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# Development and Validation of a Self-Instructional Material on Selected Topics in Analytic Geometry Integrating Electronic Concepts

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**Abstract:** The objective of mathematics teaching in the tertiary level is not just to produce students who are knowledgeable in math but also to help these students develop critical thinking to solve problems they will encounter in their profession. For these reasons, the instructor must find ways and means to make their teaching effective. Emphasis must be directed to a variety of mathematical exercises, which cater to the differing needs of particular learners. Hence, the researcher conducted a study on material development with the end in mind of producing a material in Analytic Geometry that is suitable to the needs of the Bachelor of Industrial Technology freshman students. This consequently will influence the students' performance and attitude towards mathematics. Specifically, it dealt with the components of the self-instructional material; the Analytic Geometry instructors' rating on the quality elements of the self-instructional material; the students' rating on the quality elements of the self-instructional material; the readability level of the material; and the significant difference between the experimental group which was exposed to the self-instructional material and the control group which was exposed to teacher-directed method in term of performance and attitude towards mathematics. By employing the descriptive-experimental method of research, the study revealed that the developed and validated self-instructional material in this investigation seemed to yield better learning output than the usual lecture instruction since the use of the material improved the performance of the students, facilitated their interest and developed in the students a more favorable attitude towards mathematics.

**Keywords**: self-instructional material, Analytic Geometry, Electronic concepts, suitability of objectives, content and layout, suitability of approach, level of difficulty, over-all effectiveness, format and content, performance, attitude towards mathematics.

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## Introduction

Teachers, as prime molders of young minds play one of the biggest roles in the development of our society's future, a role, next in importance to that of parents. This is quite a

responsibility, for in their hands lies the future of our young people. From their guiding hands emerge the great achievers in all fields of human endeavor. The teacher is the most important figure in the classroom. S/he is the source of knowledge and information. Because of this role, the teacher must be a subject matter expert ands/he should see to it that s/he gets the desired results from the students.

In school, mathematics is one important course in the curriculum. This course is regarded as a system of thinking, as a method of inquiry. It is neither a set of arbitrary rules nor mere memorization of facts. It is a system of investigation and discovery (Asakil, 1990). This is also recognized as an indispensable tool utilized by other branches of studies for the realization of the main objective of education. In the area of mathematics education, the emphasis now is on the structure of mathematics and its underlying principles rather than on meaningless manipulation of figures (Garcia, 1985).

Mathematics teachers, on the other hand, play an important role in the teaching-learning process of the course. Fontanilla (1989) asserts that the teacher is the guide, the inspiration and the model in the study of mathematics. It is, therefore, of paramount importance for the teachers to know what to teach and how to teach it, and how to motivate the students to learn. Thus, a teacher should always search for ways and means to help students succeed at their own rate of learning. Basically, teaching is a communication process between teacher and students. In the past, teaching depended entirely on verbal communication. Although this kind of communication process continues an important role in the teaching-learning task, current educational practice recognizes the value of a growing number of instructional materials as aid to effective communication and, in turn, to effective teaching and learning.

Lardizabal (1991) stated that large portions of instructional materials are printed matters, which fall into two broad classes: the textbook and the supplemental materials. The textbook is the most commonly used teaching aid. If a well-organized textbook is placed in the hands of an effective teacher, it can be a most helpful aid to promote learning. Supplemental materials used to supplement regular class work and textbooks. These include workbooks, worksheets, duplicated materials, teachers' prepared study guides, reference books, pamphlets, magazine articles and newspapers. Indeed, the effectiveness of the teaching-learning process can be increased greatly through the proper use of instructional materials. As a mathematics teacher, it is not only a matter of being knowledgeable on the modern methods, strategies and the rules and procedures in teaching mathematics, but s/he should be skillful enough in the preparation of teaching materials. Cagaanan (1993) emphasized that preparing a teaching material for every mathematical skill to be developed will motivate the students to learn better rather than teaching verbally without instructional materials. However, these materials cannot teach by themselves. They need a skillful teacher to make them effective.

