Journal for Educators, Teachers and Trainers
The PROFESIOLab electronic, peer-reviewed, open-access Magazine

ISSN 1989 – 9572

DOI: 10.47750/jett.2023.14.02.050

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Journal for Educators,Teachers and Trainers, Vol. 14 (2)

https://jett.labosfor.com/

Date of reception: 16 Jan 2023

Date of revision: 16 Mar 2023

Date of acceptance: 18 Mar 2023

Nancy G. De Leon (2023). Localized Traditional Learning Modules in the History of Mathematics its Effect to the Learning Competency of Students.*Journal for Educators, Teachers and Trainers*,Vol. 14(2). 557-566.

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[1]Isabela State University, Philippines

Journal for Educators, Teachers and Trainers
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Localized Traditional Learning Modules in the History of Mathematics its Effect to the Learning Competency of Students

Nancy G. De Leon
Isabela State University, Philippines
Email: nancy.g.deleon@isu.edu.ph

ABSTRACT
In Philippine higher education, modular learning is regarded as one of the most flexible, accessible, and mobile methods of instruction. The Philippine Commission on Higher Education (CHED) also recognizes the merits of flexible learning, especially with regards to the current situation of the academe during the pandemic. In the CHED Memorandum Order (CMO) No. 4 Series of 2020, CHED pointed out the rationale behind flexible learning and the guidelines for its implementation in higher education institutions and state universities and colleges. One of the learning objects specified therein is the module, both printed and electronic. In this scenario, the researcher was motivated to develop traditional modules that employed developmental research design to d validate traditional learning modules in the history of mathematics. The researcher carried out the study from January 2020 to January 2022 academic year. Results shows that the developed learning modules' high inter-rater and intra-rater reliability were confirmed using well-known scientific methodologies. The results also revealed that the traditional learning modules had a statistically significant effect on the performances of Mathematics Major History of Mathematics course participants. The developed learning modules were acceptable based on the participants' assessments. It is proposed that further development of additional instructional approaches be carried out so that they can be used in the improved version of the traditional modules.

Keywords: traditional learning modules, modular learning, History of Mathematics, development and validation, learning materials, achievement

INTRODUCTION

The printed module is already a familiar learning material to many students in higher education. As for its impact on students' learning, several studies have already been explored in studies. The survey of Columbano (2019) proved the usefulness of modular education as a tool for enhancing the learning and attitude of college students in Mathematics. Similarly, Lim's (2016) study on BEEd Students' use of modules as learning materials was perceived to be effective. It was found out that students who underwent modular instruction performed better than their counterparts who were taught through lectures.

The acquisition of knowledge is widely regarded as one of the most significant qualities and traits that contribute significantly to the development of a nation; moreover, it has a beneficial and all-encompassing influence on the generations that are currently coming of age while drawing on contemporary and cutting-edge scientific underpinnings. The level of information that educators have regarding teaching strategies, techniques, and theories, as well as their familiarity with contemporary teaching orientations, is used as a metric to determine the amount of this advancement.

Advancement of Science is needed

According to Tobaji (1981), the advancement of science has resulted in the development of a vastly increased number of means from which educators may benefit when preparing interaction opportunities with learners' experiences, sharing such experiences, and reviewing them with the intention of preparing students with a high level of competency. In addition, in the recent study of Tobaji (1986) explains that, in this particular setting, a teacher's function is not only limited on explanation and following the conventional approaches, but rather, his primary responsibility has become to draw a layout of teaching strategies along with teaching approaches and means in order to accomplish particular goals.

