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# Development and Validation of Self-Explanatory and Exploratory Learning Material in Inferential Statistics for Education Students

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**ABSTRACT:-** This research aims to develop and test the validity of the developed self-explanatory and exploratory learning tool in Statistics for education students. Three sets of evaluators were the respondents of the study (education students, Mathematics/Statistics teachers, and non-Mathematics/Statistics teachers). The following hypotheses were tested in the study: there is no significant difference between the respondents' levels of evaluation of the developed self-explanatory and exploratory instructional material in statistics, and there is no significant difference between the respondents' levels of evaluation of the developed self-explanatory and exploratory instructional material in statistics when grouped according to their classification. Two major instruments were utilized in the study consisting of the developed instructional material, and the evaluation tool used by the evaluators. Constructs included in the research instrument involved the objectives of the instructional material with five items (α=0.940), contents of the module with 10 items (α=0.927), language used with five items (α=0.929), and evaluation activities with 10 items (α=0.954). Statistical treatments such as Weighted Mean and Kruskal-Wallis Test were used. Based on the result, the developed instructional material is valid in all of its major characteristics such as objectives, language, content, and evaluation activities. Results are confirmed by the test of significant difference in which both Mathematics and non-Mathematics teachers provided the same responses. Finally, based on the feedback and suggestions of the evaluators, the developed instructional material can be utilized by both teachers and students with or without an interest in Statistics.

**Keywords –**Instructional Materials, Development, Validation, Statistics, Education

## I. INTRODUCTION

Statistics plays a vital role in the field of education. Its presence in every aspect of education is very tangible. From the roster of students, encoding of performances, test results, and assessment and evaluation of grades, statistics have always been part of the process. Statistics is also important in students' decision-making process. For instance, the present performance of students in their subject can be the basis of their decision and action on whether they need to focus more on that particular subject or not. Even when graduated, students assess whether they are ready or not to take the licensure examination. Thus, they use statistics to help them decide if they are going to enroll in an intensive review to ensure passing the licensure examination for their future careers as teachers. Therefore, it is really noteworthy to claim that statistics are useful for students specializing in education. On the contrary, despite the cited importance in education, students find statistics a difficult one (Kandeel, 2019) due to falling in conceptual understanding, process skills, understanding questions, notation (Kurniawan &Wahyuningsih, 2018), being unable to explicit data in statistical terminology, spending more time to do the graphs than interpreting them, insufficient emphasis on reading data and inferencing (Koparan, 2015).

While numerous studies attempted to increase the performance of students in Statistics, little is focused on the combination of the explanatory and exploratory scheme. Since literature says learning the presence of explanatory learning materials shows significant help to the students (Aksan, 2021) and students learn if they are able to apply what they have learned through hands-on activities (Benning & Agyei, 2016), the combination of the two approaches would create an advanced learning opportunity for the students. Likewise, the use of instructional material as a learning tool is claimed to be more adequate than plain teaching using chalk and talk as it helps students improve their conceptual understanding (Guido, 2014).

However, there are negative implications of using modular learning as revealed by Abude (2021) which include time allotment in accomplishing learning tasks placed in the module, the absence of interaction of teachers and learners, and educational attainment of the parents. In addition, Dargo and Dimas (2021) found that the use of modules reduces socialization among learners and their children, and adds a burden to the working parents since they are the ones acting as para-teachers to their children. These negative implications need to be considered by educators in the development of their instructional materials particularly those in the flexible learning modality or those who are using modular distance learning, asynchronous, and synchronous modes where the use of instructional material is imperative.

For this reason, this study is conducted focusing on the development of self-explanatory and exploratory learning tools in Statistics for education students.

This study is anchored on Self-directed learning theory. In this theory, individuals (students) take responsibility for their learning. When students know how to be responsible for their own learning, they will be more ready for the complexity of reality and thus, will be able to cope-up with different circumstances. Self-explanatory and exploratory instructional material may assist students on this journey. Instructional material provides a variety of instructional activities that can enhance students' innate learning capability. According to Hasibuan (2021), the use of instructional material helps students achieve a higher level of learning and helps students go over the difficulties in the early stages of learning hence, it is necessary to teachers to develop modules based on students' needs.

**Objectives**

This study tries to determine the validity level of the developed self-explanatory and exploratory instructional material in Statistics specifically for education students. In particular, this study tries to explore the following:

1. determine the validity level of the developed self-explanatory and exploratory instructional material with regard to the following:
    a. objectives;
    b. content;
    c. language used; and
    d. assessment and evaluation.
2. test the significant difference between the respondents' levels of evaluation on the developed self-explanatory and exploratory instructional material in statistics.
3. test the significant difference between the respondents' levels of evaluation on the developed self-explanatory and exploratory instructional material in statistics when grouped according to their classification.
4. determine if the developed module can be utilized by the target beneficiaries based on the feedback and suggestions of the respondents.

