Development and Acceptability of Worktext in Differential Calculus among Students of University of Rizal System

Jose D. Elveña Jr., Emmanuel M. Llarenas

University of Rizal System – RDEP

DOI: https://dx.doi.org/10.47772/IJRISS.2024.804062

Received: 11 March 2024; Accepted: 29 March 2024; Published: 04 May 2024

ABSTRACT

There has been an increased emphasis on students to recognizesignificance of Calculus in many areas of life. Hence, the demand of instructional materials like worktext despite rapid development of new technologies continues. This research is focused on developing a worktext that enhance students' solving ability, improving academic performance and creative thinking towards teaching material for this course. It is based on the outline prescribed by the Commission on Higher Education Memorandum Order (CMO) No. 12, series of 2008 (CHED, 2008).Developmental method of research was employed, and it utilized the ADDIE model(Analysis, Design, Develop, Implement, and Evaluate) to develop the instrument of instruction. Mathematics experts determined its acceptability using a validated evaluation instrument. Results showed that the worktext is acceptable in terms of content, relevance' style and presentation, usefulness, and clarity using weighted mean.Furthermore, the performance of students using the worktext reflected a significant difference compared to those who did not use. Thus, it validates the successful development and integration of the worktext into the course.

Mathematics teachers and professors are hereby recommended to develop and design their supplementary materials for their students develop and enhance their mathematics performance.

Keywords:acceptability, worktext, development, differential calculus

INTRODUCTION

Mathematics, as a fundamental discipline, plays a crucial role in various academic fields and is an essential component of any educational curriculum. Among its branches, calculus stands out as one of the cornerstones of mathematical knowledge, providing valuable tools for analyzing change and solving complex problems. Differential calculusis a necessity and of highly important as it serves as a vital foundation for many scientific and engineering disciplines.It provides a basis for understanding mathematical concepts and helps a person develop practical scientific and engineering sense and problem-solving skills. In a sense, calculus is a form of communication about the world just as much as language is a form of communication about thought.

The University of Rizal System, a prominent institution of higher education known for its commitment to

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

academic and service excellence, recognizes the significance of shaping students' analytical and problem-solving skills. To enhance the learning experience of its students, faculty are encouraged to use instruction suited to the level of understanding of students. Current instructional materials should be employed as tools to make instruction more effective,efficient, and interesting to the learners.

To enrich instruction is to provide the learners with systematic and carefully developed instructional materials designed to meet and support learners with varying levels of ability and skills.A worktext, as a hybrid of a workbook and a textbook, offers a unique learning approach that combines theoretical content with practical exercises. Designed to promote active learning, it engages students in hands-on activities, encouraging them to apply mathematical principles in real-world contexts. By using worktexts, educators aim to create a dynamic learning environment that fosters critical thinking and deep understanding of the subject matter.

This study focuses on the development and acceptability of a worktextin Differential Calculusto improve the mathematics proficiency of students at University of Rizal System. The primary objective is to create a comprehensive, accessible, and engaging worktext that addresses the learning needs and preferences of the students. It is envisioned to cover fundamental topics in differential calculusbased on CHED Memorandum Order (CMO) No. 12, series of 2008 such as limits, derivatives, and their applications.In addition to the development of the worktext, it also aims to evaluate degree to which the students find the worktext useful, user-friendly, and effective in facilitating their learning experience. By conducting acceptability assessments and gathering feedbacks, the researchers can make necessary improvements to enhance the worktext's overall class and quality.

Objectives

The main objective of the study was to develop and determine the level of acceptability of the worktext in Differential Calculus.

Specifically, the study sought to the following questions:

1. What instructional material may be developed to enhance the skills and competency of students based on the result of the diagnostic test in Differential Calculus?

2. What is the level of acceptability of mathematics experts on the proposed work text in Differential Calculus in terms:

    2.1 content;

    2.2 relevance;

    2.3 style and presentation;

    2.4 usefulness; and

    2.5 Clarity?

3. Is there a significant difference in the performance between the experimental and control group in Differential Calculus after worktext was utilized?

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

LITERATURE REVIEW

The low performance of students in Mathematics could be attributed to the of instructional resources in the classroom such as work text. In relation to this, the study of Auditor (2014) development and validation of aenth grade physics module stated that the use of a work text is effective in knowledge acquisition andis a useful tool for teaching and learning basic physics. Reyes and De Guia (2017) mentioned that many student who are using worktext or textbook feel secure and have a sense of progress in learning the lessons.Students find math concepts difficult due to the abstract and shallow discussion, less visualization and more on imagination brought out by the inadequate learning materials.

These frightening issues implied that teaching-learning is affected, the overall competencies and lessons discussed to the students for the school year were not totally achieved.

One reason perceived by the researcher as well as by other mathematics teachers is the lack of textbooks suited to students' level. Gibbon (2004) stressed the need to develop self-instructional materials with the current shift toward individualized programs in all levels of instruction.

In a study conducted by Kaptan (2012) mentioned that the challenges for mathematics education are the following: an insufficient number of math teachers' taking an active role in the preparation of the programs, students generally lack motivation and have low self-confidence in learning, a huge number of students in a class, the broken link with other lessons, insufficient physical conditions of schools. The intensive curriculum but insufficient time allocation for mathematics and the instruction of lesson in an information level and students in passive position (only listening and writing), teachers' inactive position (writing on the board and teaching classically).

There were schools that lacks instructional materials for teaching and learning mathematics. The inadequacy of these materials has been of serious concern to math teachers in rural areas (Aina, 2013).

