences. Put it in a document and submit it in a PDF file. Make the content concise, organized, and creative. The content of your reflection will be evaluated with these criteria:

Criteria	1	2	3	4
Depth of Reflection	Demonstrates little or no understanding of the writing task and subject matter. Needs serious revision.	Demonstrates a limited understanding of the writing task. Needs revision	Demonstrates a thoughtful understanding of the writing task and subject matter	Demonstrates a thorough and conscious understanding of the writing task and subject matter.
Development of examples and evidence	None or very few specific examples used to support claims.	Uses some vaguely developed examples to support claims.	Uses relevant examples from experience to support claims. Makes applicable connections between ideas	Uses specific and convincing examples to support ideas and makes insightful connections.
Language use/style	Uses language that is unsuitable for the audience and purpose with little or no awareness of sentence structure.	Uses some imprecise language with little sense of voice and limited awareness of how to vary sentence structure.	Uses language that is usually fresh and original with a sense of awareness of audience and purpose. Able to vary sentence structure	Uses stylistically sophisticated language that is precis and engaging with a good sense of voice and awareness of audience and purpose. Skillful sentence structure.
Grammar/conventions	Demonstrates little or no control of grammar and conventions, making comprehensions difficult	Demonstrates partial control of grammar and conventions with occasional errors that do not hinder comprehensi	Demonstrates control of grammar and conventions with only slight errors when using sophisticated language.	Demonstrates total control of grammar and conventions with essentially no errors, even with

		on.		sophisticated language.

G. Generalization

The teacher will ask the following questions:

- How can we solve a function using The Chain Rule?
- How can we apply Chain Rule in our everyday life?

IV. ASSESSMENT

Find the derivative by using Chain Rule.

1. $y = (3x^2 + 2)(-2x^3 - 3)^3$
2. $y = 2\cos(3x) + 3\sin(x^7)$
3. $y = \frac{\sin 4}{\cos 4x}$
4. $y = \cos^2(2x^2)$
5. $f(x) = \tan^3(4x)$

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

This chapter presents the summary, findings, conclusions, and recommendations of the study.

Summary

This study used a quantitative-qualitative method of research which specifically employed pretest-posttest with control and experimental group to investigate the effectiveness of the Contextual Teaching and Learning Approach (CTL) in enhancing the academic performance in Mathematics-Basic Calculus of the Senior High School (SHS) Grade 11 STEM students in a blended learning modality. Specifically, it sought to answer the following questions:

1. What is the pretest Mathematics performance of the students in the:

1.1 control group (conventional lecture method) and

1.2 experimental group (with CTL)?

2. What is the posttest Mathematics performance of the students in the:

2.1 control group and

2.2 experimental group?

3. Is there a significant mean gain difference from the pretest to the posttest Mathematics performance of the students in the:

3.1 control group and

3.2 experimental group?

4. Is there a significant difference in the mean gains in Mathematics academic performance between control and experimental group?

5. What are the feedbacks of the experimental group students towards CTL approach in Basic Calculus?

6. What instructional material can be developed out of this contextual teaching and learning approach in secondary schools as an integrated module for STEM students?

Findings

As a result of the analyses and interpretation of data, the following were the findings of the study:

1. The control and experimental groups had Below Average pretest performance in Basic Calculus.

2. The control group had Below Average posttest performance while the experimental group had Above Average posttest performance in Basic Calculus.

3. There was no significant difference in the mean gain of the pretest and posttest of the control group while there is a significant difference in the mean gain of the pretest and posttest of the experimental group.

4. The experimental group had a significant difference in the academic performance in basic calculus compared to the control group. This suggests that the CTL approach was not comparable to the conventional lecture in improving the performance of Grade 11 students in Basic Calculus.

5. The feedback coming from the students was encouraging. The majority expressed that the CTL approach helped them to understand the topic well by connecting it to real-life situations. They confirmed that they want to experience the CTL approach rather than the conventional approach in their future classes.

6. The researcher developed three (3) instructional designs for Basic Calculus. Specifically on the topics of The Derivative as the Slope of a Tangent Line, Differentiation Rules, and Chain Rule, it highlighted the Inquiry, Learning Community, Reflection, and Authentic Assessment as categories of the CTL approach.

Conclusion

Concepts in Basic Calculus are considered challenging for the students due to their complexity and has been taught focusing on lecture method and problem solving. However, as the trend of education develops, different strategies and approaches could be applied while teaching the subject matter.

CTL approach is working more effectively than the conventional approach. The utilization of the Contextual Teaching and Learning Approach is a potential method for enhancing students' academic performance of the students in Basic Calculus. It makes them responsible for their own performance as it includes collaboration where they work as a group and allows them to connect in real-life situations. However, it still faces some challenges, especially the lack of resources – internet connection.