There are many methods that work together in an integrated fashion to address the curriculum and enrich the educational process. These methods aim to stimulate the learner's mind in a way that assists them in paying attention to the instructions process, maintaining focus, comprehending the material, and remembering it. In addition, the modern era is marked by the revelation of information and communication, in which discoveries, scientific theories, and their technical implementations are rapidly evolving in a way that humans have never

previously experienced. This period is distinguished by its complete reliance on the human mind, advanced electronics, and the swift flow of information made possible by advances in computer technology and communication. These developments have virtually removed the concept of time and place as independent variables. It is very important to respond to it through the development of social organizations with all of its types, forms, and sizes including educational establishments which carry top priority to be developed in order to keep pace with the nature of this era and to respond the transformations in every of life's aspects. As a result of this magnificent change, in addition to the elimination of cultural variance and the globalization of the economy, it is also very important to respond to it through the development of social organizations. As a response to the various factors that have an effect on education, educational institutions have been stocked with learning books, resources, and software that make the processes of teaching and learning more manageable. (Afat,1990)
The new innovations such as communication means and devices have been effectively employed in education in order to overcome many of the problems relevant to education in our days as a result of economic, financial, and social factors such as the drastic increase in population, the number of learners have also been increased drastically in different school cycles, cognitive explosion, and the insufficient number of qualified teachers. These issues have been brought about as a result of factors such as population drastic increase, the number of learners has also been increased drastically in different school cycles, cognitive explosion, and Because of all of these factors, the utility and usage of non-traditional methods in education have expanded drastically in recent years. This is done with the intention of enhancing and increasing the effectiveness of the educational process along with the development of thinking skills.
To improve students' abilities in light of the increased complexity of the world as a consequence of the problems given by information and communication technology. So, to be successful in tackling such issues, it is not via the quantity of knowledge that one possesses but rather through the know-how of how to employ that knowledge.
Schools have found themselves in a position in which they are required to respond to the technological revolution and incorporate elements of this technology into their programs. In addition, they must find ways to benefit from the products of this revolution in order to activate their operations, achieve their goals, and reap the educational benefits of high-tech curriculum in order to keep up with the demands and requirements of the current time period. In order for us to effectively address the issues that now exist, we need to give some thought to searching various sorts and sources of information.
The ability to think correctly generates rewards, particularly in educational settings. In the year 1929, educator Alfred Whitehead uttered the following words: "All you had learned would be useless if you do not throw your books aside, burn your lectures notes, and forget what you learnt pretty well for exam." According to Whitehead, the real fruit of education is the generation of cognitive processes via the study of any branch of knowledge that is not contained in the accumulated material associated with that branch. Educators are in agreement that the most effective teaching methods are those that not only result in students receiving a quality education but also assist teachers in successfully bringing about the desired behavioral changes in their student body. (Al-Lakani 1976)
According to the findings of research, there is no one method that can be considered the standard for education, and no single educational strategy can be deemed superior to the others outside of specific contexts. It's possible that the practices used in education now are no longer relevant in today's world; perhaps conditions in the past in instructing students were limited to the teacher, the blackboard, and the textbook. In the modern era, we are witnessing both a population and a cognitive explosion. People are therefore compelled to engage in self-education programs and seek work in technological fields. As a direct consequence of this, there is a growing demand for instructional methods that diverge significantly from the traditional practices of both teachers and schools. And to be more suitable for the age of information technology, in which the module is one of the tools of this progress. (Traci, 2001)
Educators are in agreement that the best teaching approaches are the ones that lead to better education and help teachers succeed in initiating the desired changes with students. In addition, this type of teaching approach includes planned procedures that the teacher utilizes when interacting with his students in order to make education easier and more streamlined (Al-Lakani, 1976).

Current Practices
Current educational practices may be invalid in today's world due to the fact that the circumstances and considerations of the past, which used to be the same, are no longer the same. This is especially true if we take into account the determination framework for most current practices, which is the relationship between teacher-background and text book under the current teaching practices abilities shall be under the current teaching practices abilities (Jabber, 1983).
Consequently, the need arose for teaching approaches that are different from the conventional approaches of schools and the teachers; these approaches are more suitable for the modern age of information technology; and the module approach is considered to be the modern approach to development. (Traci, 2001)

As a result, educational establishments are searching for the most efficient means of instructing a growing number of students in as little time and at as low a cost as is practicable. In addition, in order to make up for a shortage in the number of qualified educators, nations all over the world have turned to modern technology in the classroom in an effort to solve education-related issues. This has resulted in the development of innovative approaches and strategies for generating an efficient form of education and for preparing educators who are qualified methodological (Jaraddat, 1985).

