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**Research Article**

# An Inquiry-Based Learning Module for General Mathematics: Its' Development and Evaluation

April Mae C. Lumabit[1]*, Roberto G. Sagge, Jr.[2]

[1]Alimodian National Comprehensive High School, Philippines
[2]West Visayas State University, Philippines

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**Corresponding author:*
E-mail:
aprilmae.lumabit@deped.gov.ph

**ABSTRACT**

Through exploration and challenging questions, students are kept interested in their learning through inquiry-based learning. This study's objective was to develop and evaluate an inquiry-based learning module for general mathematics for students in grade 11. The study was conducted at two secondary schools with one hundred forty-one Grade 11 students and four mathematics teachers as respondents. When obtaining data for the study, a questionnaire checklist was utilized to describe and evaluate the developed module using the descriptive-evaluative method. The modified Borg and Gall model, which includes curriculum guide inspection, planning, product development, assessment instrument design, development of the instructional materials, validation of mathematics teachers and experts, revisions, limited student trial, and the finalization of the instructional material, was used in the development of the module. On the following criteria: objectives, contents, activities, style and presentation, organization, creativity, and assessment, the respondents were asked to rate the worktext. The final result shows that the generated module was verbally rated as "very good" in terms of objectives, contents, activities, style and presentation, organization, creativity, and assessment. The respondents rated the produced module as "very good" in general. This indicates that the generated module satisfies the criteria with a minimum number of revisions. To facilitate teaching and learning, the researcher recommends Grade 11 teachers and students use the developed inquiry-based learning module for General Mathematics.

***Keywords***: *Development and evaluation, General Mathematics, Inquiry-based learning module*

## Introduction

The purpose of education is to maximize the potential of human resources. In reality, it is an ongoing process in all levels and types of education, which are interconnected within a comprehensive educational system. Its

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objective is to help people grow as people who act with awareness and purpose. The purpose of education, according to Hamalik (2001) in Andrini (2016), is to provide teachers with guidance or counsel so they can choose and decide on instructional strategies or make a positive learning environment for learners.

It is a typical problem that the majority of learners are less engaged, reluctant, afraid, or bashful to express their ideas during the learning process. The kids' capacity to study effectively and use their creativity in the classroom will surely be hindered by this situation. The primary focus of the educational process remains the instructor. The teacher frequently only conveys information in one way, allowing pupils to contribute orally or through performance only sometimes (Andrini, 2016). If this keeps happening, learners will struggle to learn, which will lead to outcomes that are not what was anticipated. As a result, there is a need to address this by offering materials that will aid learners in developing the competencies required of them. The module must also be self-directed so that students can complete it without the assistance of an instructor (Sagge & Espiritu, 2023; Sagge & Divinagracia, 2023).

In their study, Cepeda (2023) and Cabiles (2023) noted the significance of creating instructional materials and the need to give both students and teachers the materials they require. Additionally, printed materials like textbooks and worktext are seen to be the most effective tool for enhancing learning transfer since they may mimic the efficient and successful teaching methods of a person facilitator. Bacio, Sagge, & 2019b). Furthermore, according to Bacio and Sagge (2022a & 2019a), learning resources are necessary for developing knowledge and specialized skills. They argue that educational resources shouldn't be used to replace a great teacher or a textbook, but rather to complement the teaching process.

With this in mind, the study's objective was to create an inquiry-based learning worktext for general mathematics that would let learners get their understanding of the material through experience. Another way to hold learners interested is to assign them tasks that they can complete on their own after receiving the proper direction and instruction in using educational materials that can make learning enjoyable and improve students' knowledge, skills, and abilities.

According to Sanjaya (2006) in Andrini (2016), inquiry-based learning is a series of educational activities that encourages the process of thinking critically and analytically to investigate and come up with one's answer to a problem. The concept that people are inherently motivated to seek out knowledge serves as the cornerstone of inquiry-based learning. Inquiry-based learning seeks to help students build intellectual discipline and thinking skills by encouraging them to ask questions and look for answers when they are interested in something. Through the use of an inquiry-based learning strategy, learners are taught how to express their ideas and come up with their answers to problems. With the efficient and effective application of inquiry-based learning methodologies, the monopoly of teachers over the direction of the learning process will diminish.