Funding

"This research received NO external funding"

Ethical Approval

This study adhered to the ethical principles of beneficence, non-maleficence, autonomy, and justice. Appropriate mechanisms were employed in the equal distribution of risks and benefits. To adhere to the ethical principle of non-maleficence, the physical risk of possible exposure to the COVID-19 virus was avoided in data collection using Google Forms. The participants' responses will be kept on the researchers' computers with the password. The results will be presented in aggregate form to protect their privacy and ensure the de-identification of the study respondents.

By the principle of autonomy, the participants will be given the option of whether to participate in the study. They will be asked to signify their willingness to be the research respondents by affixing their signature to the Informed Consent Form (ICF), comprising two parts: the information sheet about the scope and methodology of the study and the data privacy agreement/certificate of consent. The contents will also be discussed with the target respondents before they are asked to sign it.

Competing Interest

“The author declares no conflicts of interest”

Data Availability

“Data will be made available by the corresponding author on request”

Declaration of Artificial Intelligence Use

In this work, the author utilized artificial intelligence (AI) tools and methodologies, Perplexity AI to paraphrase content paragraph, Grammarly AI to check and auto change the grammar of the content, Scribbr Ai to arrange alphabetically the list of references. After using these tool/service, the author evaluated and revised the content as necessary and take full responsibility for the published content.

ACKNOWLEDGEMENT

The researcher would like to extend his most tremendous gratitude to the following people who contributed a lot to the completion of this special problem:

To Sir Dexter Gabica, his adviser, thank you for being so patient and for sharing your expertise in making this paper possible; Thank you for guiding him step-by-step in the completion of his paper. Your kind words never fail to encourage him to continue,

to his family, especially Mama Eming, Ate Phobee and Ate Celes for the full encouragement and support. He is thankful to them for being always there for him and for supporting him for anything he does;

to his colleagues in UC-Banilad, Richard, Sarah, Beejay and Jude for the advice, time and support and assistance. Parody people, Dave, Abby, James, Glaiza and Apple for just being there. To Katrina, Harold, Maki, Shan and Kenneth as my constant listeners.

REFERENCES

1. Adams, G., & Carnine, D. (2003). Direct instruction. Handbook of learning disabilities, 403-416.
2. Butzler, K. B. (2014). The effects of motivation on achievement and satisfaction in a flipped classroom learning environment. Northcentral University.
3. Bradley, R. H., & Corwyn, R. F. (2002). Socioeconomic status and child development. Annual review of psychology, 53(1), 371-399.
4. Clark, K. R. (2018). Learning theories: constructivism. Radiological Technology, 90(2), 180–182. de Vera, B. O. (2021, July 1). 80% of PH kids don’t know what they should know – World Bank. INQUIRER.Net. https://newsinfo.inquirer.net/1453814/wb-80-of-ph-kids-dont-know-what-they-should-know.
5. Dehghanzadeh, S., & Jafaraghaee, F. (2018). Comparing the effects of traditional lecture and flipped classroom on nursing students' critical thinking disposition: A quasi-experimental study. Nurse education today, 71, 151-156.