**Hypothesis**

1. There is no significant difference between the respondents' levels of evaluation on the developed self-explanatory and exploratory instructional material in statistics.
2. There is no significant difference between the respondents' levels of evaluation of the developed self-explanatory and exploratory instructional material in statistics when grouped according to their classification.

**Research Framework**

The research used descriptive-developmental research that focuses directly on the development of instructional tools, materials, or processes that will serve as the output of the study. In the development process, this study utilized the ADDIE model which stands for Analysis, Design, Development, Implementation, and Evaluation. This specific model guides educational researchers in crafting and developing instructional materials without following a sophisticated series of steps.

Similar studies show the advantage of using ADDIE model in developing tools for instructional purposes both in Mathematics (ChairilHikayat, Hairun, &Suharna, 2020; Widyastuti, 2019; Setiyani, Ferdianto, &Fauji, 2020; Patri, &Heswari, 2021) and Non-Mathematics subjects (Rafiq, Hashim, Yunus, &Pazilah, 2019;

In the Analysis phase, the researcher determined the most useful, yet most abused parametric statistical treatments for significant measuring significant differences among variables. These statistical treatments include t-tests (one-sample, paired t-test, unpaired t-test,) and analysis of variance (one-way, two-way, and three-way). They serve as inputs in the design phase of the study. The second phase includes the design of the instructional material. The researcher decided to present each lesson in the instructional material in 4E's approach (Expectation, Explanation, Exploration, and Examination). In the expectation part, objectives for each lesson are

presented followed by the explanatory part of the material. In the explanatory part, the lesson for each parametric test of difference is presented comprehensively and includes a step-by-step procedure on how students will perform manually each statistical treatment. The exploration part includes the part where students will use a spreadsheet and do the provided activity by themselves. After performing both, the instructional material provided an assessment (examination) to the students.

In the development phase, the researcher started the instructional material preparation for the flexible learning modality in FY 2021 due to the onslaught of the COVID-19 pandemic. Additional inputs were also included such as suggestions from statisticians outside the university where the study was conducted. In the implementation phase, the developed instructional material was pilot tested on BS Education students. The researcher also provided the developed instructional material to mathematics and non-mathematics teachers for evaluation. Education students, mathematics teachers, and non-mathematics teachers were provided an instrument as part of the validation of the developed instrument. The researcher also asked for feedback and suggestions from the respondents which would serve as another input for the polishing of the instructional material.

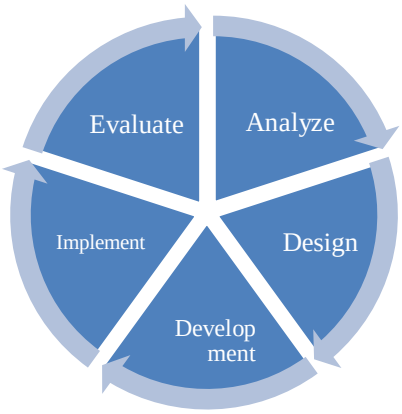



**Figure 1. The ADDIE Model**

## II. METHODOLOGY

**Respondents**

The respondents of the study consisted of 55 individuals. Twenty-five were education students while fifteen were Mathematics/Statistics teachers and the fifteen remaining were non-Mathematics/Statistics teachers. The instructional material was provided to them as well as the validated instrument for their evaluation. The instrument was translated into google form to minimize contact with the respondents as adhered to the existing protocol of physical distancing. Respondents were given 4 months to accomplish the evaluation form. After the specified period, the researcher closed the google form and started with the analysis of the data.

**Data Analysis**

Quantitative data analysis was used in treating the collected data from the respondents. Statistical measures such as weighted mean, ranking, and some non-parametric inferential treatments such as Kruskal-Wallis H-Test were used. Statistical significance was tested at 5% alpha level of significance. After the statistical analyses, feedback and suggestions from the respondents were analyzed using content analysis and presented.

**Research Instrument**

The research instrument utilized in the study is classified into two major categories: the first category is the developed instructional material while the other category is the questionnaire checklist.

