Innovations

# Development and validation of instructional module on CHED Mandated topics in mathematics in the modern world

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***Abstract***

*One of the important educational innovations in instructional design that can complement the traditional face-to-face instructions programmed instruction in modular form. The modular approach consists of self-directed learning activity packets that are self-instructional, self-paced, student-directed, and placed the responsibility of learning on the students. The objective of the study was to develop and validate an instructional module on CHED mandated topics in Mathematics in the Modern World in order to address new trends and fit in with the new normal. The investigation was carried out using a developmental research design According to the findings, the panel of experts assessed the instructional module to be "excellent". The developed instructional module was found to be valid in terms of objectives, content, format and language, presentation and usefulness based on the experts' assessment. The face validity of the developed instructional module was assessed by the student-respondents to be valid. Student-respondents performed better in the post-test because of their learnings from the instructional module. They considered it to be very useful since it helped them understand the lessons in the module. It is then suggested that the proposed validated instructional module be used by the Mathematics teachers from other colleges and universities to increase its reliability and usability.*

***Keywords:*** *Development and validation, instructional module, mathematics in the modern world.*

## Introduction

Education is very crucial in shaping the youth to become efficient and capable individuals in the future professions. It functions as a key to unlock the door to success in the future and open up many doors in life. It enlightens and promotes a person's intellect and thinking quality education to benefit people of any age, race, or creed, religion, and area attain their goals in life. If the world evolves over time, so will education system (Torio, 2015).

The educational system must adapt to society's rapid changes and complexity. The need to prepare students for productive functioning in a constantly changing and highly demanding environment has grown over time. The government's first step toward improving education is implementing the Department of Education's K-12 program. The DepEd's Enhanced K to 12 Basic Education Program aims to improve Philippine basic education. A vision based on human development and improved curriculum give graduates a better understanding of the world.

The Commission on Higher Education (CHED) was required to affiliate with the Department of Education and other institutions for teacher training and education, including meeting curricula quality standards, to support the program. This prepares future teachers to teach young Filipinos under the new educational system.

In response to the College Readiness Standards (CHED Memorandum No. 20, Series 2013), the Enhanced Basic Education Curriculum (K-12) has integrated General Education (GE) courses in high school core courses of higher education programs, revising the current GE curriculum (CHED Memorandum No. 59 Series 1996). The new GE curriculum exposes undergraduates to a variety of knowledge domains and approaches to understanding social and natural realities, development, intellectual competencies, and civic capacities.

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Mathematics in the Modern World is one of the course mandated by CHED under the new curriculum. It contains the following core topics: Mathematics in our World; Mathematical Language and Symbols; Problem Solving and Reasoning; and Data Management.According to Marasigan, et.al. (2019), studying these themes, students are encouraged to see mathematics as more than just a collection of formulas, but as a source of aesthetics in natural patterns, as well as a rich language ruled by logic and reasoning.

With the country in crisis because of the pandemic, it is especially important that teachers in schools and other universities that use modules as a platform for learning acquisition among students receive adequate training on how to develop an effective instructional module that bridges the teaching-learning process. The traditional classroom setup is not recommended for the upcoming 2020-2021 school year, so teachers will need to find other ways to teach their students. In regions with spotty internet access or where students lack the financial resources to purchase their own computers, laptops, or tablets specifically for online learning, instructional modules can be an invaluable resource. Since educators have been given the tools they need to create effective modules, they should have no trouble conveying all of the knowledge their students need to know while also protecting their wellbeing.

One of the important educational innovations in instructional design that can complement the traditional face-to-face instruction is programmed instruction in module form (Torrefranca E.C., 2017). This approach, often called as modular approach, consists of self-directed learning activity packets that are self-instructional, self-paced, student-directed, and place the responsibility of learning on the students.

For the past 2 years of teaching tertiary mathematics, the researcher strongly believes that developing mathematical understanding does not merely mean getting high scores in different assessments such as quizzes and tests or being able to solve drills in mathematics books; rather, it is manifested in the students' ability to relate and communicate to previously acquired knowledge and be able to identify its practical purpose. Faced with such a challenge, the researcher has the purpose of developing instructional module that can benefit both the researcher and the students. The instructional module consists of selected topics in Mathematics in the Modern World. With this, the researcher hopes that the developed instructional module can be used in teaching the concepts of Mathematics in the Modern World under the new curriculum. It is with great hope that the module can be used to the upcoming first year students of the University.