According to the Guidelines for the Academic Preparation of Mathematics Faculty at Two-Year Colleges (AMATYC, 1992), effective teachers are reflective, creative and resourceful. They use a variety of instructional materials which respond to the needs of the particular type of students they are teaching. Furthermore, Bruner (1981) emphasized that teachers are the key figures in the successful implementation of programmed instruction in the school. As such, it is imperative that they upgrade their teaching skills and competencies reflective of new instructional realities. Nevertheless, instructional materials that must be used by the teacher in any particular discipline should always be consistent with the objectives of the specific programme. This is the reason why instructional materials are always modified from

time to time to give immediate response to the problems of the students have been facing. Thus, findings of many studies have been considered to bring about improvement in education to its fullest degree.

Considering the fact that changes in the curriculum happen every now and then, it is of prime significance that a teacher must learn how to be flexible and must employ strategic innovations to develop his/her own set of instructional materials consonant to the needs of the students. Dick and Carey (1990) verified that a more contemporary view of instruction is that, it is a systemic process in which every component, like the teacher, students, materials and learning environment is crucial to successful learning.

Faced with such a challenge, the researcher being a mathematics instructor conceived this study with the purpose of introducing instructional innovations that will benefit both the teacher and the students. Based from the researcher's observations and experiences, she found out that the students need adequate and concrete knowledge in electronics so as to prepare them in the world of work.

With the new turn of events in an increasingly electronic environment as evidenced by the establishment of LIMA Technology Center with the vicinity of Lipa and Malvar as well as the First Philippine Industrial Park in Sto. Tomas Batangas, the researcher deemed it necessary that the skills, competencies and capabilities of Malvareños be enhanced. The establishment of the different electronics technology firms, general industrial zones and export processing zones in local communities has deeply convinced the researcher that that mathematics instruction plays an increasingly more crucial role in the past. And that, if it is to serve not just the academe but the larger society as well, some educational and instructional reforms in mathematics education are necessary.

It is, therefore, the hope of the researcher that the developed self-instructional material integrating electronic concepts will be useful for all Bachelor of Industrial Technology (BIT) students regardless of specialization knowing that basic electronics is an integral part of the course. Since mathematics is precisely learned by doing, sufficient exercises are contained in the material, which are of practical value to the students to suit their needs.

Lesson dealing with this ever-changing area will help students tackle whatever task may be assigned to them so that upon the completion of their studies, without fear, they could land on an occupation with strong foundation in mathematics.

## Objective of the Study

The primary objective of this was to develop and validate a slef-instructional material on selected topics in Analytic Geometry integrating electronic concepts that would serve as an additional resource material in teaching at the college level. Specifically, it attempted to the following questions: What are the components of the self-instructional material?; What is the rating given by the Analytic Geometry instructors to the quality elements of the self-inctructional material in terms of suitability of objectives, content and layout, suitability of approach, level of difficulty and over-all effectiveness?; What is the rating given by the students to the quality elements of the self-inctructional material in terms of fomat and content?; What is the readability level of the self-instructional material?; and lastly, Is there a significant difference between the experimental group which was exposed to the self-instructional material and the control group which was exposed to teacher-directed method in term of performance and attitude towards mathematics?

## Methodology

The purpose of the study is to develop and validate a self–instructional material on selected topics in Analytic Geometry integrating electronic concepts. For this reason, the study made use the descriptive method in order to depict the development of the self-instuctional material and the experimental method was employed for its validation.

The researcher utilized questionnaire, attitudinaire, and two kinds of test: the mental ability test and the achievement test–to furnish accurate answers to the specific problems of the study. The frequency distribution, weighted arithmetic mean, standard deviation and t-test were applied to analyze the results and to test the hypotheses posed in this endeavor.

## Results and Discussion

This presents the data gathered together with its corresponding analysis and interpretation. The data gathered are presented in tabular form organized in sequential manner which resembles the order of presentation of the specific problems posed in chapter I.

## Components of the Self–instructional Material

The developed self-instructional material in Analytic Geometry consists of the following lessons: Chapter I contains Inclination and Slope of a Line, Chapter II contains Parallel and Perpendicular Lines and Chapter III contains First-Degree Equations.