6. Dziuban, C., Graham, C. R., Moskal, P. D., Norberg, A., & Sicilia, N. (2018). Blended learning: the new normal and emerging technologies. International Journal of Educational Technology in Higher Education, 15(1), 3. https://doi.org/10.1186/s41239-017-0087-5.
7. Engelmann, S. (1980). Direct instruction (Vol. 22). Educational Technology.
8. Ezeano, C., & Agwu, D. U. (2015). Comparative Study of Effects of Learning Activity Package Instructional Strategy (Lapis) and Lecture Method on Students' academic Achievement in Senior Secondary School Chemistry. Journal Of Science & Computer Education, 3(3).
9. Fabito, B. S., Trillanes, A. O., & Sarmiento, J. R. (2021). Barriers and challenges of computing students in an online learning environment: Insights from one private university in the Philippines. International Journal of Computing Sciences Research, 5(1), 441-458. doi: 10.25147/ijcsr.2017.001.1.51.
10. Glynn, S. M., & Winter, L. K. (2004). Contextual Teaching and Learning of science in elementary schools. Journal of Elementary Science Education, 16(2), 51–63. https://doi.org/10.1007/bf03173645.
11. Gordon, M. (2008). Between Constructivism and Connectedness. Journal of Teacher Education, 59(4), 322–331. https://doi.org/10.1177/0022487108321379.
12. Hänze, M., & Berger, R. (2007). Cooperative learning, motivational effects, and student characteristics: An experimental study comparing cooperative learning anddirect instruction in 12th grade physics classes. Learning and instruction, 17(1), 29-41.
13. Hendriana, H., & Fadhillah, F. M. (2019). THE STUDENTS' MATHEMATICAL CREATIVE THINKING ABILITY OF JUNIOR HIGH SCHOOL THROUGH PROBLEM-SOLVING APPROACH. Infinity Journal, 8(1), 11–20. https://doi.org/10.22460/infinity.v8i1.p11-20.
14. Hudojo, H. (2005). Pengembangan kurikulum dan pembelajaran matematika. UM Press.
15. Johnson, E. B. (2002). Contextual teaching and learning: What it is and why it's here to stay. Corwin Press.
16. Johnson-Glenberg, M. C., Birchfield, D. A., Tolentino, L., & Koziupa, T. (2014). Collaborative embodied learning in mixed reality motion-capture environments: Two science studies. Journal of Educational Psychology, 106(1), 86–104. https://doi.org/10.1037/a0034008.
17. Kadarsono, M., Suyitno, H., & Waluya, S. B. (2019). The Mathematical Critical Thinking Ability of Students in CTL Learning Based on Cognitive Style. Unnes Journal of Mathematics Education Research, 8(1), 89-95.
18. Khotimah, H. (2014, September 16). Khotimah, Husnul::Penerapan model pembelajaran kooperatif tipe Think Pair Share (TPS) untuk meningkatkan aktivitas belajar sisa pada materi transformasi kelas VII-A SMP Negeri 15 Malang / Husnul Khotimah UPT Perpustakaan UM. UPT PERPUSTAKAAN. http://library.um.ac.id/ptk/index.php?mod=detail&id=66649.
19. Kistian, A. (2018). PENGARUH MODEL PEMBELAJARAN CONTEXTUAL TEACHING AND LEARNING (CTL) TERHADAP HASIL BELAJAR MATEMATIKA SISWA KELAS IV SD NEGERI LANGUNG KABUPATEN ACEH BARAT. Bina Gogik, 5(2).
20. Lai, C. L., & Hwang, G. J. (2016). A self-regulated flipped classroom approach to improving students' learning performance in a mathematics course. Computers & Education, 100, 126–140. https://doi.org/10.1016/j.compedu.2016.05.006.
21. Laili, H. (2016). Keefektifan Pembelajaran dengan Pendekatan CTL dan PBL Ditinjau dari Motivasi dan Prestasi Belajar Matematika. PYTHAGORAS: Jurnal Pendidikan Matematika, 11(1), 25. https://doi.org/10.21831/pg.v11i1.9679.
22. Lastrijanah, L., Prasetyo, T., & Mawardini, A. (2017). PENGARUH MEDIA PEMBELAJARAN GEOBOARD TERHADAP HASIL BELAJAR SISWA. DIDAKTIKA TAUHIDI: JURNAL PENDIDIKAN GURU SEKOLAH DASAR, 4(2), 87. https://doi.org/10.30997/dt.v4i2.895.
23. Li, Y., & Schoenfeld, A. H. (2019). Problematizing teaching and learning mathematics as "given" in STEM education. International Journal of STEM Education, 6(1). https://doi.org/10.1186/s40594-019-0197-9.
24. Magliaro, S. G., Lockee, B. B., & Burton, J. K. (2005). Direct instruction revisited: A key model for instructional technology. Educational technology research and development, 53(4), 41-55.
25. Martin, N. (2019). From Containment to Realpolitik and Back Again: A Realist Constructivist Analysis of Turkey–EU Relations and the Migration Issue. JCMS: Journal of Common Market Studies, 57(6), 1349–1365. https://doi.org/10.1111/jcms.12947.