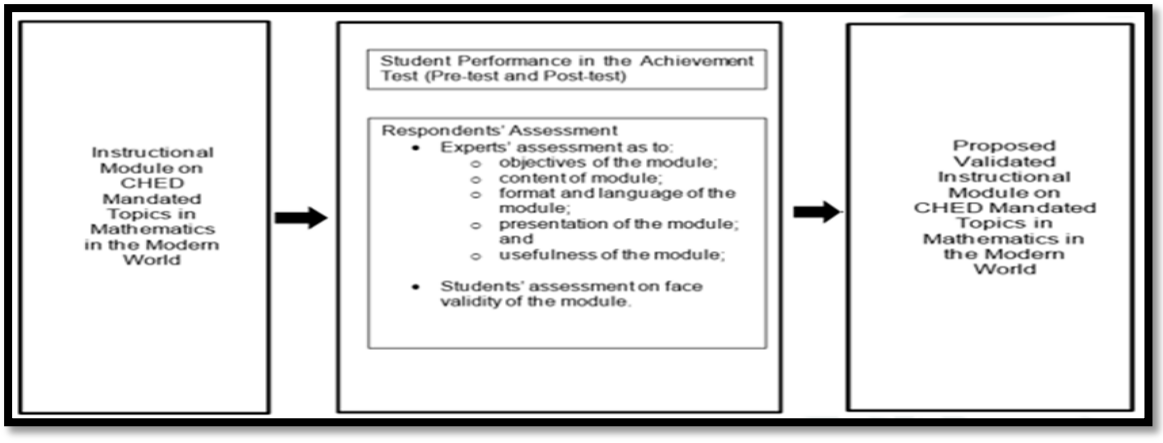
**Framework**

The study is focused on developing and validating instructional module in teaching some selected topics in Mathematics in the Modern World, a subject under the new curriculum that must be taken by freshmen of Northwest Samar State University. It is anchored on theories regarding individualizing instruction through modules.

According to Meriam, Caffarella, and Baumgartner (2007) the necessity for learners to become self-reliant, self-disciplined, and self-confident in their ability to direct their own learning is becoming increasingly important. They believed that through Self-Directed Learning (SDL), the learner has the capacity to plan, implement, and evaluate his own learning activity. In the same manner,Guglielmino (2008) explicated self directed learning (SDL) as an effective mode of learning for an individual to possess in the formation age as it underscores his capacity to cope with constant changes. Given the high speed of information changes in the society, the individual must learn how to direct himself in acquiring information and knowledge to be able to survive and compete with others.

On the other hand, Smedley (2007) proposed five set of strategies that may assist self-directed learning readiness: to wit, a) creating supportive learning environment; b) providing constructive feedback; c) encouraging self-assessment; using self-reflection; d) providing opportunities to engage in their own learning process; and e) developing goal orientation values. By these aforementioned strategies, Macarandang (2009) added a certain approach to self-directed learning which is the utilization of instructional materials that are designed to help students learn by themselves. These instructional materials, which could be in module form, consisted of self-contained, independent unit of instruction prepared for purpose of attaining defined instructional objectives.

The study proceeded from the self-made instructional module on CHED mandated topics in Mathematics in the modern world. The module was then fielded to measure the learning increment of student performance between the post-test and pre-test. Experts, operationally defined as Mathematics teachers in Northwest Samar State University, evaluated the characteristics of the module's objectives, content,




format and language, presentation, and usefulness. Students' evaluation on the face validity of the module made up for the final validity test of the material. With all inputs considered, a validated instructional module on CHED mandated topics in the Mathematics in the modern world has been constituted.

**Objectives**

The study aimed to develop and validate an instructional module on CHED mandated topics in Mathematics in the Modern World with the end-view of coming up with a resource material in teaching the course.

Specifically, the study sought answer to the following questions:

- What is the experts' assessment on the instructional module on CHED mandated topics in Mathematics in the Modern World in terms of: objectives; content; format and language; presentation; and usefulness/usability?
- What is the performance in the achievement test of the student-respondents in the pre-test and post-test?
- Is there a significant mean difference between the pre-test and post-test results?

**Methodology**

The developmental research design was used in this study. A developmental research design, according to Richey and Klein (2007), is a systematic study of creating, developing, and assessing educational programs, procedures, and products that must meet internal consistency and effectiveness requirements. In the realm of instructional technology, developmental research is especially essential. The researcher employed the ADDIE (Analysis, Design, Development, Implement, Evaluate) Model in building the instructional module on the different lessons under the subject in order to establish an empirical basis for producing self-instructional modules in the subject Mathematics in the Modern World. The development of material was managed and expedited using this strategy.