Furthermore, workbook/worktext provide practice materials and suggestions design to make what would otherwise be trial and error learning definite, fool proof, economical and interesting (Gates, 2005). Similarly, Gray(2007), concluded that the use of workbooks/worktexts is beneficial, resulting in not only higher scores on standardized but also in n increase power of self-direction, helps in retention, skill in fundamental processes, reasoning ability and solving problems.

With the current shift from Inputs-based Education (IBE) to Outcomes-based Education (OBE), particularly in the tertiary level, it is necessary for the teachers to carefully design activities placing the students at the center of all educational planning. They must employ current instructional materials as tools to make instruction more effectiveefficient and appealing to the learners. One way to enhance instruction is to provide the learners with carefully developed lessons. Numerous studies over the years have introduced a range of instructional materials such as worktexts, workbooks and modules to meet the learners' needs and equip them with skills required for their level (Adora, 2014). Selga (2013) explained that worktexts are helpful in keeping one child occupied while working with another. As revealed in her study, the proposed worktext was found to be valid. She further concluded that worktexts contribute to the achievement of specific objectives of the subject and provide activities for the development of higher cognitive skills. Worktexts of better quality include problem-solving exercises that encourage higher-level thinking in addition to the traditional fillin-the-blank and define-the-term exercises (Knapp, 2006). Auditor and Naval (2014) addressed the need to improve the performance of all students across schools as manifested in the results of the 2012 National Achievement Test (NAT). As revealed in their study, the developed modules

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

were found acceptable for the 10th grade physics students. Also, the developed set of modules was found to be effective in terms of knowledge acquisition. Thus, they recommended that the adoption of the developed module can be a useful tool for teaching and learning basic physics. The integration of enrichment activities such as computer animations in the proposed instructional material generated a more innovative and interesting learning environment. Thus, through this material, students found Mathematics learning more meaningful and interesting (Dacanay, 2010).

Worksheets are materials by which students are given transaction steps regarding what they are supposed to learn. Also, they include activities which give the students main responsibility in their own learning. Thus worksheets are known to help students gain scientific process skills such as setting up experimental mechanism, recording data, interpreting the data, and so on so that they can conceptualize the concepts in their mind (Kurt &Akdeniz, 2002).

Teaching materials are a set of learning tools or tools that contain learning materials, methods, limitations, and evaluation methods that are designed specifically, systematically and attractively in order to achieve learning objectives in accordance with the minimum competencies of these subjects. This is in line with what Widodo and Jasmadi said in Lestari (2015). Even Widodo and Jasmadi emphasized the learning objectives to be achieved down to sub-competencies and all their complexities. While Prastowo (2011), said that teaching materials are materials or subject matter that are systematically arranged that are used by teachers and students in the learning process. Sumantri (2015), said that teaching materials a source of learning in the form of concepts, principles, definitions, content groups (context), data, facts, processes, values, abilities, and skills. Formally Komalasari (2011: 28) and Anonymous (2008: 6) say, teaching materials are materials needed for the formation of knowledge, skills, and attitudes that must be mastered by students in an effort to meet the competency standards set and used to help teachers (lecturers)) or instructors in carrying out teaching and learning activities in the classroom. There are at least three principles that must contained in a teaching material as stated by Amri (2010:162) saying, relevance, consistency, and adequacy are three principles that need to be considered in compiling teaching materials.