26. Masitoh, M. (2018). Pengembangan Media Pembelajaran Papan Berpaku Untuk Meningkatkan Pemahaman Konsep Luas Bangun Datar. Ibtida'i: Jurnal Kependidikan Dasar, 5(1), 49–60.
27. Mauliana, Ikhsan, M., & Subianto, M. (2018). Development of Learning Tool with Contextual Teaching and Learning (CTL) Approach to Improve Student Mathematical Connection Ability. Journal of Physics: Conference Series, 1088, 012012. https://doi.org/10.1088/1742-6596/1088/1/012012.
28. Nawas, A. (2018). Contextual Teaching and Learning (CTL) Approach through REACT Strategies on Improving the Students' Critical Thinking in Writing. International Journal of Applied Management Science, 4, 46–49.
29. Nurhadi, & Senduk, A. G. (2003). Pembelajaran Kontekstual (Contextual Teaching and Learning/CTL) dan penerapannya dalam KBK. Surabaya. Universitas Negeri Malang Press.
30. Pangemanan, A. (2020). Application of Contextual Teaching and Learning Approach on Statistics Material Against Student Results. International Education Studies, 13(4), 1–7. https://doi.org/10.5539/ies.v13n4p1.
31. Piaget, J. (1936). Origins of intelligence in the child. London: Routledge & Kegan Paul.
32. Piaget, J. (1955). The construction of reality in the child. Psychoanalytic Review, 42(3), 313–314.
33. Purba, G. I. D., & Surya, E. (2020). The Improving of Mathematical Understanding Ability and Positive Attitudes of Unimed FMIPA Students by Using the Contextual Teaching Learning (CTL)Approach. Journal of Physics: Conference Series, 1462(1), 012019. https://doi.org/10.1088/1742-6596/1462/1/012019.
34. Rahmaniah, R., & Dassa, A. (2021). The Implementation of Contextual Teaching and Learning Approach to Improve Students' Mathematics Achievement at Grade VII SMP Negeri 3 Makassar. ATLANTIS PRESS.
35. Ramsden, P. (2003). Learning to teach in higher education, (2).
36. Rosa, M., Shirley, L., Gavarrete, M. E., & Alangui, W., V. (2017). Ethnomathematics and its Diverse Approaches for Mathematics Education (ICME-13 Monographs) (1st ed. 2017 ed.). Springer.
37. Sadeghi, R., Sedaghat, M. M., & Ahmadi, F. S. (2014). Comparison of the effect of lecture and blended teaching methods on students' learning and satisfaction. Journal of advances in medical education & professionalism, 2(4), 146.
38. Saville, B. K., Zinn, T. E., Neef, N. A., Norman, R. V., & Ferreri, S. J. (2006). A comparison of interteaching and lecture in the college classroom. Journal of applied behavior analysis, 39(1), 49-61.
39. Selvianiresa, D., & Prabawanto, S. (2017). Contextual Teaching and Learning Approach of Mathematics in Primary Schools. Journal of Physics: Conference Series, 895, 012171. https://doi.org/10.1088/1742-6596/895/1/012171.
40. Shanti, E. A., & Aziz, Z. (2021). The Efforts To Improve Student's Interest In Learning Mathematics By Using The Ctl (Contextual Teaching And Learning) Learning Model In Muhammadiyah 8 Middle Students In Medan T.P 2018/2019. IJEMS:Indonesian Journal of Education and Mathematical Science, 95–102. https://doi.org/10.30596/ijems.v2i3.8130.
41. Schofield, M. (n.d.). Plato: The Laws. Internet Encyclopedia of Philosophy. Retrieved July 15, 2022, from https://iep.utm.edu/pla-laws/.
42. Smart, K. L., Witt, C., & Scott, J. P. (2012). Toward learner-centered teaching: An inductive approach. Business Communication Quarterly, 75(4), 392-403.
43. Sudarmin, S., Mursiti, S., & Asih, A. G. (2018, April). The use of scientific direct instruction model with video learning of ethnoscience to improve students' critical thinking skills. In Journal of Physics: Conference Series (Vol. 1006, No. 1, p. 012011). IOP Publishing.
44. Supiyati, S., Hanum, F., & Jailani, J. (2019). ETHNOMATHEMATICS IN SASAKNESE ARCHITECTURE. Journal on Mathematics Education, 10(1), 47–58. https://doi.org/10.22342/jme.10.1.5383.47-58.
45. Stockard, J., Wood, T. W., Coughlin, C., & Rasplica Khoury, C. (2018). The effectiveness of direct instruction curricula: A meta-analysis of a half century of research. Review of Educational Research, 88(4), 479-507.
46. Syamsuddin, S., & Istiyono, E. (2018). The effectiveness of mathematics learning through contextual teaching and learning approach in Junior High School. AIP Conference Proceedings. https://doi.org/10.1063/1.5054489

47. Tam, M. (2000). Constructivism, instructional design, and technology: Implications for transforming distance learning. Educational Technology & Society, 3(2), 50–60.
48. Tari, D. K., & Rosana, D. (2019). Contextual Teaching and Learning to Develop Critical Thinking and Practical Skills. Journal of Physics: Conference Series, 1233(1), 012102. https://doi.org/10.1088/1742-6596/1233/1/012102
49. Tamur, M., Jehadus, E., Nendi, F., Mandur, K., & Murni, V. (2020, October). Assessing the effectiveness of the contextual teaching and learning model on students' mathematical understanding ability: a meta-analysis study. In Journal of Physics: Conference Series (Vol. 1657, No. 1, p. 012067). IOP Publishing.
50. The ASEAN Post. (2020, June 7). "Blended Learning" In Virus-Hit Philippines. https://theaseanpost.com/article/blended-learning-virus-hit-philippines.
51. Tularam, G. A. (2018). Traditional vs Non-traditional Teaching and Learning Strategies–the case of E-learning. International Journal for Mathematics Teaching and Learning, 19(1), 129-158.
52. Ummul Uslima, U. U., Chandra Ertikanto, C. E., & Undang Rosidin, U. R. (2018). Contextual learning module based on multiple representations: the influence on students' concept understanding. Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah, 3(1), 11-29.
53. Wiggins, G. (2014). How Good Is Good Enough? E, 71(4), 10–16.
54. Xu, Z., & Shi, Y. (2018). Application of Constructivist Theory in Flipped Classroom — Take College English Teaching as a Case Study. Theory and Practice in Language Studies, 8(7), 880. https://doi.org/10.17507/tpls.0807.21.
55. Yildirim, A., & Yilmaz, S. S. (2016). The Effect of Context-Based Chemical Equilibrium on Grade 11 Students' Learning, Motivation and Constructivist Learning Environment. International Journal of Environmental and Science Education, 11(9), 3117–3137.
56. Yudha, A., Sufianto, S., Damara, B. E. P., Taqwan, B., & Haji, S. (2019). The impact of contextual teaching and learning (CTL) ability in understanding mathematical concepts. International Conference on Educational Sciences and Teacher Profession, 170–173.