**Participants**

The respondents of the study included the panel of experts and the student- respondents. The panel of experts are teachers who have the knowledge and trainings in the development and validation of modules and have specialization in the field of Mathematics. These respondents gave comments and suggestions and at the same time evaluated the over-all content and efficacy of the module. The student-respondents are the freshmen students of Northwest SamarState University who took Mathematics in the Modern World course wherein the researcher was their instructor. They evaluated the instructional modules' face validity.

**Sampling Procedure**

The researcher used the universal sampling method in determining the student-respondents since these freshmen were under the researcher's class in the course, Mathematics in the Modern World. For the panel of experts, purposive sampling method was used, taking consideration of their educational qualification, knowledge, expertise in the field of Mathematics and teaching experience.

**Instrumentation**

The study utilized the following instruments for data gathering: 1) Achievement Test 2) Evaluation Rating Scale to be used by the experts and the student-respondents in assessing the aspects of the module.

Achievement Test. The 30-item pre-test was used to gather baseline information regarding the students' knowledge about the topics prior to their exposure to the instructional module. It also served as a post-test to me

Experts' Evaluation Rating Scale. To know the acceptability of the designed instructional module, a five-point rating scale was adopted from the theses of Torrefranca (2017) and Marasigan (2019). Some of the items were revised to suit them to the data that were needed in the study.

Student-Respondents' Evaluation Rating Scale. The instrument was adopted from the work of Torrefranca (2017) and Marasigan (2019). A five-point rating scale was used in rating the items. There were 10 items to assess the content and another 10 items to evaluate the format of the module.

**Validation of Instruments**

In establishing the validity of pre-test and post-test for the instructional module, the following process was applied to results/answers of the test items.

From the 60 items developed and proposed by the researcher, the thesis committee together with the researcher's adviser considered the items irrelevant and undergo item analysis to establish the validity of the achievement test.

The 60-item achievement test proposed by the researcher underwent for a try-out. There were 150 students who took the exam. It took approximately one and half hours for the students to answer the achievement test. Then, an item analysis was done with the test result.

In deciding whether an item is retained, revised or removed, the researcher used a Target Analyzer Probe (tap exe.) Program. In using the program, the items that were deleted were those with adjusted point biserial value of less than 0.20.

From 41 items that remained after the item analysis, 30 items were taken for the pre-test/post-test of the instructional module. These 30 items were selected based on the computed Table of Specification (TOS) prepared by the researcher. The achievement test was subjected to expert validation for its content validity. The evaluation rating scales of the experts and the students were validated by the adviser and panel.

**Data Gathering Procedure**

The process of gathering data underwent four phases, namely: phase 1 – planning; phase 2 – designing/developing; phase 3 – validation and try-out; and phase 4 – evaluation and finalization.

Phase 1 – Planning. In this phase, the researcher browsed all print and non-print materials which are related to the topics under study for him to be guided in determining the essential competencies to be included in the module. He chose the instructional setting, estimated the cost of the module productions and allocated the budget for the module print-out. He further considered the possible respondents/participants of the study and the topics included in the module.

Phase 2 – Designing/Developing. This phase covered the structuring of the modules. Procedures were observed in developing the modules: stage 1 – determining the design of the module. These are the basic parts of the module, namely: pre-test, Let's Hit These (objectives), Let's Read (Discussion), Let's Do This

(practice task) and post-test; stage 2 – is on specifying the objectives and sub-topics; stage 3 – determining the instructional activities; stage 4 – preparing the achievement test, which served as the pre-test and post-test to be given to the students. A table of specification for the formulation of items was made for a valid and reliable achievement test.

Phase 3 – Validation and Try-out. The achievement underwent expert validation and item analysis. The item was revised and refined based on the comments and suggestions of the adviser, experts and the panel.

For the evaluation, rating scale of the expert was considered for the adequacy of the objectives, content, format and language, presentation and usefulness of the instructional module to the intended users. For the experts' assessment, the first draft of the instructional module was printed and given to the researcher's adviser, panel of examiners, and experts on the development of instructional module in Mathematics. Then, the researcher revised the said module based on the comments and suggestions given by the adviser, the panel of examiners and experts who were requested to read and evaluate the module. The revised instructional module was validated by experts as they evaluated and rated the following indicators: 1) objectives; 2) content; 3) format and language; 4) presentation; and 5) usefulness of the instructional module.
For the try-out, a pre-test was given to the students through Google form with a duration of 1 hour. After 12 weeks from the time of administering the pre-test, a post-test was given to the students through Google form also with a time limit of 1 hour.
Phase 4 – Evaluation and Finalization. Aside from the experts' assessment, the instructional module was also validated by the students. Two sources of information were considered by the researcher from the student: 1) feedback of the student-respondents on the instructional module through face validity; and 2) results of the comparison of the student-respondents' performance in the pre-test and post-test. The instructional module was finalized based on the outputs obtained in the evaluation stage.