Adopting the format used in Colombo Plan Staff College in Singapore with some modifications, the developed self-instructional material consists of the following components:

**1) General Objectives:** They indicate what the students should attain after working through self-instructional material.
**2) Statement of the Purpose.** This indicates the main purpose of the self-instructional material and its intended users.
**3) Overview.** This contains what the students should expect to learn and how it shall be presented.
**4) Content of the Material:** This indicates the topics included in the material.
**5) Sequence of Learning Activities:** This provides the content of each lesson for the students to discern what to expect in the material.
**a. Specific Objectives:** These are objectives specifically formulated and clearly stated so that the students will know what they are expected to accomplish in each lesson.
**b. Introduction**: This gives a short foreword about the lesson.
**c. Activity**: This consists of the procedure in the development of the concepts undertaken by answering the questions that lead to the learning of those concepts.
**1. Example:** This is designed to provide enlightenment and opportunity to apply the knowledge and skills learned.
**2. Exercise:** This is prepared to offer practice for skill-building and for checking of students' progress.
**d. Self-Check:** This is prepared for the purpose of assessing the students' progress and teachers' evaluation of students. This is also a follow-up exercise that serves as reinforcement towards the mastery of the concepts.
**e. Answer Key:** This gives the correct responses for the exercises in the Self Check.
**f. Only for Fun:** These are added features of the material necessary to improve students' higher-order thinking skills.
**6. Instructions:** These include directions on what the user has to do to successfully accomplish the self-instructional material and the activities to be undertaken.

## The Analytic Geometry Instructors' Rating on the Quality Elements of the Self-Instructional Material

The succeeding tables present the data gathered through the questionnaire accomplished by the faculty-respondents. The data presented herein concern the assessment of the quality elements of the self-instructional material.

**Table 1. Evaluation of the Self-Instructional Material by the Faculty-Respondents in Terms of Suitability of Objectives**

| Items | Mean Rating | Interpretation |
|---|---|---|
| 1. The self-instructional material meets clearly defined need. | 4.43 | Strongly Agree |
| 2. The purpose of the self-instructional material has been made clear to all likely users. | 4.14 | Agree |
| 3. The self-instructional material introduction gives a clear account of its goal. | 4.71 | Strongly Agree |
| 4. The entry behavior of potential users has been carefully described in terms of comprehensive list of knowledge and skills. | 4.29 | Strongly Agree |
| 5. The aims clearly relate to the purpose of the self-instructional material. | 4.29 | Strongly Agree |
| 6. All the general objectives clearly relate to the purpose of the self-instructional material. | 3.57 | Agree |
| 7. Each set of specific objectives leads to the achievement of its relevant general objectives. | 4.57 | Strongly Agree |
| **Total Mean Score** | **4.29** | **Very Good** |

It is significant to note that the faculty-respondents strongly agree to five out of seven statements. Also, the statements related to the main concern of the researcher in including various exercises obtained the highest rating. These findings may be due to the fact that the students are more interested to deal with a material that includes the background and coverage for a better and clearer understanding of the lesson. In general, the faculty-respondents marked the instructional material an overall mean score of 4.29 characterized as **Very Good**. This means that they consider the objectives of the material extremely suitable in developing the needed skills of the learners.

**Table 2. Evaluation of the Self-Instructional Material by the Faculty-Respondents in Terms of Content and Layout**

| Items | Mean Rating | Interpretation |
|---|---|---|
| 1. All the contents are directly relevant to the objectives. | 4.00 | Agree |
| 2. The content has been arranged in a logical sequence of learning. | 4.57 | Strongly Agree |
| 3. Each lesson of the self-instructional material is in a clearly defined category of the content of the material as a whole. | 4.14 | Agree |
| 4. The material forms a series of logical steps in the learning sequences. | 4.29 | Strongly Agree |

| | | |
|---|---|---|
| 5. All activities are appropriate for their content and objectives. | 4.14 | Agree |
| 6. All learning activities promote active participation and response. | 4.29 | Strongly Agree |
| 7. Each learning activity is divided into small steps. | 4.29 | Strongly Agree |
| 8. All learning activities have been clearly planned as input-process-output cycles. | 3.71 | Agree |
| 9. Appropriate Self Check questions and answers have been included at all necessary points. | 4.43 | Strongly Agree |
| 10. All Self Check question have been answered clearly and unambiguously. | 4.43 | Strongly Agree |
| 11. All Self Check questions have been interpreted in a satisfactory manner. | 4.14 | Agree |
| 12. Self-Check follows the learning sequence. | 4.57 | Strongly Agree |
| 13. Effective reinforcement statements have been included at necessary point. | 3.43 | Agree |
| 14. All visual elements have been successfully integrated into the learning sequence. | 4.14 | Agree |
| 15. Continuity of learning has been ensured by the inclusion of bridge passage at all necessary points. | 4.57 | Strongly Agree |
| 16. Whenever appropriate, a touch of humour has been added using cartoons, humorous comments, etc. | 4.86 | Strongly Agree |
| 17. All concepts in the self-instructional are well presented. | 4.00 | Agree |
| **Total Mean Score** | **4.24** | **Very Good** |