The instructional material entitled: Parametric Test of Difference: A Self-Explanatory and Exploratory Learning Tool for Education Students is a set of 6 lessons in the field of Parametric Inferential Statistics. These lessons focused on hypothesis testing procedures in different parametric statistical treatments to test the significant difference between two or more variables. The lessons are presented in 4E's approach (Expectation, Explanation, Exploration, and Examination). Each lesson in this learning tool is divided into two major components. The first component is the explanatory part that deals with the discussion of the lesson content while the second component of the lesson focuses on the exploratory part where the student will be asked to perform electronically (using a spreadsheet) each given problem. At the end of every lesson is a learning assessment that measures the level of achievement of the set objectives before the start of each lesson. On the

right corner of the paper is a box intended for the student's notes. Students will be encouraged to write their important notes in the box. It is assumed that the content of this learning tool is enough for a semester in an undergraduate program.

The second research instrument is a questionnaire consisting of thirty items adopted from the study of Roman (2016). Constructs included in the research instrument involved the objectives of the instructional material with five items (α=0.940), contents of the module with 10 items (α=0.927), language used with five items (α=0.929), and evaluation activities with 10 items (α=0.954). The analysis of the obtained values was based similar to what Afifi and Rahim (2021) did in processing the validity of the developed instructional material.

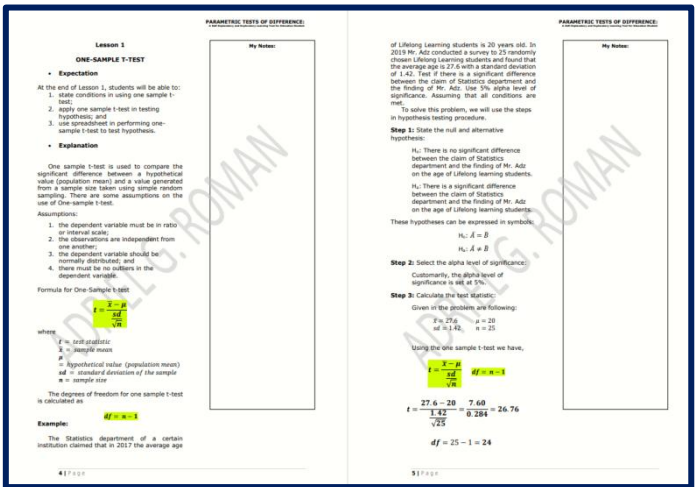


**Figure 2. Sample Lesson in the Self-Explanatory and Exploratory Instructional Material in Statistics for Education Students**

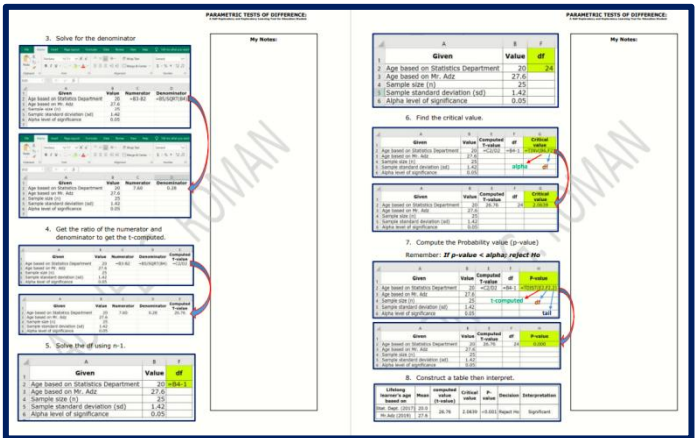
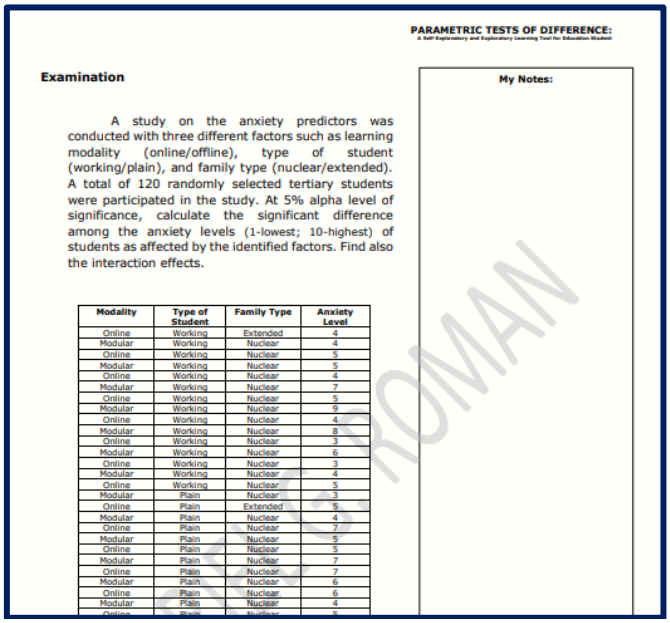


**Figure 3. Sample Exploratory Activity in the developed Instructional Material in Statistics**



PARAMETRIC TESTS OF DIFFERENCE:

Examination

A study on the anxiety predictors was conducted with three different factors such as learning modality (online/offline), type of student (working/plain), and family type (nuclear/extended). A total of 120 randomly selected tertiary students were participated in the study. At 5% alpha level of significance, calculate the significant difference among the anxiety levels (1-lowest; 10-highest) of students as affected by the identified factors. Find also the interaction effects.