In recent years, the topic of individualization in education has attracted the attention of a large number of educationists and psychologists. These professionals have a strong interest in the individual differences of students because they believe that each learner is one of a kind and deserves special treatment. Furthermore, they believe that teaching is an individual process. As a direct result of this new approach, new teaching methods have brought this teaching process from the teaching subject and the dependency on the teacher into the teaching process. In addition, they have provided students with more (Globe, 1988).

There has recently been a group of individual teaching approaches that depend on individualizing the teaching process as modules. The word "module" has its origin in Greek and means a piece of music. In Arabic, the word "module" means a piece of methodology. The module approach is known as a modern education method and way of teaching that was developed in the early 1960s for the twentieth century. It was presented by Wijaya (2020) as audio recordings as teachers' preparations for activities that are supplementary to the text.

Learner-Centered Environments

Learning for teachers ought to be adapted specifically to meet their requirements. The topic knowledge, pedagogical understanding, and experience of a teacher are three of the most crucial factors in determining whether or not a student is successful in their academic pursuits (Whitehurst, 2002; Rand 2003; Garet, et al., 2001).

The empirical evidence reveals that a significant number of math educators in the United States do not have the essential content knowledge in the areas of mathematics that they teach (Gitomer, Latham, and Ziomek, 1999; Hiebert, et al., 2003). According to NCLB, in order to be considered "well competent," an elementary school teacher must show that they have attained certain fundamental knowledge. For instance, the completion of pertinent college coursework might be an acceptable predictor of core knowledge. The majority of math teachers in primary schools are education majors, even though education majors often take fewer math courses overall than other types of college graduates. Comparatively, education majors take 6.3 credit hours of mathematics as opposed to the 8.3 credit hours that are required of the ordinary college graduate (NCES, 2002). Because they are geared toward education students, the mathematics courses that count toward these six credits are typically of a lower academic caliber than other courses offered at many universities.

To be considered "well qualified" as a math educator at the middle school or secondary school level, one needs to either possess or demonstrate the equivalent of a mathematics major. When compared to teachers in other nations with greater average student achievement, the majority of eighth-grade teachers in the United States did not major in mathematics. For instance, 61 percent of eighth-grade math teachers in the United States had mathematics as their major field of study for their college or education degree, whereas in Singapore, where they scored highest on the TIMSS, 84 percent of eighth-grade math teachers had mathematics as their major field of study (Mullis et al., 2000). In the United States, only 32 percent of math teachers in middle schools and 69 percent of math teachers in secondary schools have majored and been certified in the subject of mathematics respectively (McMillen, 2002).

Learner-centered professional development needs to satisfy the educational requirements of teachers while while responding to the significant time restrictions they face. It is crucial that this happen. Teachers in the United States do not have the luxury that their counterparts in many high-performing Asian countries do, where it is common for mathematics and other teachers to spend up to 30–40 percent of their time away from the classroom in order to prepare lessons, meet with students, or participate in professional development (NECTL, 1994). In the United States, time spent on professional development that takes a teacher away from the classroom is sometimes regarded as time wasted (Cambone, 1995).

As for the e-module, studies by Wijaya and Vidianti (2019) and Jaenudin et al. (2017) have evidenced the positive impact of e-modules in higher education students' learning in different courses. Given the favorable impact of utilizing modules for instruction as cited by the literature mentioned above, the researcher endeavors to develop and test the effectiveness of traditional learning modules as a learning tool for the course History of Mathematics.

METHODOLOGY

A product development research design was used in this study. The researcher used purposive sampling to select study participants. The participants volunteered to take part in the study. The researcher used a quantitative technique - descriptive design - to assess the learning modules' validity based on expert opinions. The researcher used a pretest-posttest control group approach to evaluate the participants' performance. Each individual's pre-test score is deducted from his or her post-test score when the data is analyzed utilizing a pretest-posttest control design.