The finalized instructional module was reproduced and distributed to the respondents of the study. Permission was asked from the school administrator for the conduct of the study. The student-respondents were contacted for the administration of the test and the instructional module through on-line manner. The obtained data were subjected to statistical treatment for proper interpretation.

**Statistical Treatment**

The following are the statistical measures that were used in the study:
Mean and standard deviation were used to determine the assessment of the respondents on the aspects of instructional module;

The t-test for dependent means was utilized to test the significant difference between the pre-test and post-test mean scores of the student-respondents on the lessons covered in the module.

## Results and Discussion

**Assessment of the Experts on the Characteristics of the Instructional Module on Mathematics in the Modern World**

The data on the experts' assessment on the instructional module are displayed in Table 4. The instructional module was assessed in terms of objectives, content, format and language, presentation and

usefulness/usability. And evaluation rating scale was used by the experts in determining the acceptability of the designed instructional module.

**Table 1: Mean and Standard Deviation in the Assessment of the Experts on the Characteristics of the Instructional Module on Mathematics in the Modern World**

| **Aspects** | **Mean (n=4)** | **Desc** | **sd** |
|---|---|---|---|
| Objective of the Module | | | |
| 1. The of objectives are clearly stated. | 4.75 | E | 0.50 |
| 2. The objectives are specific. | 4.75 | E | 0.50 |
| 3. The objectives are measurable and attainable. | 4.75 | E | 0.50 |
| 5. The objectives are closely related to the purpose of the module. | 5.00 | E | 0.00 |
| 6. The objectives are relevant to the topics of each lesson of the module. | 5.00 | E | 0.00 |
| 7. The objectives are well-planned and organized. | 4.50 | E | 0.58 |
| 8. The objectives are well-formulated. | 5.00 | E | 0.00 |
| 9. Each set of specific objectives leads to the achievement of its relevant general objectives. | 4.50 | E | 0.58 |
| 10. The objectives are well-disseminated. | 5.00 | E | 0.00 |
| **Average (Objective)** | **4.81** | **E** | **0.26** |
| Content of the Module | | | |
| 1. The contents are relevant to the objectives. | 4.50 | E | 0.58 |
| 2. The contents are arranged in logical sequence of learning. | 4.75 | E | 0.50 |
| 3. The topic(s) of each lesson is (are) fully discussed. | 4.25 | VG | 0.96 |
| 4. The content of each lesson is simple and easy to understand. | 4.75 | E | 0.50 |
| 5. The topics of each lesson are fully discussed. | 4.50 | E | 0.58 |
| 6. Each topic is given equal emphasis in the lesson. | 4.50 | E | 0.58 |
| 7. The topics are supported by illustrative examples, and the practice task are suited to the level of the students. | 4.50 | E | 0.58 |
| 8. All activities are appropriate for their content and objectives. | 4.50 | E | 0.58 |
| 9. All learning activities promote active participation and response. | 4.50 | E | 0.58 |
| 10. Appropriate self-check questions and answers have been included at all necessary points. | 4.75 | E | 0.50 |
| **Average (Content)** | **4.55** | **E** | **0.37** |
| Format and Language of the Module | | | |
| 1. The format/layout is well-organized making the lessons interesting. | 4.50 | E | 0.58 |
| 2. The language used is easy to understand. | 4.75 | E | 0.50 |
| 3. The language used is clear and concise. | 4.75 | E | 0.50 |
| 4. The language used is motivating. | 5.00 | E | 0.00 |
| 5. The mathematical symbols are well-defined. | 4.50 | E | 0.58 |
| 6. The instructions given are clear, understandable and easy to follow. | 4.50 | E | 1.00 |
| 7. All visual elements have been successfully integrated into the learning sequence. | 4.75 | E | 0.50 |
| 8. Learning activities are shown as input-process-output cycle. | 4.75 | E | 0.50 |
| 9. All concepts in the modules are well displayed/suggested. | 4.00 | VG | 0.00 |
| 10. Whenever appropriate, a touch of humour has been added using cartoons, humorous comments, caricatures, and other similar aspects. | 4.00 | VG | 0.00 |