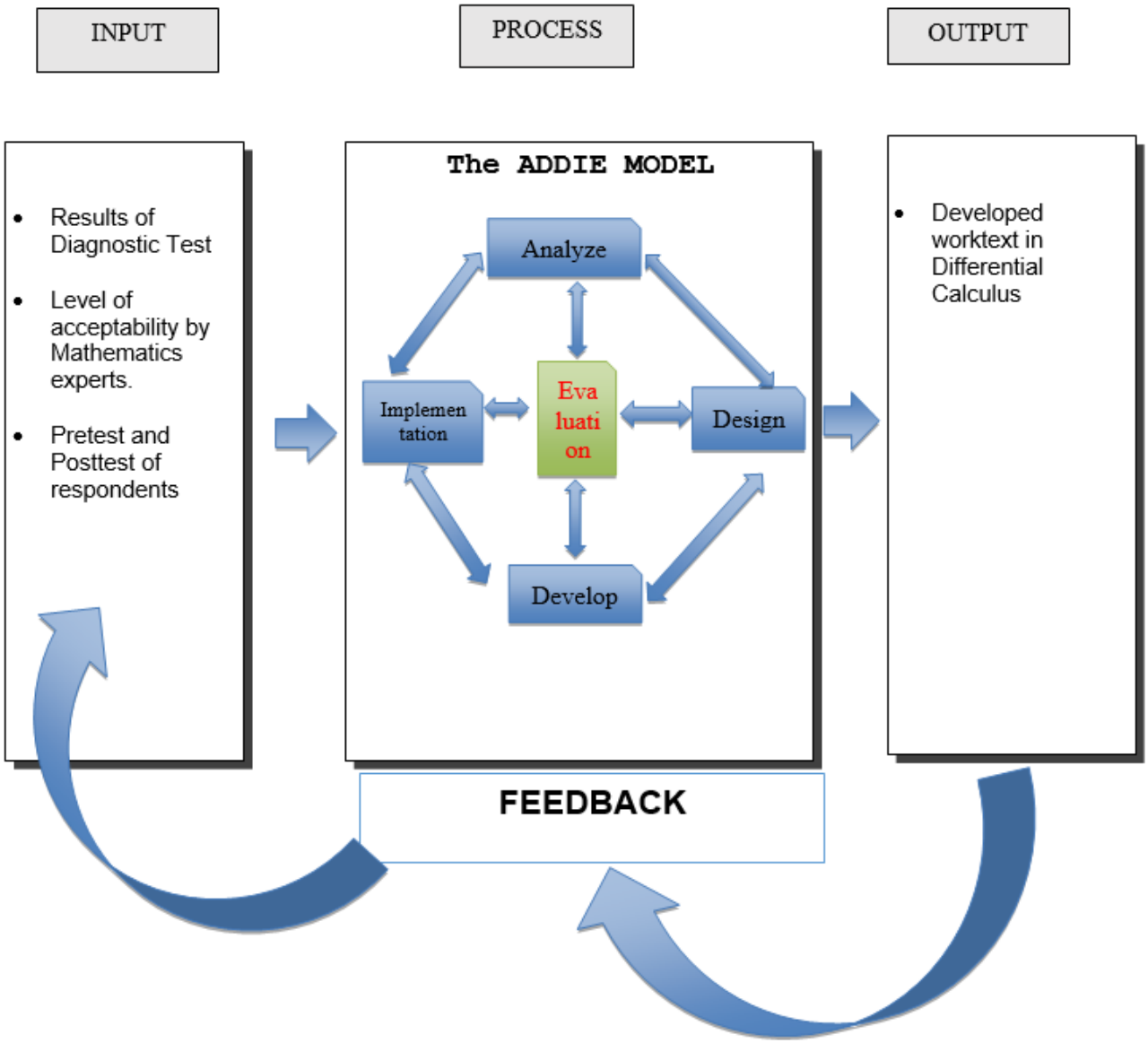
Some characteristics of teaching materials, including self-instructional, self-contained, stand-alone, adaptive, and user friendly (Lestari, 2015). Self-instructional means that the teaching materials can make students able to teach themselves, therefore the teaching materials must contain learning objectives, and be packaged into more specific units.One of the characteristics of the module as a teaching material is that the module is designed in such a way with the aim that students can learn independently by minimizing the role of the teacher in the learning process. This is in accordance with Anonymous (2017) which says, modules are teaching materials that are specially prepared and systematically designed based on a curriculum that is packaged into the smallest learning unit that students can use independently to achieve certain learning objectives that have been set. The following table 1 presents the differences between textbooks and teaching materials (Anonymous, 2011).

CONCEPTUAL FRAMEWORK

The conceptual framework is illustrated visually using the input-process-output model. Inputs are the variables used to arrive at the research outcome like the results of diagnostic test, level of acceptability by Mathematics experts and the pretest and posttest results of respondents. The research process utilized the ADDIE model (Analysis, Design, Develop, Implement, and Evaluate) to come out with the output – a worktext in Differential Calculus. The feedback indicates continuous process and relationships among the variables affecting the outcome.

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

Conceptual Framework



METHODOLOGY

This study utilized the descriptive Developmental research. According to Richey, Rita C. (2004), developmental research has been defined as the systematic study of designing, developing, and evaluating instructional programs, processes, and products that must meet criteria of internal consistency and effectiveness. It is particularly important in the field of instructional technology which involve situations in which the product-development process is analyzed and described, and the final product is evaluated.

This method is suitable for this study as the researchers have developed a worktext in Differential Calculus in accordance with the course outline prescribed by the Commission on Higher Education.

The researchers employed a systematic approach utilizing the ADDIE framework described by Aldoobie (2015). ADDIE is an acronym for analysis, design, development, implementation, and evaluation. Each

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

phaserepresents the fundamental concepts of the ID process and is related to and interact with each otherensuring that the design must be student-centered, goal-oriented with meaningful performance and outcomes that can be validly measured (Reiser & Dempsey, 2012)

In the analysis phase, the researchersexamined and surveyed the existing knowledge, skills, experience, characteristics,and attitudes of 234 students taking Differential Calculus course - the

target learners and determined instructional goals as well as the learning environment.As Beishuizen and Stoutjesdijk (1999) stated that the quality of learning material is enhanced if the students' learning styles are considered.To recognize the needs of students, result of diagnostic test was carefully examined, review of related studies and literature followed, where developing a worktext in Differential Calculus was planned and conceptualized.

In the design phase, designer identifies the learning objectives to outline contents and instructional strategies. Features like styles, exercises, activities and references were mapped out.Contents of the worktext matched theoutline prescribed by the Commission on Higher Education Memorandum Order (CMO) No. 12, series of 2008 (CHED, 2008). The contents are as follows:

1. Functions, Limits and Continuity
2. The Derivatives: Algebraic Functions
3. The Tangent line, Normal Line and Rate of Change
4. The Chain Rule and General Power Rule
5. Analysis of Functions
6. Applications of Derivatives: Optimization Problems
7. Derivatives of Trigonometric and Inverse Trigonometric Functions
8. Derivatives of Exponential and Logarithmic Functions
9. Derivatives of Hyperbolic and Inverse Hyperbolic Functions
10. Parametric Equations
11. Partial Differentiation

In the develop phase, careful analysis and study were undertaken where learning outcomes were stated before each topic. In such manner, learners would have a clear idea of what can be achieved at the end of each course. The Bloom's Taxonomy is helpful in writing the learning objectives and classifying them based on complexity and specificity using the cognitive, psychomotor, and affective learning domains (Adams, 2015).Based on the identified learningoutcomes, teaching context, learning activities and assessment scheme was properly designed and discussions were made simple for students to appreciate and successfully understand the lesson.Problem based learning is applied, where lots of drills were emphasized. Hence, the designer would think of how the instruction can be effective in ways that able the learners to interact with the materials (Aldoobie, 2015). At this stage, the development of the worktext, cover design, layout, font selection, editing, validation, and revisions are carried out by determining the level of

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

acceptability of mathematics experts in terms of content, relevance, style and presentation, usefulness, andclarity. Evaluation instrument together with the worktext was evaluated by distributing it to the experts.These experts are those professors in the university having thought thecourse for at least 5 years which also include some senior high school (SHS) teachers handling the course in the STEM strand.