My Notes:

| Modality | Type of Student | Family Type | Anxiety Level |
|---|---|---|---|
| Online | Working | Extended | 4 |
| Modular | Working | Nuclear | 4 |
| Online | Working | Nuclear | 5 |
| Modular | Working | Nuclear | 5 |
| Online | Working | Nuclear | 4 |
| Modular | Working | Nuclear | 7 |
| Online | Working | Nuclear | 5 |
| Modular | Working | Nuclear | 9 |
| Online | Working | Nuclear | 4 |
| Modular | Working | Nuclear | 8 |
| Online | Working | Nuclear | 3 |
| Modular | Working | Nuclear | 6 |
| Online | Working | Nuclear | 3 |
| Modular | Working | Nuclear | 4 |
| Online | Working | Nuclear | 5 |
| Modular | Plain | Nuclear | 3 |
| Online | Plain | Extended | 5 |
| Modular | Plain | Nuclear | 4 |
| Online | Plain | Nuclear | 7 |
| Modular | Plain | Nuclear | 5 |
| Online | Plain | Nuclear | 5 |
| Modular | Plain | Nuclear | 7 |
| Online | Plain | Nuclear | 7 |
| Modular | Plain | Nuclear | 6 |
| Online | Plain | Nuclear | 6 |
| Modular | Plain | Nuclear | 4 |

**Figure 4. Sample of Assessment in the developed Instructional Material in Statistics**

## III. RESULTS AND DISCUSSIONS

Table 1 shows the extent of validity of the developed instructional material in Statistics in terms of objectives. It is reflected in the table that the average weighted mean of 4.63 indicates that the developed instructional material has a very high level of validity. In particular, all indicated items measuring the construct are of a very high level of validity. The result shows that the developed module as evaluated by the respondents is conformant with the SMARTness of constructing the objectives for each lesson. The developed instructional material in Statistics also conforms with appropriate words/taxonomy used for educational objectives. In addition, both Mathematics and non-Mathematics teachers rated the developed instructional material in Statistics as Very Great Extent of validity while students rated it as Great Extent. Results signify that despite being non-math majors, students-respondents noticed the objectivity of the developed instructional material for each explanatory and exploratory part. As Manurung (2017) argued, instructional objectives are relevant to guide the preparation, and design of the instructional material that fit the needs of the learners.

**Table 1. Extent of Validity of the Developed Instructional Material in Statistics in Terms of Objectives**

| Objectives | ES | MT | NMT | WM | VI |
|---|---|---|---|---|---|
| 1. Specific objectives in every lesson | 4.32 | 4.67 | 4.87 | 4.62 | VGE |
| 2. Clear and easily understood words in the objectives | 4.28 | 4.73 | 4.87 | 4.63 | VGE |
| 3. Realistic specific objectives | 4.44 | 4.80 | 4.87 | 4.70 | VGE |
| 4. Measurability objectives | 4.36 | 4.87 | 4.87 | 4.70 | VGE |
| 5. Attainability of objectives | 4.24 | 4.67 | 4.67 | 4.52 | VGE |
| **AWM** | **4.33** | **4.75** | **4.83** | **4.63** | VGE |

In terms of the content of the instructional material developed for non-Statistics majors, the overall weighted mean of 4.61 reveals that the developed instructional material, in terms of its content, is valid to a very great extent. Similarly, the results of responses/evaluation of the three types of respondents (education student: 4.31; math teachers: 4.83; and non-math teachers: 4.72) signify that the developed instructional material, specifically the contents is valid. This, in particular, means that the developed instructional material in Statistics reflects what is necessary to be taught to the students. Respondents of the study evaluated that the content of the developed instructional material leads to the attainment of the set objectives conversely, the objectives set in the instructional material could be attained while consuming the content of the instructional material. The presence also of the supplementary activities/exercises gains the approval of the respondents of the study. All respondents strongly agreed that the contents of the instructional material are aligned with what the curriculum sets. Similar results were found also on the presentation of examples in the developed instructional material. Based on the respondents, the ideas presented in the examples are current and points are well-presented and expressed.