Table 2 summarizes the mean ratings given by the faculty-respondents who evaluated the content and layout of the material. It is revealed in the table that for statement 1 “Whenever appropriate, a touch of humor has been added using cartoons, humorous comments, etc.”, a mean rating of 4.86 was computed, which means that the respondents strongly agree to it. It appears that the content and layout of the self-instructional material have been arranged in a logical sequence of learning. There is continuity of learning in the material. Appropriate feedback has also been included, which follows the learning sequence.

**Table 3. Evaluation of the Self-Instructional Material by the Faculty-Respondents in Terms of Suitability of Approach**

| Items | Mean Rating | Interpretation |
|---|---|---|
| 1. The form and wording of each item the Self Check is appropriate for the objective it is intended to assess. | 4.43 | Strongly Agree |
| 2. Results of the Self Check have been clearly interpreted in terms of the | 3.71 | Agree |

| | | |
|---|---|---|
| achievement of the objectives. | | |
| 3. The length of time needed to complete the self-instructional material appears optimal for the type of the intended users. | 4.14 | Agree |
| 4. The Self Check includes at least one item for each specific objective. | 4.29 | Strongly Agree |
| **Total Mean Score** | **4.14** | **Good** |

Table 3 reveals that the faculty-respondents strongly agree that the form and wording in the self-instructional material are consistent with the skills to be developed receiving a mean rating of 4.43. The verbal problems presented in the Self Check are relevant to the specific objectives as shown by a 4.29 mean score, which means that the respondents strongly agree with it.

The statement "The length of time needed to complete the self-instructional material appears optimal for the type of the intended users." garnered a mean score of 4.14 while the lowest mean score of 3.71 for the statement that is concerned with the result of the Self Check. The faculty-respondents agree to these two statements.

Summing up all the mean ratings indicated in Table 8, an overall mean score of 4.14 interpreted as **Good** is computed. This connotes that the approach of the material is suitable to the level of the learners.

**Table 4. Evaluation of the Self-Instructional Material by the Faculty-Respondents in Terms of Level of Difficulty**

| Items | Mean Rating | Interpretation |
|---|---|---|
| 1. All instructions are clear and easy to follow. | 4.57 | Strongly Agree |
| 2. The layout of the pages is well-organized making the whole self-instructional material appears interesting and easy to study. | 4.71 | Strongly Agree |
| 3. Satisfactory consideration passages have been included whenever appropriate. | 4.14 | Agree |
| 4. The self-instructional material concludes with a comprehensive summary of all main points. | 4.29 | Strongly Agree |
| **Total Mean Score** | **4.43** | **Very Good** |

It can be seen from the table that the four criteria concerning the level of difficulty of the content of the self-instructional material is interpreted **Very Good.** Of these four criteria, the faculty-respondents agreed that the explanations conveyed a clear idea as proven by a 4.43 total mean score.

The data in the foregoing table further reveal that the self-instructional material in Analytic Geometry utilizes terms that are understandable to the students and that the exercises are constructed within the level of the learners' capability and understanding.

**Table 5. Evaluation of the Self-Instructional Material by the Faculty-Respondents in Terms of Overall Effectiveness**

| Items | Mean Rating | Interpretation |
|---|---|---|
| 1. As a whole, the self-instructional material appears to be interesting and likely to motivate learners. | 4.29 | Strongly Agree |
| 2. All aspects of the self-instructional are well-presented giving a high probability that it will be a successful learning resource. | 4.43 | Strongly Agree |
| 3. In general, the self-instructional material can be used for various purposes and wide range of learners. | 4.29 | Strongly Agree |
| **Total Mean Score** | **4.34** | **Very Good** |

As indicated in the table, the mean rating for the second statement is 4.43, which means that the respondents strongly agree to the statement. This supports the finding of Young (1991), which revealed that instructional materials are very effective learning resources.