APPENDIX A

Permit to Conduct Study

[DATE]

[NAME]

[SCHOOL PRINCIPAL]

Dear Ms. _________;

Greetings of Peace!

It is my great honor to be part of the ___ family. I learn a lot of things that shaped both my personal and professional growth. With that, there are still things that I need in order to improve my skills in teaching and to give our learners a valuable learning experience. That is why I strongly believe that for a continuous improvement for teaching-learning process, in this academe one way is to conduct research.

I am currently writing my research proposal for this school year, which focuses on the instruction using contextual teaching and learning (CTL) approach in teaching Basic Calculus. Contextual teaching and learning approach refer to the approach that recognizes and addresses the fact that knowledge is context- or situation based. It strives to make experience relevant and meaningful to students through linkages both in and beyond of the classroom. In the study, it will manly focus on Inquiry, Learning Community, Reflection and Authentic Assessment. I got interested to conduct this study because for the sudden change of mode of our modality, students need a new approach to help them learn math in an easy and comprehensive way.

With this, I am asking for your consent to allow me to conduct my study to the STEM Grade-11 students of the SY:2021-2022.

With your trust and support, the result of this study will be highly beneficial to students, teachers, to the school, and to the research community.

Your permission to conduct this study will be highly appreciated.

Thank you and God Bless.

Sincerely,

FRANZ A. MAG-USARA

Researcher

Appendix B

Consent for Research Participation

University Of The Philippines Cebu

College of Social Sciences

Master of Education Program

Consent Form For Research Participation

Title: CONTEXTUAL TEACHING AND LEARNING APPROACH IN MATHEMATICS FOR STEM STUDENTS ON BLENDED LEARNING MODALITY

Researcher: Franz A. Mag-usara

Dear Ma'am/ Sir:

Introduction

The undersigned student of the Med Program of the University of the Philippines Cebu is conducting a study entitled CONTEXTUAL TEACHING AND LEARNING APPROACH IN MATHEMATICS FOR STEM STUDENTS ON BLENDED LEARNING MODALITY. This part of our requirements in Educ 298 (Special Problem in Education}. We are inviting you to voluntarily participate in the study.

Purpose of the Study

The study aims to determine the effectiveness of the Contextual Teaching and Learning Approach (CTL) in enhancing the academic performance in Mathematics-Basic Calculus of the Senior High School (SHS) Grade 11 STEM students in a blended learning modality. Specifically, it sought to answer the following questions:

1. What is the pretest Mathematics performance of the students in the:

a. control group (conventional lecture method) and

b. experimental group (with CTL)?

2. What is the posttest Mathematics performance of the students in the:

a. control group (conventional lecture method) and

b. experimental group (with CTL)?

3. Is there a significant mean gain difference from the pretest to the posttest Mathematics performance of the students in the:

a. control group (conventional lecture method) and

b. experimental group (with CTL)?

4. Is there a significant difference in the mean gains in Mathematics academic performance between control and experimental group?

5. What are the feedbacks of the experimental group students towards CTL approach in Basic Calculus?

6. What instructional material can be developed out of this contextual teaching and learning approach in secondary schools as integrated module for STEM students?

Participant Selection

You are being invited to take part in this research because your knowledge and opinions can contribute to further our understanding of how the mathematics learning log can affect the performance in mathematics. You qualify to participate in the research in your capacity as

- Grade 11 STEM students taking up Basic Calculus

Voluntary Participation

Your participation in this study is entirely **voluntary**. If you decide to participate, you need to sign this consent form. You are still free to withdraw your participation anytime. During the interview, you can opt not to answer any of the questions you find too intrusive or offensive. You do not have to give any reason for not

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responding to any question, or for refusing to take part in the interview. Your information will not be shared to anyone outside the research project. You may cancel this consent at any time and without any reason. Withdrawing from the study means that your participation in the study will end and information will no longer be collected from you.

Risks and Benefits

Participation in this study has a minimal risk. If in any case, you may feel uncomfortable in some of the questions, you may opt not to answer or withdraw your participation in the study.

Your participation in the study will help us understand the effects of mathematics learning log on mathematics performance. It will also be the basis on what intervention measure may be proposed to improve students' mathematics performance in the new normal.

Procedure

If you agree to participate in this study, you will be asked to answer questions related to the topic. Participation and conducting the study will take approximately 3-4 weeks all in all or should you wish to give more information after the time, it would be highly appreciated. You will be given a copy of the questionnaire ahead so that you will be able to prepare for the topics that will be discussed. You may answer the questions to the best of your ability.