Six mathematics specialists validated the produced learning modules. The study included 32 mathematics major students enrolled in the History of Mathematics course for the first semester of 2021-2022. There are twelve lessons in the learning modules. The researcher used the instrument from Torrefranca (2017)'s thesis for evaluating the acceptability of the generated instructional modules. It consists of twenty-five elements that focus on the following aspects of instructional modules. Some changes were made to the item format to better align the items with the study's goal.

The following statistical tools were used: Mean, Intraclass Correlations, Percentage Calculation Method, Kolmogorov-Smirnov Test, and Paired t-test.

RESULTS AND DISCUSSIONS

Table 1:Intrarater Correlation Coefficient (ICC)

Modules Classification	Intra-class Correlation [b]	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df_1	df_2	Sig
Traditional Modules	.360[c]	-0.216	0.694	2.026	24	24	.041

The researcher used the mean ratings from all six experts' first and second evaluations as the basis for measurement. The researcher also used the average-measures, absolute-agreement, 2-way mixed-effects model for her ICC calculation. As seen in Table 1, the stated 95 percent confidence interval extends from -0.215 to 0.694 for the intra-rater reliability on Traditional modules, and the estimated ICC is 0.360, indicating "poor" reliability. According to Koo et al. (2016), ICC values below 0.5 suggest poor reliability, those between 0.5 and 0.75 indicate moderate reliability, those between 0.75 and 0.9 indicate good reliability and those greater than 0.90 indicate excellent reliability. The "poor" intra-rater reliability demonstrates inconsistency among observational ratings provided by six experts for traditional modules. This suggests that the experts have different opinions regarding the traditional modules' aspects based on their observations.

Table 2:Inter-rater Agreement Across the Traditional Modules Various Aspects

Aspect of the Modules	Traditional Modules			
	First Evaluation		Second Evaluation	
	% Agreement	Strength Agreement	% Agreement	Strength of Agreement
A. Objectives 1. The objectives are clearly stated in behavioral form.	66.67	Low	83.33	High
2. The objectives are well-planned, formulated, and organized.	83.33	High	83.33	High
3. The objectives stated are specific, measurable, and attainable.	100	High	100	High
4. The objectives are relevant to the topics of each lesson of the modules.	83.33	High	83.33	High
5. The objectives take into account the needs of the students.	83.33	High	83.33	High
Average	83.33 - High		86.66 - High	
B. Content 1. The content of each lesson is directly relevant to the defined objectives.	66.67	Low	83.33	High
2. The content of each lesson is simple and easy to understand.	66.67	Low	100	High
3. The topics of each lesson are fully discussed.	100	High	100	High
4. The topics are supported by illustrative examples, and the practice tasks are suited to the level of the students.	66.67	Low	83.33	High
5. Each topic is given equal emphasis in the	66.67	Low	83.33	High

lesson.				
Average	73.34 - High		90 - High	
C. Format and Language 1. The format/layout is well-organized, which makes the lessons more interesting.	66.67	Low	83.33	High
2. The language used is easy to understand.	83.33	High	83.33	High
3. The language used is clear, concise, and motivating.	83.33	High	83.33	High
4. The mathematical symbols used are well-defined.	66.67	Low	83.33	High
5. The instructions in the learning modules are concise and easy to follow.	66.67	Low	100	High
Average	73.34 - High		86.66 - High	
D. Presentation 1. The topics are presented in a logical and sequential order.	66.67	Low	83.33	High
2. The lessons of the modules are presented in a unique and original form.	66.67	Low	83.33	High
3. The learning activities are presented clearly.	66.67	Low	100	High
4. The presentation of each lesson is attractive and interesting to the students.	66.67	Low	83.33	High
5. Adequate examples are given to each topic.	50	Low	83.33	High
Average	63.34 - Low		86.66 - High	
E. Usefulness 1. The learning modules will motivate the students to study History of Mathematics.	50	Low	83.33	High
2. The learning modules will help the students master the topics at their own pace.	66.67	Low	83.33	High
3. The learning modules will allow the students to use their time more efficiently.	83.33	High	83.33	High
4. The learning modules will develop the analytical thinking and reasoning skills of students in solving problems in History of Mathematics.	50	Low	83.33	High
5. The learning modules will serve as a supplementary material that can cater to the needs of the students.	66.67	Low	83.33	High
Average	63.33 - Low		83.33 - High	
Overall Average	71.94 - High		86.66 - High	