In general, the evaluation of the self-instructional material by the faculty-respondents in terms of the Over All Effectiveness is **Very Good** garnering a total mean score of 4.34. This means that the faculty-respondents consider the material very well fitted to the learners and that, it appears attractive and appealing to them, giving a high probability that it will be a flourishing learning resource.

## Students' Rating to the Quality Elements of the Self-Instructional Material in terms of Format and Content

**Table 6. Evaluation of the Self-Instructional Material by the Student-Respondents in Terms of Format**

| Items | Mean Rating | Interpretation |
|---|---|---|
| 1. The self-instructional material is a good size for easy handling. | 4.25 | Strongly Agree |
| 2. The layout of the pages is attractive and modern. | 4.35 | Strongly Agree |
| 3. The type-size of the text is easy to read. | 4.60 | Strongly Agree |
| 4. There are right proportions of diagrams and photos. | 4.15 | Agree |
| 5. The diagrams and photos are well-placed for easy reference. | 4.25 | Strongly Agree |
| 6. The tables are generally well laid out and easy to follow. | 4.40 | Strongly Agree |
| 7. The exercises are well-arranged on the page so that they are easy to read and follow. | 4.45 | Strongly Agree |
| 8. All instructions stand out clearly from the rest of the text. | 4.50 | Strongly Agree |

| | | |
|---|---|---|
| 9. Key points and concepts are well-highlighted for focused attention while reading. | 4.20 | Agree |
| 10. Titles and subtitles are clearly brought out. | 4.30 | Strongly Agree |
| **Total Mean Score** | **4.34** | **Very Good** |

From the table, it can be deduced that the student-respondents strongly agree on eight out of ten statements with 4.60 as the highest mean rating. This implies that students welcome the attractive and modern way of presenting lessons using diagrams and photos, which add excitement and enjoyment while reading the lesson. These diagrams and photos are well-placed for easy reference and easy reading. However, the student-respondents only **agree** on two statements with mean ratings of 4.20 and 4.15. Key points and concepts, which are well-highlighted complemented with the visual or graphical displays, are found logical by the students.

**Table 7. Evaluation of the Self-Instructional Material by the Student-Respondents in Terms of Content**

| Items | Mean Rating | Interpretation |
|---|---|---|
| 1. I understand the objectives clearly. | 4.20 | Agree |
| 2. It was easy to understand; the skill-mentoring materials what I was expected to do. | 4.25 | Strongly Agree |
| 3. I could work through the skill-mentoring material without too much difficulty. | 4.00 | Agree |
| 4. I understand the ideas in the skill-mentoring materials. | 4.30 | Strongly Agree |
| 5. The Self Check questions were easy to answer. | 4.10 | Agree |
| 6. I could do all the things the skill-mentoring materials instructed me to do. | 4.20 | Agree |
| 7. The ideas in the skill-mentoring materials were interesting. | 4.50 | Strongly Agree |
| 8. The words used were easy to understand. | 4.40 | Strongly Agree |
| 9. The styles of written expressions were just right for me. | 4.45 | Strongly Agree |
| 10. The text was free of unfamiliar words. | 4.60 | Strongly Agree |
| 11. The skill-mentoring materials made it easy for me to study this subject. | 4.50 | Strongly Agree |
| 12. I enjoyed working through the skill-mentoring materials | 4.45 | Strongly Agree |
| 13. I find the skill-mentoring material facilitating in my course. | 4.20 | Agree |
| 14. The skill-mentoring material presented various ideas/concepts in | 4.35 | Strongly Agree |

| | | |
|---|---|---|
| a sequence easy for me to remember. | | |
| 15. The presentation of the concepts' summary at the end of each discussion helped me in understanding the lesson. | 4.30 | Strongly Agree |
| **Total Mean Score** | **4.32** | **Very Good** |

Table 7 shows the mean ratings given by the student-respondents when they evaluated the content of the self-instructional material. The student-respondents strongly agree and agree to the statements, which satisfy the ratio 2:1. This means that more statements in this area are very much agreeable to the student because they believe that the material is just right for them.