Confidentiality

We assure you that all data gathered in the interview will be kept at the highest level of confidentiality and will only be used for academic purposes. All personal information of the respondents will be protected and will not be shared. In case of questions or complaints about the research you may contact our research adviser Prof. Dexter G. Gabica at dggabica@up.edu.ph.

Your approval to participate in this study will be greatly appreciated. Thank you for your time and consideration regarding this matter.

Respectfully,

Franz A. Mag-usara

Researcher (09205166632)

famagusara@up.edu.ph

Participant's Consent

- I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it, and any questions I have asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study.
- I have been made to understand that my identity will be anonymized and that all information I will share will be kept confidential.
- I confirm that I have been provided a copy of the Informed Consent Form by the researcher. I affirm that this consent is given freely and voluntarily.

Name of the Participant: ________________________________

Signature of the Participant: ______________________________

Date (dd/mm/year): _______________________

Name of the Participant's Parent: ______________________________________

Signature of the Participant's Parent: ___________________________________

Date (dd/mm/year): ___________________________

Certificate of Consent Received by:

Print Name of Researcher: _____________________________________

Signature of Researcher: _______________________________________

Date (dd/mm/year): ____

Appendix C

Researcher-constructed Instrument for the Pretest and Posttest

Direction: Read and analyze each item carefully. Choose the letter of the BEST answer.

1. Which of the following statements is **TRUE?**

A. Secant line to a circle is a line intersecting any three points on that circle.

B. Secant line to a circle is a line intersecting at exactly one point on that circle.

C. Tangent line to a circle is a line intersecting at the center of that circle.

D. Tangent line to a circle is a line intersecting at exactly one point, the point of tangency.

2. Given points A, B, and C, had coordinates (1, -3), (3, - 2) and (-1, 0) respectively, which of the following lines has a positive slope?

A. $\overleftrightarrow{AB}$

B. $\overleftrightarrow{AC}$

C. $\overleftrightarrow{BC}$

D. $\overleftrightarrow{CD}$

3. Which of the following is the formula for finding the slope of a line?

A. $m = \frac{y-y_0}{x-x_0}$

B. $m = \frac{y_0-y}{x-x_0}$

C. $m = \frac{y-y_0}{x+x_0}$

D. $m = \frac{y+y_0}{x-x_0}$

4. Find an equation for the line tangent to given curve, $y = x^2 - x \; at \; x = -3$.

A. $y = -7x - 6$

B. $y = -7x + 6$

C. $y = -7x - 9$

D. $y = -7x + 9$

5. Which of the following is the point-slope form?

A. $y - y_0 = x_0(x - m)$

B. $y - y_0 = m(x - x_0)$

C. $y + y_0 = x_0(x - m)$

D. $x - x_0 = m(y - y_0)$

6. What is the equation of the line containing points (2,3) and (-1, 0)?

A. $y = -x + 1$

B. $y = x + 1$

C. $y = x - 1$

D. $y = -x - 1$

7. Which of the following is the process involved in the step shown below?

$$\lim_{x \to \frac{5}{3}} \frac{\sqrt{3x - 1} - 2}{x - \frac{5}{3}} \cdot \frac{\sqrt{3x - 1} + 2}{\sqrt{3x - 1} + 2}$$

A. Rationalization

B. Factoring

C. Finding LCM

D. Simplification

8. For a function ***g,*** we are given that g(7) = -3 and g'(7) = -1. What is the equation of the tangent line to the graph of ***g*** at x = 7?

A. $y + 1 = -3(x - 7)$

B. $y + 3 = -1(x - 7)$

C. $y - 7 = -1(x + 3)$

D. $y - 7 = -3(x + 1)$

9. When is the slope of a tangent line to a curve at a given point equal to zero?

A. broken line

B. diagonal line

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C. horizontal line

D. vertical line

10. What is the equivalent slope-intercept form of the point-slope form,

$$y - 5 = -4(x - 7)?$$

A. $y = -4x + 33$

B. $y = -4x - 33$

C. $y = 4x - 23$

D. $y = 4x + 23$

11. Which of the following is the derivative or $f'(1)\ of\ f(x) = \frac{2x}{x+1}$?

A. $\frac{1}{4}$

B. $\frac{1}{2}$

C. 1

D. 2

12. Which of the following is the slope and equation (standard form) of the tangent line to the $f(x) = \frac{1}{x+1}\ at\ x = 2$?