For the implementation phase,the researchers revised, amended, and reconsidered all the comments and suggestions made by the experts after their thorough evaluation of the instrument's acceptability. The worktext was reproduced and handed over to the experimental group for their utilization to determine the impact on the quality of the learning process which includes, effectiveness, attractiveness, and efficiency. Respondents from the experimental group were allowed to use the worktext throughout the semester while the control group were treated by the usual lecture method without using the worktext.

For the evaluation phase, the quality and usefulness of the worktext was meticulously tested. The researchers made sure that the goalshave been met and the worktext is efficient and effective. Aside from administering a post test for the experimental and control group to find out the disparity in their performance, evaluation is carried out on each step to determine if flaw occurs in each procedure.

RESULTS AND DISCUSSIONS

What instructional material may be developed to enhance the skills and competency of students based on the result of the diagnostic test in Differential Calculus?

The table shows the average performance of students in Differential Calculus for each topic with an overall average of 34.621.

Result of Diagnostic Test in Differential Calculus

TOPICS	**Average Score**
1. Functions, Limits and Continuity	4.17
2. The Derivatives: Algebraic Functions	3.64
3. The Tangent line, Normal Line and Rate of Change	3.85
4. The Chain Rule and General Power Rule	3.04
5. Analysis of Functions	4.95
6. Applications of Derivatives: Optimization Problems	3.58
7. Derivatives of Trigonometric and Inverse Trigonometric Functions	3.61
8. Derivatives of Exponential and Logarithmic Functions	2.87
9. Derivatives of Hyperbolic and Inverse Hyperbolic Functions	2.96

10. Parametric Equations	1.83
11. Partial Differentiation	2.07
AVERAGE	**32.651**

The poor performanceof the studentsis noted which emanates from a variety of challenges. These include lack of algebraic skills and conceptual knowledge. In a study of Domondon et. al. (2023) made emphasis that errors committed by students in Basic Calculus should be undertaken. He found out that students find Basic Calculus difficult. Moreover, some of the difficulties experienced by the students were on lack of knowledge of the concepts, poor application, complicated formulas and processes, and confusion in understanding the problem. The researchers noticed the students' lack of proficiency and difficulties in learning, mastering and deficiency of proper background in Calculus, from which development of work text is conceptualized. As Dejarlo (2022) stated that teachers/profess sorsbe motivated to make their own worktext/module/ instructional materials to enhance the teaching-learning process of the course.

What is the level of acceptability of mathematics experts on the proposed work text in Differential Calculus in termsof:

3.1 content;

3.2 relevance;

3.3 style and presentation;

3.4 usefulness; and

3.5 clarity?

The table shows that the respondents rated the items on content as **veryacceptable**. Content is up-to-date with weighted mean of 4.73; content is accurate as shown by a weighted mean of 4.67; content is appropriate for college level with a weighted mean of 4.53; and content and skills are clearly stated and emphasize as supported by 4.60 weighted mean. Rated **acceptable** are the items: content which includes adequate development of concept and is appropriate for the student with a rating of 4.47 and content is relevant to students which received a rating of 4.20.The obtained overall mean value of 4.53 showed that the developed worktext has content very acceptable in the development of knowledge and skills in Differential Calculus.

Level of Acceptability of Mathematics

Experts on the Worktext in Terms of Content

Criteria	Weighted Mean	Interpretation
1. Content is up to date	4.73	VA
2. Content is accurate	4.67	VA

3. Content includes adequate development of concepts and is appropriate for the student.	4.47	VA
4. Content is appropriate for college level.	4.53	VA
5. Content is relevant to students.	4.20	A
6. Concept and skills to develop are clearly stated and emphasized	4.60	VA
Overall Mean	**4.53**	**VA**

Legend:

ScaleRange Verbal Interpretation

5 –(4.50-5.00) Very Acceptable (VA)

4 –(3.50-4.49) Acceptable (A)

3 –(2.50-3.49) Moderately Acceptable (MA)

2 –(1.50-2.49) Less Acceptable (LA)

1 – (1.00-1.49)Not Acceptable (NA)

The data imply that the respondents have given very satisfactory ratings on the materials. These findings ascribed to the results of the study conducted by Geneta and Guinto "teacher performed different mathematical activities so as to guide the students in performing generalizations and at the same time developing their own skills."

Relevance

The respondents agreed that the worktext has activities and learning areas relevant to the objectives and significant to the needs of the learner, skills are appropriate to the existing conditions and promote relative evaluative manners, used for practical applications, and concepts being developed in each topics.

Level of Acceptability of Mathematics

Experts on the Worktext in of Relevance

Criteria	Weighted Mean	Interpretation
1. The activities are relevant to the objectives/skills.	4.67	VA
2. The material provides a variety of	4.67	VA

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

relevant evaluative measures.		
3. The materials are significant to the needs of the students.	4.20	A
4. The materials are relevant, interesting and self-motivating for the learner.	4.60	VA
5. The materials are to the concepts being developed in each topic.	4.60	VA
6. The materials can be used for practical applications	4.20	A
Overall Mean	**4.49**	**A**

Specifically, all items under relevance were rated ***acceptable*** as evidenced by an overall mean score ranging from 4.20 – 4.67 mean scores.