A study conducted by Wang et al. (2013) shows the advantages of inquiry-based instruction in the classroom. They discovered that the connection between the desire to learn science and goal-setting and self-directed learning has improved. A considerable improvement was seen between the cognitive capacity pretest and posttest among high school learners. The average score for the test group went from 23 to 96.6. Anxiety levels among the students were somewhat reduced. Since inquiry-based instruction encourages students to adopt a variety of learning strategies, makes it simpler for them to get familiar with ongoing experiments and topics of research, and helps them perform well on exams, students' self-confidence naturally developed.

The contemporary educational system seeks to provide the future generation with the abilities needed for moral deliberation on issues, effective communication, critical thinking, and environmental responsibility (Fajarini, 2016). Therefore, these goals need to be attainable in the classroom, particularly when

teaching math. For learners to actively seek out, discover, construct, and use knowledge to solve problems, mathematics teaching must be provided. The K to 12 curriculum should be competency-based, technologically-based, and research-oriented, yet some instructors find it difficult to implement. Schools with computers, internet connectivity, and enough resources for teaching and learning can fully facilitate the teaching-learning process; however, schools without power or any teaching or learning tools cannot. Teaching resources with the right pedagogical approach will help the objectives of learning mathematics. One kind of practical educational material is the module. Thus, the study is carried out.

### *Description of the Issue*

This study intends to develop and evaluate an inquiry-based learning module for General Mathematics. In particular, it seeks answers to the following questions:

1. What instructional material can be developed for Grade 11 General Mathematics?
2. What are the teachers' and students' evaluations of the inquiry-based learning module in General Mathematics in terms of a) objectives, b) content, c) activities, d) style and presentation, e) organization, f) creativity, and g) assessment?

## Methods

### *Research Design*

The developmental research design was used in this study. It is the systematic study of creating, producing, and assessing instructional programs, processes, and products that must abide by internal consistency and effectiveness standards, according to Richey (1994). Additionally, a modified version of Borg and Gall's (2003) development model served as a guide for this study's whole research process.

The researcher developed questions regarding teachers' and students' assessments of the inquiry-based learning module in General Mathematics in terms of a) objectives, b) content, c) activities, d) style and presentation, e) organization, f) creativity, and g) assessment to describe the fundamental aspects of the study.

### *Research Participants*

The inquiry-based learning module for General Mathematics was developed using data acquired from 141 Grade 11 students, 21 mathematics teachers, and 17 secondary and 4 senior high school mathematics teachers.

**Teachers**. The creation of the Inquiry-Based Learning Module for General Mathematics involved seventeen (17) secondary mathematics teachers from several schools. They also took part in the Focus Group Discussion (FGD) that was held during the early stages of the learning module's development. These secondary mathematics teachers were specifically picked based on their expertise in the subject. The evaluation of the module included four (4) senior high school mathematics teachers who also participated in the implementation of the modules.

**Learners**. The study involved 141 Grade 11 students who were enrolled in one of the city schools and one of the provincial schools. The general mathematics inquiry-based learning module was used to instruct the participants. Additionally, they took part in the module's evaluation.

**Experts**. Five experts evaluated and assessed the module throughout the process.

### *Data Gathering Instruments*

The researchers used a questionnaire checklist as a data-gathering instrument for this study. This was done to assess the General Mathematics module's acceptance. The questionnaire checklist was adapted and modified from the questionnaire of Cruz (2015). The updated survey was validated by a group of experts. The instrument was then pilot-tested to determine its reliability using Cronbach's Alpha. The instrument's alpha level was 0.764, indicating that it was reliable. The objectives, contents, activities, style and presentation, organization, creativity, and assessment were among the elements covered in the questionnaire checklist. To interpret the weighted mean scores for the assessment of the Objectives, Contents, Activities, Style and Presentation, Organization, and Assessment of the developed module, the following scale was employed:

| Score | Description | Interpretation |
|---|---|---|
| 4.50 – 5.00 | Excellent | The developed module excellently met the standards, and no revision is needed. |
| 3.51 – 4.50 | Very Good | The developed module very satisfactorily met the standards, and very few revision is needed. |
| 2.51 – 3.50 | Good | The developed module satisfactorily met the standards, and few revisions are needed. |
| 1.51 – 2.50 | Fair | The developed module fairly met the standards, and needs revisions. |
| 1.00 – 1.50 | Needs Improvement | The developed module had not met the standards, and needs a lot of revisions. |

***Data Collection Procedure***

The researcher wrote to the Superintendent of the Division of Iloilo seeking permission to conduct the study. Another letter was written to ask for permission to utilize the module from the division superintendent of Iloilo, the principal, and the assistant principal of the school.