**Table 2. Extent of Validity of the Developed Instructional Material in Statistics in Terms of Content**

| Content of the Module | ES | MT | NMT | WM | VI |
|---|---|---|---|---|---|
| 6. Each lesson reflects the most important aspects of what is being taught | 4.28 | 4.67 | 4.80 | 4.58 | VGE |
| 7. The lessons are presented at a pace that allows for reflection and review | 4.20 | 4.73 | 4.73 | 4.56 | VGE |
| 8. There is adequate provision for supplementary activities/exercises. | 4.32 | 4.73 | 4.80 | 4.62 | VGE |
| 9. The content leads to the attainment of the objectives. | 4.36 | 4.87 | 4.73 | 4.65 | VGE |
| 10. There is adequate presentation/discussion of content | 4.32 | 4.80 | 4.60 | 4.57 | VGE |
| 11. The information about the different topics is accurate and precise | 4.40 | 4.80 | 4.67 | 4.62 | VGE |
| 12. There is a variety of supplementary activities | 4.28 | 4.73 | 4.87 | 4.63 | VGE |
| 13. The ideas, concepts, and points presented are well-expressed | 4.32 | 4.80 | 4.67 | 4.60 | VGE |
| 14. The examples presented are current, accurate, and defensible | 4.28 | 4.87 | 4.53 | 4.56 | VGE |
| 15. The lessons are aligned with the curriculum | 4.36 | 4.87 | 4.80 | 4.68 | VGE |
| **AWM** | **4.31** | **4.79** | **4.72** | **4.61** | VGE |

The language used in the developed instructional material was evaluated by the respondents to a very great extent. This shows that the language used in the developed instructional material is not highly technical and presented in layman's terms of being easy to understand by the non-Statistics major. Likewise, based on the responses, a very great extent is obtained by the developed instructional material in terms of clarity of directions. Respondents also rated to a very great extent the characteristics of the developed instructional material in terms of its unambiguity easy-to-follow directions. The result of the study is similar to the findings of Rochsun and Agustin (2020) that language used in the instructional material is valid in addition to construction of contextual problems, and content.

**Table 3. Extent of Validity of the Developed Instructional Material in Statistics in Terms of Language Used**

| Language Used | ES | MT | NMT | WM | VI |
|---|---|---|---|---|---|
| 16. The words used in the module are correctly used. | 4.28 | 4.80 | 4.73 | 4.60 | VGE |
| 17. The module is accompanied by clear and specific directions for their use. | 4.32 | 4.87 | 4.73 | 4.64 | VGE |
| 18. The vocabulary used is suitable to the reading and understanding level of students to whom the modules are intended | 4.32 | 4.80 | 4.60 | 4.57 | VGE |
| 19. Instructions to students are clear, unambiguous, and easy to follow. | 4.36 | 4.80 | 4.60 | 4.59 | VGE |
| 20 The lessons are presented in paragraphs/sentences that are grammatically correct | 4.36 | 4.87 | 4.73 | 4.65 | VGE |
| **AWM** | **4.33** | **4.83** | **4.68** | **4.61** | **VGE** |

In general, respondents evaluated the developed instructional material in terms of evaluation activities to a very great extent. Mathematics and non-Mathematics teacher rated the instructional material to a very great extent while education students rated it to a great extent. In particular, respondents agreed that the module has provision for self-assessment, items that help increase understanding and retention of the content covered. They also evaluated the developed instructional material to a very great extent on the responsiveness of the assessment tools to the set objectives and instructional material content. Also, the developed instructional material, based on the respondents is written at a level that students can understand.

**Table 4. Extent of Validity of the Developed Instructional Material in Statistics in Terms of Evaluation Activities**

| Evaluation Activities | ES | MT | NMT | WM | VI |
|---|---|---|---|---|---|
| 21. The module has provision for self-assessment | 4.40 | 4.73 | 4.67 | 4.60 | VGE |
| 22. The items help increase understanding and retention of the content covered | 4.36 | 4.67 | 4.73 | 4.59 | VGE |
| 23. The items focus on important objectives and content of the lessons | 4.36 | 4.93 | 4.73 | 4.68 | VGE |
| 24. The items in the evaluation are congruent to the specific objectives | 4.32 | 4.87 | 4.67 | 4.62 | VGE |
| 25. There are items that measure higher thinking skills | 4.40 | 4.87 | 4.73 | 4.67 | VGE |

| | | | | | |
|---|---|---|---|---|---|
| 26. The items are grammatically correct. | 4.24 | 4.87 | 4.73 | 4.61 | VGE |
| 27. The items are arranged from easy to difficult | 4.32 | 4.67 | 4.80 | 4.60 | VGE |
| 28. The test items are written at a level that students can understand | 4.16 | 4.67 | 4.60 | 4.48 | GE |
| 29. The answer to one item furnishes or gives clue to the answer in another item. | 4.28 | 4.67 | 4.67 | 4.54 | VGE |
| 30. The items cover the important competencies to be developed | 4.44 | 4.80 | 4.67 | 4.64 | VGE |
| **AWM** | **4.33** | **4.77** | **4.70** | **4.60** | **VGE** |