| **Average (Format and Language)** | **4.55** | **E** | **0.25** |
|---|---|---|---|
| Presentation of the Module | | | |
| 1. The topics are presented in a logical and sequential order. | 5.00 | E | 0.00 |
| 2. The lessons are presented in a unique/original style/form. | 3.50 | G | 0.58 |
| 3. The learning activities promote active participation and response. | 4.50 | E | 0.58 |
| 4. The learning activities are clearly presented. | 4.25 | VG | 0.50 |
| 5. The presentation of each lesson is attractive and interesting. | 4.50 | E | 0.58 |
| 6. Adequate examples are given in each topic. | 4.25 | VG | 0.96 |
| 7. The learning activities are divided into small steps/units. | 4.50 | E | 0.58 |
| 8. The length of time needed to complete the module is adequate/sufficient. | 4.50 | E | 0.58 |
| 9. Effective reinforcement statements have been included at necessary point. | 4.25 | VG | 0.50 |
| 10. Continuity of learning has been ensured by the inclusion of bridge passage at all necessary point. | 4.75 | E | 0.50 |
| **Average (Presentation)** | **4.40** | **VG** | **0.29** |
| Usefulness of the Module | | | |
| 1. The instructional module motivates the students to study the subject. | 4.75 | E | 0.50 |
| 2. The instructional module helps the students master the topics at their own pace. | 5.00 | E | 0.00 |
| 3. The instructional module allows the students to use their time wisely/efficiently. | 4.75 | E | 0.50 |
| 4. The instructional module develops the analytical thinking and reasoning skills of the students. | 4.75 | E | 0.50 |
| 5. The instructional module encourage independent learning for the students. | 4.75 | E | 0.50 |
| 6. The instructional module serves as supplementary material for teachers and students. | 5.00 | E | 0.00 |
| 7. The instructional module encourage students to develop their study habits. | 5.00 | E | 0.00 |
| 8. The instructional module allows students to develop some values like patience, creativity, self-worth, self-confidence, etc. | 4.75 | E | 0.50 |
| 9. The instructional module leads the students to develop positive attitude toward mathematics. | 5.00 | E | 0.00 |
| 10. The instructional module attains the course outcome. | 4.75 | E | 0.50 |
| **Average (Usefulness)** | **4.85** | **E** | **0.13** |
| **Over-all Average** | **4.63** | **E** | **0.25** |

Legend:

4.51 – 5.00 = Excellent (E)
3.51 – 4.50 = Very Good (VG)
2.51 – 3.50 = Good (G)
1.51 – 2.50 = Fair (F)
1.00 – 1.50 = Poor (P)

**Objective of the module**

As depicted in the table, these were 10 items on objectives that were rated by the experts. Their evaluation showed an over-all mean of 4.81, described as "excellent" and standard deviation of 0.26. There were four items which were rated 5.00 described as "excellent", to wit: item 5 "The objectives are closely related to the purpose of the module"; item 6 "The objectives are relevant to the topics of each

lesson of the module"; item 8 "The objectives are well-formulated"; and item 10 "The objectives are well-disseminated". Theobtained standard deviation scores of these items resulting to 0.00 imply that the experts shared the same rating in evaluating the objectives. They were one in their evaluation of the instructional module in terms of objective. The characteristics of the objectives as to their being relevant, purposeful, well-formulated and well-disseminated stand-out in their evaluation.

**Content of the Module**

Displayed in the table are 10 items describing the content of the instructional module. There were three items which showed high mean rating of 4.75 described as "excellent" and these are: item 2 "The contents are arranged in logical sequence of learning"; item 4 "The content of each lesson is simple and easy to understand"; and item 10 "Appropriate self-check questions and answers have been included at all necessary points". The items registered a standard deviation of 0.50. However, there was one item, item 3 "The topic(s) of each lesson is (are) fully discussed" which registered a mean rating of 4.25 described as "very good", and was the lowest mean rating from among the ten items. The obtained over-all mean rating of the content aspect is 4.55 described as "excellent" with a standard deviation of 0.37.

The results showed that the raters were homogeneous in their evaluation of the content aspect. They were one in considering the content of the module to be logical, understandable and verifiable since appropriate self-check questions and answers were included in all necessary parts of the module. However, more discussions should be given for topic(s) of each lesson.