Style and Presentation

Table below reveals the assessment of the respondents as to style and presentation.

Level of Acceptability of Mathematics

Experts on the Worktext in Terms of Style and Presentation

Criteria	Weighted Mean	Interpretation
1. The language of the material is clear in terms of vocabulary and terms used.	4.33	A
2. The writing style of the material is conversational and friendly.	4.20	A
3. The material uses correct grammar	4.33	A
4. Skill lessons are presented in logical order.	4.20	A
5. There are enough activities at the end of each lesson.	4.20	A
6. The level of the language used is appropriate to the level of the learners.	4.53	VA
Overall Mean	**4.30**	**A**

The respondents agreed that the worktext is clear in terms of vocabulary, style of the material is friendly; correct grammar is used; skill lessons are presented in logical order; enough activities at the end of the lessons; and language used are appropriate to the level of the learners.

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

The math experts agreed that the modular instructional material in terms of style and presentation is **acceptable** as evidenced by the overall composite mean of **4.30.**

Usefulness

Based on the table below, the respondents agreed as to the usefulness of that the worktext in Differential Calculus as acceptable. They all agreed that the worktext (differentiation and its applications) prepares the students to think logically and critically, simple, and comprehensive, encourages the students to become actively involved in learning activities and seek to relate new learning from previous learning.

The math experts agreed that the worktext in terms of usefulness is **acceptable** as evidenced by the overall composite mean of **4.48.**

Level of Acceptability of Mathematics

Experts on the Worktext in Terms of Usefulness

Criteria	Weighted Mean	Interpretation
1. The materials prepare the students to think logically and critically.	4.67	VA
2. The concepts in the material are simple and comprehensible.	4.73	VA
3. As a whole the materials are teachable.	4.53	VA
4. The materials provide opportunity for the development/enhancement of mathematical skills.	4.53	VA
5. The learning contents provide adequate information on the topics presented.	4.33	A
6. They encourage the students to become actively involved in the learning activities.	4.20	A
7. They stimulate the learners to intellectual activities.	4.33	A
8. The activities seek to relate new learning from previous learning.	4.53	VA
Overall Mean	**4.48**	**A**

Clarity

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

It can be gleaned from the table that the respondents rated the worktext in Differential Calculus as acceptable with an overall composite mean of 4.27. This shows that the instructional material is clear and easy to understand. Concepts for each activity are arranged logically to ensure that there is no duplication of content, and clear, simple, and engaging.

Level of Acceptability of Mathematics

Experts on the Worktext in Terms of Clarity

Criteria	Weighted Mean	Interpretation
1. Information is clear, simple and engaging	4.20	A
2. Language used is clear and easy to understand	4.33	A
3. Students can assess their understanding at regular interval.	4.20	A
4. The concepts for each activity are arranged logically to ensure that there is no duplication of content	4.33	A
Overall Mean	**4.27**	**A**

As a summary, the acceptability of the developed worktext as assessed by the math experts is shown belowSummary the Acceptability of Worktext in Differential Calculus

Criteria	Weighted Mean	Interpretation
1. Content	4.53	VA
2. Relevance	4.49	A
3. Style and Presentation	4.30	A
4. Usefulness	4.48	A
5. Clarity	4.27	A
Overall Mean	**4.41**	**A**

Legend:

Scale Range Verbal Interpretation

5 – (4.50-5.00) Very Acceptable (VA)

4 – (3.50-4.49) Acceptable (A)

3 – (2.50-3.49) Moderately Acceptable (MA)

2 – (1.50-2.49) Less Acceptable (LA)

1 – (1.00-1.49)Not Acceptable (NA)

It can be seen from the table that the developed worktext was ***very acceptable*** to the respondents as supported by the mean scores of 4.53 for content and ***acceptable*** to the respondents with a mean score of 4.49 for relevance, 4.30 for style and presentation, 4.48 for usefulness, and 4.27 for clarity. This was further supported by the overall mean score of 4.41.

This means that the topics, objective, content and activities of instructional materials are organized and sequenced logically; the style and presentation used is simple and easy to understand; the exercises; diagrams are adequate and relevant to the concepts and skills; and suit the needs of the students.

These foregoing results supported the findings of Cariño, Fajardo, Pineda, Marin, and Aguide that the use of instructional materials as a method of teaching keeps the learners busy, with their own work thus minimizing classroom management problems and also increase the span of students' interest and attention.

They also suggested that using the strategies of such instruction involving modular instructional materials prepares students for the mastery of the lessons, since the students can study at their own level and time.

Is there a significant difference in the performance between the experimental and control group in Differential Calculus after worktext was utilized?

The table provides an overview of the performance of the Control Group in the Differential Calculus course. in "Functions, Limits, and Continuity," the mean score is 6.15, which implies that, on average, students in the Control Group achieved a score of 6.15 out of the total possible score for this topic. The standard deviation measures the spread or variability of scores within the Control Group for each topic. A smaller standard deviation indicates that the scores are closer to the mean, suggesting more consistent performance among students. Conversely, a larger standard deviation implies greater variability in scores, indicating a wider range of performance.