The feedback of the respondents was classified according to the type of respondents. As to education students, the developed instructional material is well-defined, clear, and good, very useful, especially to students who are conducting research. The developed instructional material also can be used as reviewer material in research and statistics. Student-respondents also believe that the developed instructional material could be a great help to those who struggle in research. Also, respondents mentioned that the content of the developed instructional material is presented in a way that can be understood easily by the readers/students.

Mathematics teacher-respondents mentioned that the developed instructional material is very student-friendly due to simplified topics. The developed instructional material also provides information that is useful to the students. Mathematics teacher-respondents also rated the developed instructional material as well-organized and coherently presented. They also stated that the developed instructional material will not only be helpful to the students but also to those who would like to venture into the field of statistics.

On the part of non-mathematics teachers, several feedbacks were noted on the developed instructional material such as the clarity of the explanations provided in the IM, attainability of the activities in a prescribed time, and benefit to students and teachers. Non-math teachers also stated that the developed instructional material is very helpful to the students and the competencies needed are very timely. Based on the respondent's feedback, the developed instructional material would be useful to the students and other statistics enthusiasts.

Based on the findings, the developed instructional material in Statistics will be useful to education students based on its nature of being self-explanatory and self-exploratory. According to Jajuri, Hashim, Ali, and Abdullah (2019) when teachers introduce the activities in Science, Technology, Engineering, and Mathematics (STEM) with the integration of technology tools, it drives students to collaborate and be participative.

**Table 5. Respondents' Feedback on the Developed and Validated Instructional Material in Statistics**

| Type of Respondents | Feedback |
|---|---|
| Education Students | Clear and good |
| | For me...the instructional material is very useful for me cause it serves as my reviewer. |
| | It can help a lot of those students who conducting research. |
| | Questions are easy to understand and answer. |
| | The developed instructional material could be a great help to those, including me who struggled in doing statistics. The lessons were presented in a way that students or readers could easily understand, well, of course, excluded the reason that if we, students are not familiar with the statistical term, this part is our responsibility to know. All in all the module for me is an excellent instructional material. |
| | The developed instructional material we're reliable for the students to understand the lesson well. |
| | the module is well-defined. |
| Mathematics Teachers | Excellent |
| | For sure if we use this material, students will understand statistics very easily. |
| | good job |
| | The developed instructional material is very student-friendly since it discusses the topics with relative ease. |
| | The instructional material provides information that is useful for the students. The instructional material is well-organized as well. |

| | |
|---|---|
| | Topics are arranged accordingly, wherein the students will surely understand them. It will be very helpful not only for the student but for does who really want to know about statistics matters. |
| | The instructional material will be of great help for those who are conducting research, specifically in practicing/reviewing statistics. |
| | The instructional material will be very helpful for those who will undergo research. Each lesson can be easily understood because it was clearly explained. |
| | The lessons were clearly explained. |
| Non-Mathematics Teachers | The developed instructional material was clearly explained by the author. Every lesson has examples to better understand the topic and to guide the target readers. |
| | Some of the instructional materials necessary for effective teaching and learning. |
| | The developed instructional material I think could help a lot to both teachers and learners because this generally can be easily followed due to its clear instructions given and appropriate examples to the topic. |
| | The developed instructional material is very helpful to the students. The competencies needed are very present and activities indicated in each lesson are attainable within a given time limit. |
| | The instructional material can be used by our learners. |
| | This instructional material will be beneficial to teachers as well as to students. |
| | Well-structured content |
| | The instructional materials provide a variety of simple and student-appropriate examples, making learning easier for even the most inexperienced statistics student. |
| | The module is easy to understand. I think even those who are not Math majors will find this material clear and concise. It is also very informative and has the necessary topics to be discussed in the subject matter. |
| | The tool is clear and useful. |

Several suggestions are provided by the respondents on the developed instructional material. According to the education student-respondents, there is a need to continue on improving some learning tools' contents. Similarly, mathematics teacher-respondents suggested the technical aspect of the developed IM. On the part of the non-mathematics teacher-participants, they suggested providing high-definition photos/pictures in the developed IM for easy understanding of the step-by-step procedure. Likewise, another suggestion is on providing operational terms to the words that are confusing or difficult to understand especially on the part of the non-statistics majors.