**Format and Language of the Module**

Shown in the table are 10 items for the assessment of the format and language of the module. There were five items with high mean ratings, to wit: items 4 ($\bar{x} = 5$), "The language used is motivating"; item 2 ($\bar{x} = 4.75$), "The language used is easy to understand"; item 3 ($\bar{x} = 4.75$), "The language used is clear and concise"; item 7 ($\bar{x} = 4.75$), "All visual elements have been successfully integrated into the learning sequence"; item 8 ($\bar{x} = 4.75$), "Learning activities are shown as input-process-output cycle"; all of these mean ratings were described as "excellent" and with standard deviation of 0.00 and 0.50. The experts noted the module to be motivating, understandable, clear, concise, output oriented and the visual elements have been successfully integrated into the learning sequence. Item 9 "All concepts in the modules are well displayed/suggested" and item 10 "Whenever appropriate, a touch of humour has been added using cartoons, humorous comments, caricatures, and other similar aspects", received a mean rating of 4.0, described as "very good" which suggested that concepts should be added with a touch of humour by using cartoons, caricatures, humorous comments and other similar aspects. An over-all mean rating of 4.55 described as "excellent" with a standard deviation of 0.37 was obtained. The experts' evaluation, as the results denote, indicated that they share the same insights on the format and language of the module.

**Presentation of the Module**

The table indicated an over-all mean rating of 4.40, described as "very good" with a standard deviation of 0.29 for the presentation of the module. There were two items which obtained high mean rating, to wit: item 1 ($\bar{x} = 5$), "The topics are presented in a logical and sequential order"; and item 10 ($\bar{x} = 4.75$), "Continuity of learning has been ensured by the inclusion of bridge passage at all necessary point", both means were described as "excellent" with standard deviation scores of 0.00 and 0.50 respectively.

The data implied that the experts were one in their evaluation of the presentation of the instructional module of being logical/sequential and ensuring continuity of learning by providing bridge passage at necessary points. However, item 2 "The lessons are presented in a unique/original style/form" with a mean rating of 3.50 described as "good", and standard deviation of 0.58, suggested that the module be improved more to achieve uniqueness and originality in style/form.

**Usefulness/Usability of the Module**

As to this aspect, it registered an over-all mean rating of 4.85, described as "excellent", with a standard deviation of 0.13. The results implied that the experts homogeneously identified four items with high mean ratings of 5 and with a standard deviation of 0.00. These items included: item 2 "The instructional module helps the students master the topics at their own pace"; item 6 "The instructional module serves as supplementary material for teachers and students"; item 7 "The instructional module encourage students to develop their study habits"; and item 9 "The instructional module leads the students to develop positive attitude toward mathematics". The experts shared the same ideas that the instructional module is useful because it helps students' in the mastery of their lesson at their own pace; in the development of their study habits, in the development of positive attitude towards Mathematics and it served as a supplemental material to teachers and students.

The experts' evaluation on the characteristics of the developed instructional module is summarized in Table 2. The characteristics of usefulness, objectives, format and language, content and presentation were arranged sequentially based on their mean rating and standard deviation.

**Table 2: Summary on the Experts' Assessment on the Characteristics of the Instructional Module on Mathematics in the Modern World**

| **Aspect** | **Mean($\bar{x}$)** | **Description** | **sd** |
|---|---|---|---|
| Usefulness/Usability | 4.85 | Excellent | 0.13 |
| Objectives | 4.81 | Excellent | 0.26 |
| Format and Language | 4.55 | Excellent | 0.25 |
| Content | 4.55 | Excellent | 0.37 |
| Presentation | 4.40 | Very Good | 0.29 |
| Over-all Mean | 4.63 | Excellent | 0.25 |

As reflected in the table, the characteristics of usefulness/usability and objectives were rated highly by the experts. However, the presentation of the module occupied the bottom part of the table. The data suggested that the experts considered firstly, the use of the instructional module of paramount importance in teaching – learning process. They were one in supporting the very purpose of why the instructional module was developed and validated. Secondly, they appreciated the objective(s) found in every lesson. They are found to be valuable guides in setting the activities and deciding the methodology to be used. Thirdly, the presentation of the module has to be enhanced more. Although, this aspect was rated to be "very good", there were still items rated only "good". With this result, something should be done to improve the presentation of the module.

**Performance in the Achievement Test of the Student-Respondentsin the Pre-Test and Post-test**

An achievement test was given to the student-respondents to determined their previous learning in Mathematics. The test was administered to 188 student-respondents. It served as the pre-test and post-test to gauge the student's learning. Table 3 presents the mean and standard deviation in the pre-test and post-test scores of the student-respondents on the instructional module on the Mathematics in the Modern World.