Performance of the Control Groupin Differential Calculus			
Topics	**mean (x)**	**Standard deviation**	**Verbal interpretations**
1. Functions, Limits and Continuity	6.15	1.2	Very Satisfactory
2. The Derivatives: Algebraic Functions	5.45	1.1	Satisfactory
3. The Tangent line, Normal Line and Rate of Change	5.78	1.04	Satisfactory

4. The Chain Rule and General Power Rule	5.95	1.12	Satisfactory
5. Analysis of Functions	5.8	0.995	Satisfactory
6. Applications of Derivatives: Optimization Problems	5.71	0.92	Satisfactory
7. Derivatives of Trigonometric and Inverse Trigonometric Functions	6.12	1.45	Very Satisfactory
8. Derivatives of Exponential and Logarithmic Functions	5.45	1.27	Satisfactory
9. Derivatives of Hyperbolic and Inverse Hyperbolic Functions	5.15	1.26	Satisfactory
10. Parametric Equations	5.12	1.28	Satisfactory
11. Partial Differentiation	5.97	1.27	Satisfactory
Average	**62.65**		**Satisfactory**

The verbal interpretations in the last column provide a qualitative assessment of the students' performance for each topic. The terms used are "Very Satisfactory" and "Satisfactory." "Very Satisfactory" suggests that the students performed exceptionally well in the topic, while "Satisfactory" indicates a satisfactory performance, though not outstanding.

Finally, the table presents an overall average for all the topics, which is calculated to be **62.65**. The average score is also labeled as "Satisfactory," which indicates that, on average, the Control Group achieved satisfactory results across all the topics covered in the Differential Calculus course

Performance of the Experimental Group in Differential Calculus			
Topics	**mean (x)**	**Standard deviation**	**Verbal interpretations**
1. Functions, Limits and Continuity	7.23	1.024	Very Satisfactory
2. The Derivatives: Algebraic Functions	7.15	0.994	Very Satisfactory
3. The Tangent line, Normal Line and Rate of Change	6.85	1.14	Very Satisfactory
4. The Chain Rule and General Power Rule	7.01	0.927	Very Satisfactory
5. Analysis of Functions	6.5	0.854	Very Satisfactory
6. Applications of Derivatives: Optimization Problems	6.25	0.88	Very Satisfactory
7. Derivatives of Trigonometric and Inverse Trigonometric Functions	7.5	0.947	Very Satisfactory
8. Derivatives of Exponential and Logarithmic Functions	7.45	95	Very Satisfactory
9. Derivatives of Hyperbolic and Inverse Hyperbolic	6.05	1.04	Satisfactory

Functions			
10. Parametric Equations	5.95	1.17	Satisfactory
11. Partial Differentiation	7.15	0.954	Very Satisfactory
Average	**75.09**		**Very Satisfactory**

The above table presents the performance of the Experimental Group, who utilized the developed worktext in the Differential Calculus. It is evident that the Experimental Group, which had access to the developed worktext, achieved notably higher mean scores compared to the Control Group in almost all topics. The mean scores for each topic are consistently above 6, indicating a relatively strong performance across the board. Specifically, the mean scores range from 5.95 to 7.5, with most topics scoring above 7, signifying a high level of competence.

The standard deviations, which represent the spread or variability of scores within the Experimental Group, are generally smaller for most topics. This suggests that students in the Experimental Group exhibited more consistent performance compared to the Control Group. The verbal interpretations accompanying the mean scores reinforce the high level of achievement observed in the Experimental Group. Terms like "Very Satisfactory" are used repeatedly, indicating that the students' performance in most topics was exceptional. In particular, topics like "The Derivatives: Algebraic Functions," "The Chain Rule and General Power Rule," and "Derivatives of Exponential and Logarithmic Functions" received consistently high praise, with a mean score of 7.15 or above and standard deviations below 1.

However, it is worth noting that two topics, "Derivatives of Hyperbolic and Inverse Hyperbolic Functions" and "Parametric Equations," were assessed with mean scores below 6. These topics received a "Satisfactory" verbal interpretation, suggesting that while the students' performance was acceptable, there is room for improvement. Overall, the Experimental Group exhibited a significantly higher average mean score of **75.09** compared to the Control Group's average of 62.65. This impressive average indicates that the use of the specialized worktext had a positive impact on the students' learning and understanding of Differential Calculus. It is apparent that the worktext effectively contributed to the Experimental Group's overall very satisfactory performance, validating its development and successful implementation in the course.

The table provides the statistical analysis results of the performance of the Experimental Group and the Control Group in utilizing the worktext in the Differential Calculus course.

Significant difference in the Performance of the

Experimental Group and Control Group inutilizing Work text in Differential Calculus

Topics	**t-values**	**df**	**Sig (< .05)**	**H_O (Null Hypothesis) at .05**	**VI**
1. Functions, Limits and Continuity	6.17	9	0.000	Rejected	Significant
2. The Derivatives: Algebraic Functions	5.45	9	0.001	Rejected	Significant
3. The Tangent line, Normal Line and Rate of Change	8.40	9	0.000	Rejected	Significant
4. The Chain Rule and General Power Rule	7.14	9	0.000	Rejected	Significant

5. Analysis of Functions	6.85	9	0.000	Rejected	Significant
6. Applications of Derivatives: Optimization Problems	7.12	9	0.000	Rejected	Significant
7. Derivatives of Trigonometric and Inverse Trigonometric Functions	8.29	9	0.001	Rejected	Significant
8. Derivatives of Exponential and Logarithmic Functions	7.23	9	0.000	Rejected	Significant
9. Derivatives of Hyperbolic and Inverse Hyperbolic Functions	7.56	9	0.000	Rejected	Significant
10. Parametric Equations	7.28	9	0.000	Rejected	Significant
11. Partial Differentiation	8.36	9	0.000	Rejected	Significant

The *t-value* is a measure of the difference between the means of the Experimental and Control Groups for each specific topic. It indicates the extent to which the Experimental Group's performance differs from that of the Control Group. In this table, all the t-values are positive, indicating that the Experimental Group consistently outperformed the Control Group in every topic.