A. $3x + 9y = 7$

B. $x + 9y = 3$

C. $x - 9y = -1$

D). $x - 9y = 5$

13. Which of the following is the slope-intercept form of tangent line to the given function in item# 12?

A. $y = -\frac{1}{3}x + \frac{7}{9}$

B. $y = -\frac{1}{9}x + \frac{5}{9}$

C. $y = \frac{1}{9}x + \frac{1}{9}$

D. $y = \frac{1}{9}x - \frac{5}{9}$

14. The given limit below represents the derivative of a function $\boldsymbol{f}$ at a number , which of the following is the $\boldsymbol{f(x)}$ and $\boldsymbol{x}$**?**

$$\lim_{t \to 1} \frac{\sqrt{t+1} - \sqrt{2}}{t - 1}$$

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A. $\boldsymbol{f}(x) = t + 1\ ; \boldsymbol{x} = 1$

B. $\boldsymbol{f}(x) = t + 1\ ; \boldsymbol{x} = 2$

C. $\boldsymbol{f}(x) = \sqrt{t + 1}; \boldsymbol{x} = 1$

D. $\boldsymbol{f}(x) = \sqrt{t + 1}; \boldsymbol{x} = 2$

15. Which of the following describes the derivative of $f(x) = \sqrt{x^2 + 2x}\ at\ x = 0$?

A. infinite

B. finite

C. undefined

D. zero

16. What point will the function $y = \frac{x+3}{x-3}$ be discontinuous?

A. x = -3

B. x = 0

C. x = 1

D. x = 3

17. Is the function given below continuous or differentiable at x = 2?

$$f(x) = \begin{cases} 2x^2 - x & , x \leq 2 \\ 8x - 2 & , x > 2 \end{cases}$$

A. Continuous but not differentiable

B. Differentiable but not continuous

C. Both continuous and differentiable

D. Neither continuous nor differentiable

18. Which of the following is continuous?

A. $f(x) = |x|$

B. $f(x) = \frac{1}{x}$

C. $f(x) = \frac{2x-1}{x+1}$

D. $f(x) = \begin{cases} \ln x & , x < 0 \\ 0 & , x = 0 \end{cases}$

19. Which of the following is **NOT** differentiable?

A. $f(x) = |x|$

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B. $f(x) = (x + 4)^2$

C. $f(x) = 3$

D. $f(x) = 2x + 1$

20. Which of the following statements is **CORRECT?**

A. Continuous functions are differentiable.

B. Continuous functions do not have graphs.

C. Continuous functions are not differentiable.

D. Continuous functions have gaps on their graphs.

21. What is the derivative of $y = \ln(x^3 + 4)$?

A. $y' = \frac{2x^3+4}{4}$

B. $y' = \frac{6x^3-4}{4x}$

C. $y' = \frac{3x^2}{x^3+4}$

D. $y' = \frac{2x^3}{x^3+4}$

22. What is the derivative of $f(x) = x^6$?

A. $f'(x) = 6x^4$

B. $f'(x) = 6x^5$

C. $f'(x) = 6x^6$

D. $f'(x) = 6x^7$

23. What is the derivative of $y = 10^{5x}$?

A. $y' = ln10$

B. $y' = 10\ln(5)$

C. $y' = 50\ lnx$

D. $y' = (5)10^{5x}ln10$

24. What is the derivative of $y = 5e^x + 3\pi$?

A. $y' = 5e^x$

B. $y' = 5e^x + \pi$

C. $y' = 5e^x + 3$

D. $y' = 5e^x + 3\pi$

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25. What is the derivative of $= 3x^2 \sin x$?