**Table 3: Mean and Standard Deviation in the Pre-test and Post-test Scores of the Student-Respondents on the Instructional Module on Mathematics in the Modern World**

| Test | Mean | Standard Deviation | Interpretation |
|---|---|---|---|
| Pre-test (N = 30) | 12.10 | 3.46 | Failed |
| Post-test (N = 30) | 17.21 | 4.15 | Passed |

It can be gleaned from the table that in the pre-test, a mean rating of 12.10 with a standard deviation of 3.46 was obtained. The performance of the student-respondents was described "failed". Their test scores remarkably vary as evidenced by the obtained standard deviation. Their knowledge fall short of passing level required by the test.
The post-test registered a mean score of 17.21 with an standard deviation of 4.15. Their performance was described as "passed". With the students' exposure to the instructional module, they were able to acquire enough knowledge which facilitated the attainment of the competencies required by the test.
The interpretation of the students' performance whether the obtained score in the pre-test or post-test is considered "passed" or "failed" was based on the 50 basis transmutation table used by the College/University. If the obtained score is on the median or above, the student passed the test; if it is below the median, the student failed in the test.
The data implied that the student-respondents were aided in learning Mathematics in the Modern World with the utilization of the instructional module.

**Difference between the Pre-Test and Post-Test Results**

The test performance of the student-respondents was compared during the pre-test and post-test to gauge whether there is a noticeable difference in their scores. Table 4 shows the test of significant difference in performance scores in the pre-test and post-test.

**Table 4: Test of Significant Difference in the Pre-test and Post-test Scores of the Student-Respondents on the Instructional Module on Mathematics in the Modern World**

| Test | Mean | Sd | t-value | df | p-vaue |
|---|---|---|---|---|---|
| **Pre-test** | 12.10 | 3.46 | -15.26 ** | 177 | 0.00 |
| **Post-Test** | 17.21 | 4.15 | | | |

It can be seen from the table that from the obtained mean ratings of 12.10 and 17.21, a mean difference of 5.09 can be computed. From the value of mean difference alone, one can deduce that there is a difference of the students' performance in the pre-test and post-test. Furthermore, the t-value of 15.26 with p-value of 0.00 and df of 177 strongly supported the cited result. This leads to the rejection of null hypothesis which says "There is no significant difference in the pre-test and post-test".
The data implied that there is difference in performance of the student-respondents in the pre-test and post-test. The difference is highly significant. Student-respondents performed better in the post-test because of their learning from the instructional module.

**Students' Assessment on the Face ValidityInstructional Module on CHED MandatedTopics in Mathematics in the Modern World**

The developed instructional module on CHED mandated topics in the Mathematics in the Modern World was evaluated by the student-respondents based on its face validity. A 20-item students' evaluation checklist was administered to the student-participants. Table 8 shows the students' assessment in the face validity of the instructional module.
As displayed in the table, the instructional module's face validity was judged to be "very good". The top five items with high mean ratings included: item 14 ($\bar{x} = 4.42$), "The font size and font type of the instructional module are readable"; item 17 ($\bar{x} = 4.40$), "Titles and subtitles in the instructional module are clearly shown"; item 18 ($\bar{x} = 4.39$), "Illustrations, pictures, and captions are properly laid out for easy reference"; item 13 ($\bar{x} = 4.34$), "The mathematical symbols used in the instructional module are well-defined"; and item 20 ($\bar{x} = 4.32$), "The instructional

**Table 5: Mean & Standard Deviation on the Student Assessment on the Face Validity of the Instructional Module on Mathematics in the Modern World**

| Aspects | Mean | Desc | sd |
|---|---|---|---|
| 1. I easily understand the objectives of the lesson. | 4.01 | VS | 0.70 |
| 2. I easily understand the instructions in each lesson. | 4.15 | VS | 0.72 |
| 3. I can work on the lessons at my own pace. | 3.93 | VS | 0.78 |
| 4. I can understand clearly the ideas/concepts in each lesson. | 3.96 | VS | 0.77 |
| 5. The illustrations and captions guided me easily in following the instructions in the module. | 4.17 | VS | 0.74 |
| 6. The learning activities facilitate my understanding of the topic. | 4.19 | VS | 0.73 |
| 7. I find the learning activities and practice tasks interesting and challenging. | 4.25 | VS | 0.76 |
| 8. I appreciate the styles of illustrations and written expression. | 4.25 | VS | 0.77 |
| 9. I enjoy answering the practice tasks as presented in various forms like trivia and puzzles. | 4.13 | VS | 0.71 |
| 10. I enjoy working through the lessons until I finished the whole instructional module. | 4.03 | VS | 0.78 |
| 11. The lay-out of the instructional module is arranged in a logical sequential order. | 4.15 | VS | 0.77 |
| 12. The instructions in the instructional module are well-emphasized. | 4.27 | VS | 0.71 |
| 13. The mathematical symbols used in the instructional module are well-defined. | 4.34 | VS | 0.71 |
| 14. The font size and font type of the instructional module are readable. | 4.42 | VS | 0.74 |
| 15. The tables/diagrams are well presented and easy to understand. | 4.26 | VS | 0.79 |
| 16. Key points and concepts are well highlighted to focus attention while reading. | 4.31 | VS | 0.75 |
| 17. Titles and subtitles in the instructional module are clearly shown. | 4.40 | VS | 0.72 |
| 18. Illustrations, pictures, and captions are properly laid out for easy reference. | 4.39 | VS | 0.71 |
| 19. The steps in the solutions of the given examples and practice tasks are arranged sequentially and easy to follow. | 4.28 | VS | 0.76 |
| 20. The instructional module is generally formatted in a convenient manner considering the paper size used. | 4.33 | VS | 0.70 |