The significance level (Sig) shows the probability of obtaining the observed difference between the means by chance alone. A Sig value of less than 0.05 ($p < 0.05$) indicates that the results are statistically significant, suggesting that the observed differences are unlikely to have occurred by random chance. The null hypothesis (Ho) states that there is no significant difference between the Experimental and Control Groups in utilizing the worktext in Differential Calculus. However, based on the results in the table, the null hypothesis is rejected for all topics, as the Sig values are less than 0.05. This rejection indicates that there is a significant difference between the control group, and the Experimental Group's utilization of the worktext has led to a significantly better performance compared to the Control Group. The table's statistical analysis reinforces that the worktext played a crucial role in enhancing the students' learning and understanding of Differential Calculus. The significant differences observed in the Experimental Group's performance across all topics indicate the effectiveness of the worktext as an instructional tool in improving students' academic outcomes in this course.

SUMMARY AND CONCLUSIONS

Conclusions

1. The mathematics experts found the developed worktext highly acceptable, as evidenced by the mean scores of 4.53 for content and 4.49 for relevance. Additionally, the material received favorable ratings for style and presentation (mean score of 4.30), usefulness (mean score of 4.48), and clarity (mean score of 4.27). The overall mean score of 4.41 further supports the material's strong acceptability. These scores indicate that the instructional material's topics, objectives, content, and activities are logically organized and sequenced. The style and presentation are simple and easy to comprehend, while the exercises, and diagrams effectively relate to the concepts and skills, meeting the students' needs.

2. The Control Group achieved satisfactory results across all the topics covered in the Differential Calculus course, but the used of the work text had a more beneficial effect on the students' learning and grasp of Differential Calculus. The worktext played a significant role in enhancing the Experimental Group's performance, leading to an overall very satisfactory outcome. This outcome validates the successful development and integration of the worktext into the course.

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

3. The null hypotheses were rejected for all topics, as the Sig values are less than 0.05. This rejection indicates that there is a significant difference between the groups, and the Experimental Group's utilization of the worktext has led to a significantly better performance compared to the Control Group

IMPLICATIONS AND RECOMMENDATIONS

Recommendations

From the findings and conclusions, the following are strongly recommended:

Based on the findings of the study, the following recommendations are proposed:

1. **Integration of Worktext into Curriculum: ** Considering the high acceptability and positive feedback from the respondents, it is recommended to fully integrate the developed modular instructional material (worktext) into the Differential Calculus course curriculum. The material's logical organization, relevant content, and user-friendly style and presentation will likely enhance students' learning experiences and academic performance.
2. **Teacher Training and Support: ** To maximize the benefits of the worktext, it is crucial to provide adequate training and support to instructors who will use it in their teaching. Teachers should be familiarized with the worktext's content, pedagogical approach, and interactive activities. This will help them effectively guide students' learning and facilitate engaging classroom discussions.
3. **Continuous Improvement: ** Despite the high acceptability, there is always room for improvement. Regular evaluation and feedback sessions with students and teachers should be conducted to identify areas for enhancement. Based on this feedback, updates and revisions can be made to ensure the worktext remains relevant and effective.
4. **Further Research and Long-term Impact: ** While the study showed immediate positive outcomes, further research is recommended to assess the long-term impact of the worktext on students' performance and retention of knowledge. Follow-up studies could be conducted to track the students' progress in advanced calculus courses or related fields.
5. **Replication in Other Courses: ** The success of the worktext in Differential Calculus may motivate exploring its applicability in other courses or subjects. Institutions can consider replicating this methodology in different mathematical topics or even in other disciplines to promote active learning and engagement among students.
6. **Engage Control Group in Active Learning: ** Since the Control Group achieved satisfactory results, incorporating some elements of the worktext's interactive approach into traditional teaching methods for the Control Group could potentially improve their learning outcomes as well. Strategies such as incorporating more problem-solving exercises, visual aids, and interactive discussions may be beneficial.
7. **Sharing Best Practices: ** Encourage sharing of best practices and experiences among educators who have used the worktext. Establish platforms or workshops where instructors can exchange insights, innovative teaching techniques, and strategies for maximizing the worktext's potential in their classrooms.

ACKNOWLEDGMENT

The researchers would like to thank the University of Rizal System, with the President Dr. Nancy T. Pascual, Dr. Florante J. Mercado, Campus Director of URS - Rodriguez, colleagues, to students, their families who provided the support and motivation, and most of all to AlmightyGod for the continuous guidance and strength to complete this study.