Using the modified Borg and Gall (2003) Development Model, the developed module through various steps. First, examine the curriculum guide as the foundation for creating the module. Planning the various activities and resources was done in the second step. The third step involved developing products and creating assessment tools utilizing the inquiry-based learning (IBL) approach. The first product was validated by mathematics professors in the fourth and fifth steps through a seminar-workshop. The validation of specialists was the sixth stage. The execution of the program through tryouts at two different schools was the seventh stage. The module was evaluated in its final step by teachers and students from senior high schools. They provided feedback, and changes were made in response.

**Inspection of the Curriculum Guide.** The Department of Education distributed curriculum guides that include a curriculum framework for mathematics, material, content standards, performance standards, learning competencies, and a timetable during the first year of the K to12 curriculum's implementation for senior high school. According to the curricular structure, the objective of the K to 12 mathematics curriculum is to help students improve their analytical and problem-solving abilities. DepEd also provided several solutions for addressing these abilities. One of which is the IBL, the researcher's method for creating the module. To confirm the themes to be included in the creation of the module, the researcher also looked through the curriculum guide.

**Planning.** The researchers planned the module's content, the resources to be used, and its design during the planning stage. It also outlines what has to be done while the seminar-workshop is being conducted.

**Product Development and Designing Assessment Instrument.** The researchers used the IBL approach when creating the module. IBL is a teaching strategy built on constructivism and student-centered learning principles. When employing IBL, the teachers just serve as facilitators while the students who ask questions also find answers to their queries using their own experiences. The following elements were used in the design of the module after other modules had been thoroughly planned and examined: title, topic, content standards, performance standards, learning competencies and code, time frame, objectives, activity/think point, learning concepts, and discovering for yourself. Cruz (2015) took the questionnaire and changed it to create the assessment tool. In this chapter's section on instruments, the specifics of the instrument utilized are covered.

**Development of the Instructional Materials.** The researchers created the first draft of the module. Following that, a seminar workshop with teachers of mathematics from several schools focused on improving and reviewing the draft of the Inquiry-Based Learning Module. The panelists also reviewed the module after including comments and ideas from mathematics teachers. The revision of the

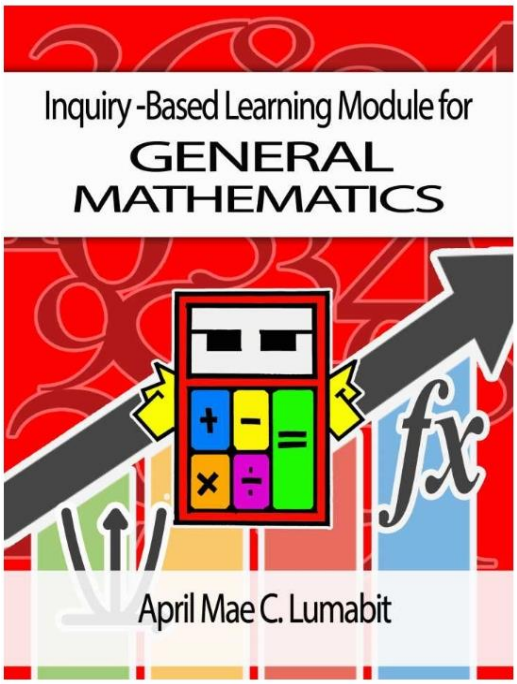
module took into account the feedback and recommendations of the mathematics teachers and the panel members. The module's content was then finalized after being tested with learners.