A. $y' = 3x^2 cosx$

B. $y' = 3x^2 cosx + \sin x$

C. $y' = 3x^2 cosx + 6x \sin x$

D. $y' = 3x^2 cosx + 3x^2 sinx$

26. What is the derivative of $= e^{2x+1}$?

A. $y' = e^{2x+1}$

B. $y' = 2e^{2x+1}$

C. $y' = 2xe^{2x+1}$

D. $y' = (2x + 1)e^{2x+1}$

27. What is the derivative of $y = 3csc^{-1}x$?

A. $y' = -\frac{3}{x\sqrt{x^2-1}}$

B. $y' = -\frac{3x}{x\sqrt{x^2-1}}$

C. $y' = -\frac{3}{x^2\sqrt{x-1}}$

D. $y' = -\frac{3x}{x^2\sqrt{x-1}}$

28. What is the derivative of $y = \log_3 2x^3$?

A. $y' = \frac{3}{3xln3}$

B. $y' = \frac{2x^2}{2x^3ln3}$

C. $y' = \frac{3x^2}{2x^3ln3}$

D. $y' = \frac{6x^2}{2x^3ln3}$

29. What is the derivative of 5x?

A. 0

B. 1

C. 5

D. 5x

30. What is the derivative of $f(x) = x^6$?

A. $f'(x) = 6x^4$

B. $f'(x) = 6x^5$

C. $f'(x) = 6x^6$

D. $f'(x) = 6x^7$

31. Find the derivative of $f(x) = (x^5 + 4)^5$.

A.$5x^5(x^4 + 4)^4$

B. $6x^5(x^6 + 4)^4$

C. $30x^5(x^6 + 4)$

D.$30x^6(x^4 + 4)$

32. If $y = f(g(x))$ where $y = csc^3x$, what is the u of the function?

A. x

B. csc^3x

C. csc x

D.x^3

33. Find the derivative of $y = (x^2 + 2)^4$.

A. $y' = 8x(x^2 + 4)^3$

B. $y' = 4x(x^2 + 4)^3$

C. $y' = 8x(x^2 + 4)^4$

D. $y' = 8x^2(x^2 + 4)^4$

34. Find the $\frac{dy}{dx}$ if $y = cos^5x$.

A. $5cos^4x$

B. $5cos^4xsinx$

C. -$5sin^4x$

D. $-5cos^4xsinx$

35. Find the $\frac{dy}{dx}$ if y =$\sqrt[3]{-2x^3 + 4}$.

A.$\frac{x}{\sqrt[3]{(-2x^3+4)^2}}$

B.$-\ \frac{2x}{\sqrt[3]{(-2x^3+4)^3}}$

C.$-\ \frac{2x}{\sqrt{(-2x^3+4)^3}}$

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D. $\frac{2x}{\sqrt[3]{(-2x^3+4)^2}}$

36. Find y' if $y = \cot(4x)$.

A. $-4\, csc^2(4x)$

B. $4\, csc^2(4x)$

C. $csc^2(4x)$

D. $-\, csc^2(4x)$

37. Find the derivative of $y = (17x^2 - 5x)^{50}$

A. $6x^5(x^6 + 4)^4$

B. $50(17x^2 - 5x)^{49}(34 - 5)$

C. $30x^5(x^6 + 4)$

D. $30x^6(x^4 + 4)$

38. Find y' if $y = \tan(2 + 3x^3)$.

A. $\sec(2 + 3x^3)$

B. $9x\, cot^2(2 + 3x^3)$

C. $9x\, sec^2(2 + 3x^3)$

D. $sec^2(2 + 3x^3)$

39. Differentiate $y = \sin(7x)$.

A. $y' = -7cos7x$

B. $y' = -7sin7x$

C. $y' = 7xcos7x$

D. $y' = 7cos7x$

40. Differentiate $y = \frac{4}{(x^2-3)^3}$

A. $y' = -\frac{24x}{(x^2-3)^4}$

B. $y' = -\frac{24x}{(x^2-3)^3}$

C. $y' = \frac{12x}{(x^2-3)^4}$

D. $y' = -\frac{12x}{(x^2-3)^3}$

41. Find the derivative of $y = \sqrt{cos2x}$.

A. $y' = \frac{cos2x}{\sqrt{\sin 2x}}$

B. $y' = -\frac{cos2x}{\sqrt{\sin 2x}}$

C. $y' = \frac{sin2x}{\sqrt{\cos 2x}}$

D. $y' = -\frac{sin2x}{\sqrt{\cos 2x}}$

42. Find y' if $y = (e^{4x}) + 8$.

A. $4e^{3x} + 8$

B. e^{4x}

C.$4e^{4x}$

D. 32

43. Find y' if $y = \cos(2x^2)$.

A. $4\sin(2x^2)$

B. -4x sin $(2x^2)$

C.$2x\cos(2x^2)$

D.$-4x\cos(4x^2)$

44. Find the $\frac{dy}{dx}$ if $y = \ (2x+3)^{-5}$.

A. $\frac{dy}{dx} = \ -\frac{10}{(2x+3)^6}$

B. $\frac{dy}{dx} = \ -\frac{3}{(2x+3)^4}$

C. $\frac{dy}{dx} = \ \frac{6}{(2x+3)^5}$

D. $\frac{dy}{dx} = \ -\frac{5}{(2x+3)^4}$

45. Find the $\frac{dy}{dx}$ if $y = \ (5x^2+3)^{-4}$.

A. $40x(5x^2-3)^3$

B. $20x^2(5x^2-3)^3$

C. $4(5x^2-3)^3$

D. $5x^2(5x^2-3)^4$

Appendix D

March 21, 2022

RE: Request Letter for Tool Validation

Dear Mr. __________:

Greetings!

I am Franz A. Mag-usara, currently enrolled in the Master of Education program at the University of the Philippines Cebu and I am in the process of writing my master's Thesis. The study is entitled **"Contextual Teaching and Learning Approach in Basic Calculus-Blended Learning"**. A pretest and posttest questionnaire as instrument will be used in the said study specifically on the topics, The Derivative as Slope of the Tangent Line, Derivative Rules, and Chain Rule. I am writing to request your expertise to validate the self-made questionnaire to qualify for conduct of the study. Knowing your expertise in the field of Mathematics, I would like to ask for your help in validating the said instrument before administering it to the respondents of the study.

Herein attached are the validation sheet, questionnaire, and the statement of the problem of the study. I will be glad to hear your suggestions and comments for the improvement of the instrument.

I am looking forward that my request would merit your positive response. Your positive response is highly appreciated. Please feel free to contact me through 09205166632 should you have any concerns, and I will be happy to answer any questions. You may reach me thru my email as well at famagusara@up.edu.ph.

Thank you and God bless.

Respectfully Yours,

Franz A. Mag-usara

M.Ed. Mathematics

UP Cebu

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