The result of the study agreed with what Mazgon and Stefanc (2012) proposed quality educational materials are adapted to the difficulty and level of the educational program and take into account the different learning styles of the students. Similarly, based on Bugler, Marple, Burr, Chen-Gaddini, and Finskelstein (2017), the quality of instructional materials includes the ease of use and support which pertain to the completeness of instructions, materials, activities, and assessment of the instructional material, in addition, to ease for teachers, students, and parents to use.

**Table 6. Respondents' Suggestions on the Developed and Validated Instructional Material in Statistics**

| Type of Respondents | Suggestions |
|---|---|
| Education Students | Continue improving some of the learning tools' content. |
| Mathematics Teachers | Kindly check the red arrows used on the materials that overlap some of the numbers on some tables. |
| Non-Mathematics Teachers | Include the link to supplemental video discussion for each lesson |
| | The developed instructional material is comprehensive, user-friendly, and also encourages learners to write notes which are proven to improve learning processes and develop skills in mathematics. Maybe you can use more HD photos as guides for the step-by-step procedure of carrying out parametric tests because the ones used are pixelated which is troublesome for individuals with eye impairment such as me. |

| | |
|---|---|
| | The instructional materials are very informative and the examples are very easy to follow because of the very clear figures. My only concern is some of the terms are confusing or hard to understand especially if you are not a mathematics-related student or teacher or if you don't have strong fundamentals in the topic. maybe input some operational terms. |

On the significant difference among the respondents' evaluation of the validity of the developed instructional material, both Mathematics and non-Mathematics show no significance in their responses while both are significant when compared to the student-respondents. As to individual median comparisons, the table reveals that in all 4 major constructs of validity (objectives, content, language, and evaluation characteristics) the median value of all responses from non-mathematics teachers is 5.00 signifying their affirmation of the developed instructional material. Likewise, the content, language, and evaluation characteristics of the developed instructional material were both rated as 5.00 by the Mathematics teachers while 4.80 on the objective characteristics. Despite the significance of the difference that existed, calculated using the Kruskal-Wallis H-Test still, student-respondents evaluation show in favor of the developed instructional material in all of its characteristics.

**Table 7. Significant Difference among the Extent of Validity of the Developed Instructional Material in Statistics as evaluated by the Respondents**

| Validity of the Instructional Material | Type of Evaluators | Median | KW-Value | p-value |
|---|---|---|---|---|
| Objectives | ES | 4.40[b] | 8.155 | 0.017 |
| | MT | 4.80[a] | | |
| | NMT | 5.00[a] | | |
| | Total | | | |
| Content | ES | 4.50[b] | 8.452 | 0.015 |
| | MT | 5.00[a] | | |
| | NMT | 5.00[a] | | |
| | Total | | | |
| Language | ES | 4.40[b] | 10.492 | 0.005 |
| | MT | 5.00[a] | | |
| | NMT | 5.00[a] | | |
| | Total | | | |
| Evaluation | ES | 4.40[b] | 10.814 | 0.004 |
| | MT | 5.00[a] | | |
| | NMT | 5.00[a] | | |
| | Total | | | |

***Note: Medians sharing the same letter are not statistically significant.***

The difference in the level of validity of instructional material in Statistics based on its characteristics revealed no significance ($p>0.05$). Hence, the levels of validity on the developed instructional material are the same for each considered constant. This denotes that as for the identified constants, the developed module is a very high extent of validity. Overall, the result of the study conforms to what Ghani and Daud (2018) concluded that an effective instruction must be well structured and imbued with innovative and relevant instructional learning materials.

Table 7. Significant Difference among the Extent of Validity of the Developed Instructional Material in Statistics based on its Characteristics

| Validity of the Instructional Material | Median | Mean Rank | KW-Value | p-value |
|---|---|---|---|---|
| Objectives | 4.80 | 113.15 | 0.380 | 0.944 |
| Content | 4.90 | 112.25 | | |
| Language | 4.80 | 110.06 | | |
| Evaluation | 4.80 | 106.55 | | |

## IV. CONCLUSION

On the basis of the results of the study, the instructional material in Parametric Statistical Treatment for Difference under the subject of Statistics is acceptable and valid considering the mathematics, non-mathematics, and education student-evaluators. The instructional material, after the analysis, is valid as to objectives, content, language, and evaluation activities. Considering the evaluation, feedback, and suggestions of the evaluators, the developed instructional material can be utilized by education students to guide them in studying statistical concepts, especially in the context of quantitative research. The use of instructional material can promote independent learning among students which is necessary for learning accountability. With the foregoing results, the instructional material in Parametric Statistical Treatments can be recommended to Statistics teachers and researchers as complementary materials in teaching inferential analysis.