The total mean score of the ratings given by the student-respondents resulted to a mean of 4.32 and interpreted as **Very Good.** This means that the students consider the content of the material very much appropriate for them, which help them tin understanding the lesson easily.

## Readability Level of the Self-Instructional Material

**Table 8. Data Analysis Sheet for Words**

| Page No. | Total No. of Words in the Page | Difficult Words | Number of Readers Indicating X | No. of Times X Appears on Page | Difficulty Index Per Page |
|---|---|---|---|---|---|
| | | cultivating | 5 | 1 | |
| 4 | 134 | inclination | 3 | 1 | 0.009 |
| | | slope | 4 | 1 | |
| | | first-degree | 2 | 1 | |
| | | tolerance | 3 | 1 | |
| 8 | 155 | verify | 3 | 1 | 0.002 |
| | | posted | 2 | 1 | |
| 12 | 128 | ratio | 1 | 3 | 0.004 |
| | | formula | 2 | 4 | |
| 16 | 96 | tangent | 1 | 2 | 0.001 |
| | | steepness | 1 | 1 | |
| 20 | 123 | coordinates | 1 | 1 | 0.001 |
| | | loop | 3 | 1 | |
| 24 | 82 | abscissa | 3 | 2 | 0.006 |
| | | axes | 1 | 1 | |
| 28 | 79 | conclusion | 1 | 1 | 0.001 |
| | | endpoints | 2 | 1 | |
| 32 | 64 | diagramming | 2 | 1 | 0.003 |
| 36 | 2 | key | 1 | 1 | 0.025 |
| 40 | 37 | point-slope | 4 | 1 | 0.009 |
| | | first-degree | 3 | 1 | |
| 44 | 29 | equation | 2 | 1 | 0.003 |
| 48 | 27 | general form | 2 | 1 | 0.009 |
| | | slope-intercept | 3 | 1 | |

| | | | | | |
|---|---|---|---|---|---|
| | | substitution | 1 | 1 | |
| 52 | 58 | transform | 2 | 1 | 0.006 |
| | | extensively | 4 | 1 | |
| 56 | 2 | key | 1 | 1 | 0.025 |
| | | flux | 3 | 2 | |
| 60 | 172 | immobilized | 3 | 1 | 0.006 |
| | | rectifying | 2 | 1 | |
| 64 | 52 | synchronized | 4 | 2 | 0.001 |
| | | slope | 1 | 1 | |
| 68 | 16 | current | 2 | 1 | 0.009 |
| | | reference | 1 | 1 | |

The communication index of the self-instructional material was computed, and is shown in the table. The average Communication Index (C.I.) of the entire self-instructional material was found to be 0.007. Since this value is within $0.001 \leq$ C.I. $<$ 0.01, this means that the readers perceived the self-instructional material to be clear and is therefore appropriate for the reading level of the intended users. The self-instructional material was considered to be highly readable and this contributes greatly to ease in comprehension of the contents of the material.

## The Significant Difference between the Experimental Group which was exposed to the Self-Instructional Material and the Control Group which was exposed to Teacher-directed method in terms of Performance and Attitude towards Mathematics

### Table 9. Pretest Performance Mean Difference of the Experimental and Control Groups

| Study Groups | Mean | Mean Difference | Standard Deviation | t-observed value | t-critical value | Interpretation |
|---|---|---|---|---|---|---|
| **Experimental Group** | 5.750 | 0.200 | 1.650 | 0.336 | 2.038 | Not Significant |
| **Control Group** | 5.550 | | 2.089 | | | |

Table 9 shows the mean difference in the pretest of the experimental and the control groups in terms of performance. It can be deduced from the table that the experimental group had a mean score of 5.750 and a standard deviation of 1.650 while the control group had a mean score and a standard deviation of 5.550 and 2.089, respectively. The t-value of 0.336 was computed which is less than the critical value of t at .05 level of confidence. This indicates that the mean difference of the two groups is not significant. This connotes that the two groups are comparable in terms of their initial knowledge of the subject matter.