Legend:

| | | |
|---|---|---|
| 4.51 – 5.00 | = | Excellent (E) |
| 3.51 – 4.50 | = | Very Good (VG) |
| 2.51 – 3.50 | = | Good (G) |
| 1.51 – 2.50 | = | Fair (F) |
| 1.00 – 1.50 | = | Poor (P) |

module is generally formatted in a convenient manner considering the paper size used". In these items the students appreciated the instructional modules' readability of fonts, clarity of title and subtitles, attractiveness of lay-out for pictures, illustrations and captions, convenient format, and well-defined mathematical symbols.

The five items in the bottom list of the table included: item 9 ($\bar{x} = 4.13$), "I enjoy answering the practice tasks as presented in various forms like trivia and puzzles"; item 10 ($\bar{x} = 4.03$), "I enjoy working through

the lessons until I finished the whole instructional module"; item 1 ($\bar{x} = 4.01$), "I easily understand the objectives of the lesson"; item 4 - ($\bar{x} = 3.96$) "I can understand clearly the ideas/concepts in each lesson"; and item 3 ($\bar{x} = 3.93$), "I can work on the lessons at my own pace". Although the mean ratings in these items were described to be "very good", there is still a need for the teacher to enhance his discussion on the objective, purpose, and instructions for each lesson in the instructional module for the students to sustain their motivation to work at their own pace, to enjoy fully the practice tasks and to finish/complete the tasks in instructional module.

**Conclusion**

Based from the cited key findings, the following conclusions were formulated:

- Mathematics in the Modern World as a GE subject contains CHED Mandated Topics. However, these four topics: Mathematics in our World, Mathematical Language and Symbols, Problem Solving and Reasoning, and Data Management are considered are non-negotiable, which means that students must learn these topics regardless of the course they took. Aside from the four topics mentioned above, there are also elective topics that are given to the students based on their course.
- The instructional module was found out to be valid in terms of its objectives, content, format and language, presentation and usefulness based on the experts' assessment. They considered the instructional module to be an excellent material in providing knowledge to the students who are taking Mathematics in the Modern World.
- The instructional module assisted the student-respondents in learning the different topics of Mathematics in the Modern World, as shown by their improvement in the test scores after being exposed to the module.
- Student-respondents performed better in the post-test because of their learnings from the instructional module.
- The student-respondents considered the instructional module to be very useful since it helped them understand the lessons and answered the test well during the post-test.

**Recommendation**

Based on the findings and conclusions:

- It is suggested that the proposed validated instructional module be used by the Mathematics teachers from colleges and universities to increase the reliability and usability of the material;
- Moreover, further validation and enhancement may be made on the content and presentation of the instructional module;
- Similar studies may be carried out on other fields/disciplines.
- Attitudes of students towards modular instruction may be studied.

**References**

1. *Marasigan, N. V., et. al. (2019). Development and Validation of a Self-Instructional Material on Selected Topics in Mathematics in the Modern World. International Journal of Recent Innovation in Academic Research. Vol. 3. Issue-5. May 2019*

2. *Meriam, S., Caffarella, R., & Baumgartner, L. (2007). Learning in adulthood: a comprehensive guide (3rd edition). San Francisco, CA: Jossey-Bass.*

3. *Richey, R. C., & Klein, J. (2007). Design and Development Research: Methods, Strategies, and Issues. Mahwah, NJ. Lawrence Erlbaum Associates, Publishers.*

4. *Smedley, A. (2007). The self-directed learning readiness of first year bachelor of nursing students. Journal of Research in Nursing, 17(2), 373-385.*

5. *Torio, M. C. (2015). Development of instructional material using Algebra as a tool in problem solving. International Journal of Education and Research, Vol. 3, No. 1.*

6. *Torrefranca, E. C. (2017). Development and validation of instructional modules on rational expression and variations. The Normal Lights, Vol. 11, No. 1, 43-73.*

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