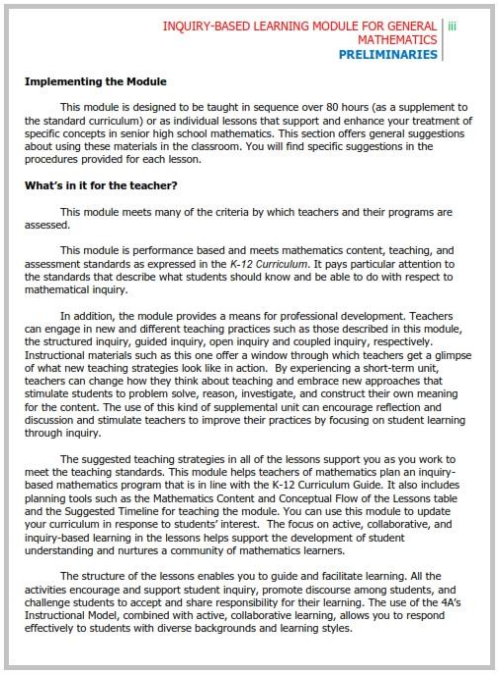
**Implementation of the Modules.** To put the produced modules into use, a trial run was done. Redesigning, updating, and modifying the module to improve the product and guarantee effective product delivery were all part of the implementation stage, which also entailed consistent design and product review, and thorough monitoring. At a school in the city, the first tryout was held. The members of the research panel were present to watch the trial run. A teacher of general mathematics in the senior high school received the module. The learners were also given copies of the module along with a topic from it. The sequence from the module was then followed by the class. Following the try-out, a conference was held to go over what had been seen there. It was discovered after the first trial run that a teacher's guide would improve the module's delivery. The teacher's guide was created right away by the researchers. Another school in the province was identified for the following tryout. The same process was followed, but this time the teachers also had a guide in addition to the module. Teachers and students who used the module rated it using the questionnaire checklist after it had been implemented into use.

**Evaluation of the Developed Module.** After implementation, the modules were evaluated by four senior high school teachers and 141 Grade 11 senior high school students. The evaluation's main goal was for teachers and students to score the modules' quality according to each factor. The following are the seven components of evaluation: goals, contents, activities, presentation and style, organization, creativity, and assessment. There was a checklist for the questionnaire. The final IBL module was developed taking into account both the teachers' and students' feedback and ideas, as well as how they made use of it.

## Results and Discussion

The researchers produced an IBL module with numerous parts and a distinguishing feature. The initial appearance of the module had been commended by the experts. The IBL module also has the following parts: a title, an overview, objectives, an explanation of the topic, a self-assessment test, evaluation activities, and references. It also follows from the description of a typical module's components in Bacio and Sagge (2022a). The learning module for general mathematics that was produced using IBL is shown below.





INQUIRY-BASED LEARNING MODULE FOR GENERAL MATHEMATICS | iii
PRELIMINARIES

**Implementing the Module**

This module is designed to be taught in sequence over 80 hours (as a supplement to the standard curriculum) or as individual lessons that support and enhance your treatment of specific concepts in senior high school mathematics. This section offers general suggestions about using these materials in the classroom. You will find specific suggestions in the procedures provided for each lesson.

**What's in it for the teacher?**

This module meets many of the criteria by which teachers and their programs are assessed.

This module is performance based and meets mathematics content, teaching, and assessment standards as expressed in the *K-12 Curriculum*. It pays particular attention to the standards that describe what students should know and be able to do with respect to mathematical inquiry.

In addition, the module provides a means for professional development. Teachers can engage in new and different teaching practices such as those described in this module, the structured inquiry, guided inquiry, open inquiry and coupled inquiry, respectively. Instructional materials such as this one offer a window through which teachers get a glimpse of what new teaching strategies look like in action. By experiencing a short-term unit, teachers can change how they think about teaching and embrace new approaches that stimulate students to problem solve, reason, investigate, and construct their own meaning for the content. The use of this kind of supplemental unit can encourage reflection and discussion and stimulate teachers to improve their practices by focusing on student learning through inquiry.

The suggested teaching strategies in all of the lessons support you as you work to meet the teaching standards. This module helps teachers of mathematics plan an inquiry-based mathematics program that is in line with the K-12 Curriculum Guide. It also includes planning tools such as the Mathematics Content and Conceptual Flow of the Lessons table and the Suggested Timeline for teaching the module. You can use this module to update your curriculum in response to students' interest. The focus on active, collaborative, and inquiry-based learning in the lessons helps support the development of student understanding and nurtures a community of mathematics learners.