## REFERENCES


[1]. Aksan, J. A. (2021). Effect Of Modular Distance Learning Approach To Academic Performance In Mathematics Of Students In Mindanao State University-Sulu Senior High School Amidst Covid-19 Pandemic. Open Access Indonesia Journal of Social Sciences, 4(4), 386-409.

[2]. Kandeel, R. (2019). Students' Academic Difficulties in Learning a Statistics and Probability Course: The Instructors' View. Journal of Education and Practice. 10(9), 43-52

[3]. Kurniawan, D., Wahyuningsih, T. (2018). Analysis of Student Difficulties in Statistics Courses. International Journal of Trends in Mathematics Education Research, 1(2), 53-55. doi:10.33122/ijtmer.v1i2.39

[4]. Koparan, T. (2015) Difficulties in learning and teaching statistics: teacher views, International Journal of Mathematical Education in Science and Technology, 46:1, 94-104,DOI: 10.1080/0020739X.2014.94142.

[5]. Roman, A. G. (2016). Development and validation of statistics module for quality educational research. International Journal of Science and Research. 5(9) p 104-108

[6]. Hasibuan, M. N. (2021).The Utilization Of Mathematics Module To Improve Student Learning Effectiveness In The Pandemic Covid 19. FMIPA, State University of Medan.

[7]. 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.

[8]. Abude, A. J. (2021). The Effectiveness of Modular Distance Learning Modality to the Academic Performance of Students: A Literature Review. *Himalayan Journal of Education and Literature. 2(*6).

[9]. Dargo, J. M. & Dimas, M. (2021). Modular Distance Learning: Its Effect in the Academic Performance of Learners in the New Normal. *Journal of Education, Teaching, and Learning. 6*(2), 204-208.

[10]. Mazgon, J., &Stefanc, D. (2012). Importance of the Various Characteristics of Educational Materials: Different Opinions, Different Perspectives. *Turkish Online Journal of Educational Technology-TOJET*, *11*(3), 174-188.

[11]. Bugler, D., Marple, S., Burr, E., Chen-Gaddini, M., & Finkelstein, N. (2017). How teachers judge the quality of instructional materials. *WestEd https://www. wested. org/wp-content/uploads/2017/03/resource-selecting-instructional-materials-brief-1-quality. pdf14.*

[12]. Manurung, K. (2017). Designing instructional materials. *Palu: Untad Press, Indonesia*.

[13]. Ghani, M. T. A., & Daud, W. A. A. W. (2018). Adaptation of ADDIE instructional model in developing educational website for language learning. *Global Journal Al-Thaqafah*, *8*(2), 7-16.

[14]. Rafiq, K. R. M., Hashim, H., Yunus, M. M., &Pazilah, F. N. (2019). Developing a MOOC for communicative english: A battle of instructional designs. *International Journal of Innovation, Creativity and Change*, *7*(7), 29-39.

[15]. ChairilHikayat, S., Hairun, Y., &Suharna, H. (2020). Design of Realistic Mathematics Education Approach to Improve Critical Thinking Skills. *Univers. J. Educ. Res*, *8*, 2232-2244.

[16]. Widyastuti, E. (2019, March). Using the ADDIE model to develop learning material for actuarial mathematics. In *Journal of Physics: Conference Series* (Vol. 1188, No. 1, p. 012052). IOP Publishing.

[17]. Setiyani, D. P. P., Ferdianto, F., &Fauji, S. H. (2020). Designing a digital teaching module based on mathematical communication in relation and function. *Journal on Mathematics Education*, *11*(2), 223-236.

[18]. Afifi, M., & Rahim, N. A. A. (2021). Mathematics Learning Module Based on Character Learning: A Proposal of The Study. *Development*, *10*(1), 139-153.

[19]. Rochsun, R., & Agustin, R. D. (2020). The Development of E-Module Mathematics Based on Contextual Problems. *European Journal of Education Studies*, *7*(10).

[20]. Jajuri, T., Hashim, S., Ali, M. N., & Abdullah, S. M. S. (2019). The implementation of science, technology, engineering, and mathematics (Stem) activities and its effect on student's academic resilience. *Asia Pacific Journal of Educators and Education*, *34*, 153-166.