### Table 10. Pretest Mean Difference of the Experimental and Control Groups in Terms of Attitude Towards Mathematics

| Study Groups | Mean | Mean Difference | Standard Deviation | t-observed value | t-critical value | Interpretation |
|---|---|---|---|---|---|---|
| **Experimental Group** | 3.608 | 0.268 | 0.516 | 1.608 | 2.038 | Not Significant |
| **Control Group** | 3.340 | | 0.538 | | | |

As revealed in the table, the experimental group had a mean score of 3.608 with a standard deviation of 0.516, while the control group had a mean score of 3.340 with a standard deviation of 0.538. The mean difference of the two groups is 0.268

The t-test analysis yielded a t-value of 1.608, which is less than the critical value of 2.038 at 0.05 level of confidence, indicating that the difference in the attitude of the two groups is not significant. This means that the two groups are comparable when it comes to interest and liking of the subject before the experiment started.

**Table 11. Posttest Performance Mean Difference of the Experimental and Control Groups**

| Study Groups | Mean | Mean Difference | Standard Deviation | t-observed value | t-critical value | Interpretation |
|---|---|---|---|---|---|---|
| **Experimental Group**<br>**Control Group** | 12.450<br>10.150 | 2.300 | 2.038<br>2.346 | 3.310 | 2.038 | Significant |

Table 11 shows that the experimental group who were exposed to the self-instructional material had a mean score and standard deviation of 12.450 and 2.038, respectively. The control group who were exposed to teacher-directed method had a mean value of 10.150 and with a standard deviation of 2.346. Thus, a mean difference of 2.300 is observed. The mean difference was subjected to a t-test analysis (Downie and Heath, 1987).

The t-observed value was 3.310, higher than the critical value at .05 level of significance, which is 2.038. This shows that there is a significant difference between the two groups. This implies students who were exposed to the self-instructional material performed better than those students who were treated using the usual method. This further implies that the experimental approach is more effective than the control one as revealed by the data gathered. This result confirms the findings of Saragcon (2001) that students who were taught using the activity modules scored significantly higher than those who were taught using the traditional method of teaching.

**Table 12. Posttest Mean Difference of the Experimental and Control Groups in Terms of Attitude Towards Mathematics**

| Study Groups | Mean | Mean Difference | Standard Deviation | t-observed value | t-critical value | Interpretation |
|---|---|---|---|---|---|---|
| **Experimental Group**<br>**Control Group** | 4.020<br>3.644 | 0.376 | 0.479<br>0.613 | 2.161 | 2.038 | Significant |

As revealed in the table, the experimental group had a mean score of 4.020 while the control group had a mean value of 3.644. The t-test undertaken yielded a t-observed value of 2.161 greater than the critical value at 0.05 level of significance, which is 2.038. This shows that the mean scores of the two groups differ significantly. This implies that the participants from the experimental group have a greater interest in the subject than those in the control group.

## Conclusion and Recommendation

This study revealed that the uniqueness of the components of the self-instructional material heightens the interest of the learners. The developed self-instructional material in this investigation was generally rated “Very Good” by the faculty and student-respondents based on the evaluation and there, it is acceptable. The developed self-instructional material is appropriate for the reading level of the intended users. The significant difference in the participants’ performance and attitude towards mathematics implies that participants from the experimental group score significantly higher in the achievement test and in attitude test than the control group.

After the study, the participants who used the self-instructional material performed better in the achievement test and showed a highly positive attitude towards mathematics. Thus, the null hypothesis of no significant difference between the two groups in terms of the variables was rejected. And the use of self-instructional material in this investigation seemed to yield better learning output than the usual lecture instruction since the use of the material improved the performance of the students, facilitated their interest and developed in the students a more favorable attitude towards mathematics.

In the light of the conclusions derived from the study, it is recommended that: The developed self-instructional material be used as a learning material in Analytic Geometry classes in the university; Teachers should be encouraged to develop instructional materials in other areas of mathematics designed according to the level of understanding of the target users; The college administrator allocate funds for the development and validation of instructional materials in various disciplines; Self-instructional materials for other topics in Analytic Geometry be developed; Learning materials in mathematics and other areas of study be subjected to readability tests to find out if these are appropriate to the level of the learners for which they are intended; For other research, a study to explore other possible variables that may related to students' performance be conducted; and lastly, the self-instructional material be subjected to a full blown experimental study to test its effectiveness in other technical schools.

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