The structure of the lessons enables you to guide and facilitate learning. All the activities encourage and support student inquiry, promote discourse among students, and challenge students to accept and share responsibility for their learning. The use of the 4A's Instructional Model, combined with active, collaborative learning, allows you to respond effectively to students with diverse backgrounds and learning styles.

### *Teachers' and Students' Evaluation of the inquiry-based learning Module*

As seen in Table 1, "Creativity" was rated as "very good" by the respondents and was the top area they gave an average of 4.45. "Activities" came in second place and was rated as "very good" with an average of 4.41. In that order, "Objectives" came in next with an average mean of 4.35, followed by "Style and Presentation" at 4.34, "Assessment" at 4.27, and "Organization" at 4.24. "Contents" came in last with an average mean of 4.17 and was verbally assessed as "very good" by all. The grand mean was 4.32 and was considered to be "very good" in general. It suggests that those who evaluated concurred that the created and produced IBL module for general mathematics was valuable educational material. The IBL module also has the characteristics of a reliable and beneficial learning resource for the student's development of knowledge and skills. This finding is supported by Bacio and Sagge's research (2022b & 2023), which found that instructional material can be suitable for its intended users if its aims, content, activities, and evaluation are adequate. Additionally, Embajador (2019) noted in her research that a high level of evaluation suggests that material may be used most effectively by teachers to foster learning among learners.

*Table 1. Evaluation of Teachers and Students on the Developed Module with Respect to Different Aspects*

| | Mean | | Average Mean | Interpretion | Rank |
|---|---|---|---|---|---|
| | Experts | Students | | | |
| Objectives | 4.45 | 4.24 | 4.35 | Very Good | 3 |
| Contents | 4.25 | 4.09 | 4.17 | Very Good | 7 |
| Activities | 4.60 | 4.22 | 4.41 | Very Good | 2 |
| Style and Presentation | 4.50 | 4.17 | 4.34 | Very Good | 4 |
| Organization | 4.35 | 4.13 | 4.24 | Very Good | 6 |
| Creativity | 4.65 | 4.25 | 4.45 | Very Good | 1 |
| Assessment | 4.50 | 4.03 | 4.27 | Very Good | 5 |
| **Grand Mean** | **4.47** | **4.16** | **4.32** | **Very Good** | |

*Note:* Interpretation is based on the following scale. 4.51-5.00: Excellent; 3.51-4.50: Very Good; 2.51-3.50: Good; 1.51-2.50: Fair;1.00-1.50: Needs Improvement.

## Conclusion

In conclusion, the designed inquiry-based learning module in mathematics has been demonstrated to be a very successful and interesting method of teaching and learning. Learners were able to actively investigate mathematical ideas, hone their critical thinking abilities, and broaden their comprehension of mathematical ideas through the course of study. Instead of only studying numbers and processes, the inquiry-based learning approach gave learners the chance to research issues, ask questions, and build their expertise. Due to their active participation, learners were better able to understand the material and connect mathematical ideas to practical applications.

The module also encouraged collaboration and communication among students, as they worked together to solve problems and share their findings. This collaborative environment promoted the development of interpersonal skills and the ability to explain and justify mathematical reasoning. Moreover, the inquiry-based learning module promoted creativity and independent thinking. Students were encouraged to think outside the box, explore multiple solution strategies, and approach problems from different angles. This approach nurtured their problem-solving abilities and instilled a sense of confidence and autonomy in their mathematical abilities.

Overall, the inquiry-based learning module in mathematics has demonstrated its effectiveness in cultivating a deeper understanding of mathematical concepts, fostering critical thinking skills, and promoting collaborative and independent learning. By engaging students in active exploration and discovery, this module

has helped them become active learners, problem solvers, and lifelong learners. Thus, it is recommended to incorporate the inquiry-based learning module as a regular component of the mathematics curriculum. This will ensure that students have consistent opportunities to engage in inquiry-based activities and develop their mathematical thinking skills.

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