LITERATURE CITED

1. Adora, N. M. (2014). Development and validation of a workbook in elementary Mathematics VI. International Journal of Humanities and Management Sciences, 2(3). Retrieved from http://www.isaet.org/images/extraimages/A1114063.pdf
2. Alam, A.Challenges and Possibilities in Teaching andLearning of Calculus: Case Study of India. Journal for the Education of Gifted Young Scientists8(1), 407-433, March 2020
3. Aldoobie, N. (2015). ADDIE model. American International Journal of Contemporary Research, 5(6), 68-71.
4. AndersonK., Getting What You Want: Developing a Workbook. New York, USA: Dutton Publishing, Inc, 2003
5. Aquino, R. J., et. al (2011). Effectiveness of the modular instructional material in the basic integration formulas in integral calculus. Proceedings of the 3rd International Conference of Teaching and Learning (ICTL 2011
6. Auditor, E., & Naval, D. J. (2014). Development and validation of tenth grade physics modules based on selected least mastered competencies. International Journal of Education and Research 2(12). Retrieved from http://www.ijern.com/journal/2014/December-2014/14.pdf
7. Batulan,R. A. (2002). Development and validation of an interactive multimedia courseware material in probability and statistics (Doctoral dissertation). Centro Escolar University.
8. Branch, R. M., & Kopcha, T. J. (2014). Instructional design models. In Handbook of research on educational communications and technology (pp. 77-87). Springer New York
9. Cruz, Erich D. Development and Validation of Worktext in Drawing 2. International Journal of Scientific Research Publications, Volume 4, Issue 9, September 2014, ISSN 2250-3153
10. Dacanay, G. (2010). The Effectiveness of a Proposed Instructional Material in Precalculus for the Students of the University of Nizwa (Doctoral dissertation). St. Paul University Philippines.
11. Dejarlo, Jenisus O. Development and validation of worktext in basicCalculus. Tianjin DaxueXuebao (Ziran KexueyuGongcheng Jishu Ban)/Journal of Tianjin University Science and TechnologyISSN (Online): 0493-2137E-Publication: Online Open AccessVol:55 Issue:03:2022DOI 10.17605/OSF.IO/8FYN9
12. Dewi C., Dewi S.W., Hefy S., Kristiandib (2016).SUPPLEMENTARY MATERIALS BASED ON CONSTRUCTIVISM. https://media.neliti.com/media/publications/171704-EN-supplementary materials-based-on-constru.pdf
13. Dlamin, Reuben Bafana. Exploring possible causes of poor performance by high school students in Differential CalculusDepartment of Mathematics Education, University of South Africa, P O Box 392, UNISA, 0003, Republic of South Africa,<http://hdl.handle.net/10500/23618>
14. Domondon, Christian S. et al. Analysis of Difficulties of Students in Learning Calculus. Science International, University of Northern Philippines 2023
15. Gates, A. I. (1921). An Experimental and Statistical Study of Reading and Reading Tests. Journal of Educational Psychology, 12(8), 445–464. https://doi.org/10.1037/h0064253
16. Espinar, M. J. T., &Ballado, R. S. (2016). Content validity and acceptability of a developed worktext in basic Mathematics 2. International Conference on Research in Social Sciences, Humanities and Education. Retrievedhttp://uruae.org/siteadmin/upload/ UH0516142.pdf
17. G. Gayagay, "Development and Validation of a Learning Package for Grade Seven Mathematics" Conference Proceedings, International Research Conference on Higher Education, Bacolod City,2014.
18. Gibbon, M. & First, M. B., (2004). The Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) and the Structured Clinical Interview for DSM-IV Axis II Disorders (SCID-II). In M. J.

Hilsenroth& D. L. Segal (Eds.), Comprehensive handbook of psychological assessment, Vol. 2. Personality assessment (pp. 134–143). John Wiley & Sons, Inc.

19. Guido, R. M. D. (2014). Evaluation of a modular teaching approach in materials science and engineering. American Journal of Educational Research, 2(11), 1126-1130. DOI: 10.12691/ education-2-11-20
20. Hartley, J. (2004). Designing instructional and informational text. Handbook of Research on Educational Communications and Technology, 917-947
21. Kaptan, Kubilay 2012. Challenges for Science Education DOI:10.1016/j.sbspro.2012.08.237https://www.researchgate.net/publication/271609857_
22. Kurt, S., & Akdeniz, A. R. (2002). The Effect of The Worksheets on Students' Achievement in Chemical.Journal of Turkish Science Education. Teknik Universitesi, Ankara.
23. Knapp, S. J., &VandeCreek, L. D. (2006). Remedial and Positive Ethics. In S. J. Knapp & L. D. VandeCreek, Practical ethics for psychologists: A positive approach (pp. 3–14). American Psychological Association. https://doi.org/10.1037/11331-001
24. Manshell, Mae Joy F. Content Validity and Acceptability of a Developed Worktext in Modern Algebra. Asia Pacific Journal of Multidisciplinary Research, Volume 5 No. 1, 72-84, February 2017, P-ISSN 2350-7756
25. Prastowo, Andi. 2009. Bahan Ajar Inovatif. Yogyakarta: Diva Press
26. Reyes, Y. D., & De Guia, R. G. (2017). Development of English worktext in English 101.
27. International Journal of Science and Research (IJSR). Retrieved from https://pdfs.semanticscholar.org/8357/259b5c0183ff5f354a85f91ab1199d5fcab2.pdf
28. Richey Rita C. Developmental Research: The Definition and Scope.Handbook of Research on EducationalCommunications and Technology,Wayne State University395 EducationDetroit, MI 48202
29. Romero, R. (2008). The development and validation of a proposed worktext in Biostatistics (Doctoral dissertation). St. Paul Universtiy Philippines.
30. Sadiq, S., & Zamir, S. (2014). Effectiveness of modular approach in teaching at university level. Journal of Education and Practice, 5(17). Retrieved from https://www.iiste.org/Journals/index.php/ JEP/article/viewFile/13916/14068
31. Terano, H. J. R. (2015). Development and acceptability of the simplified text with workbook in differential equations as an instructional material for engineering. Asia Pacific Journal of Multidisciplinary Research, 3(4), 89-94
32. WIDODO, &JASMADI. (2008). Guide to Preparing Competency-Based Teaching Materials. Jakarta: PT Elex Media Komputindo.