Table 2 shows that the mean inter-rater agreement for the traditional modules' first evaluation ranged from 63.33 percent (on usefulness) to 83.33 percent (on objectives). At the same time, the mean inter-rater agreement for the traditional modules' second rating ranged from 83.33 (on usefulness) to 90% (on content). Across all areas of traditional modules, the experts unanimously accepted that the stated objectives are specific, measurable, and attainable (A.3) and that each lesson's themes are thoroughly presented (B.3). On the other hand, the experts are split into the rest of the module's aspects, particularly the themes under presentation and usefulness. Both had a low inter-rater agreement, at 63.33 and 63.34 percent, respectively. Nevertheless, the total average of 71.94% for the first evaluation and 86.66% for the second evaluation is more significant than the required level of acceptable inter-rater agreement, which is 70% (Mohd & Ahmad, 2005). The findings of the expert's evaluation of the traditional show a high inter-rater agreement, implying that the six experts consistently awarded the learning module's various components a very satisfactory grade, adding to the module's overall acceptability.

Table 3: Mean and Standard Deviation Distribution of the Pre-test and Post-test Scores

Pre-test Mean	Descriptive Interpretation	Post-test Mean	Descriptive Interpretation
36.19	Below Average	42.06	Average

The pre-and post-tests of the participants are shown in Table 3. The participants scored 36.19 in the pre-test. Consequently, they scored lower than 41 on the pre-test, indicating that their scores were below average.
Given that they have not yet received any intervention, this occurrence is reasonable. The findings confirmed Coronel and Tan's conclusions (2019) when they discovered that the students' pre-test scores did not meet the average level of competency. In the meantime, the participants' post-test mean scores were 42.06. The post-test mean scores are rated as average, indicating that the scores have improved from the pre-test. The findings corroborated the conclusion of Estrada et al. (2019) that mean scores increased over time. The results suggest that the intervention improved the participants' scores.

Table 4:Paired T-Test Results for the Differences on the Pre-test and Post-test Scores of the Participants

Test	Mean	Mean Difference	t-value	P-value	Decision
Pretest	36.19	-5.87	-2.229	.042*	Reject H_0
Posttest	42.06				

*significant @p <.05

A paired sample t-test with p-values of 0.042 revealed statistically significant differences at $p<0.05$, as shown in Table 4. Given that the mean post-test scores of 42.06 are higher than the mean pre-test scores of 36.19, there is sufficient evidence to reject the null hypothesis. This means that participants' understanding of the History of Mathematics, in general, was improved when exposed to the developed traditional learning modules.
Additionally, the significant differences between the mean pre-test and post-test scores of the participants demonstrate the learning modules in favor of their effectiveness. This result is consistent with past studies by Isola (2010) and Aquino (2015), which show how intelligently designed learning modules can affect learning. Sadiq and Zamir (2014) also noted the effectiveness of the modular approach to learning among university students. Ambayon's (2020) study also depicted a similar, if not outstanding, improvement on the academic performance of the student-respondents who underwent experimental modular instruction.
The studies mentioned above prove the various benefits of modular instruction as a modality of flexible learning. The findings imply that implementing well-designed learning modules produced in traditional can significantly improve students' knowledge and understanding of topics in the History of Mathematics.

Table 5:Mean of the Control and Experimental Groups' Assessment on the Use of Learning Modules

Aspect of the Learning Modules	Items	Mean	Descriptive Interpretation
1. Learning Outcomes	2. 1. The learning outcomes are easy to understand.	3. 3.79	4. Excellent
	5. 2. The learning outcomes are well-planned, formulated, and organized.	6. 3.79	7. Excellent
	8. 3. The learning outcomes stated are specific, measurable, and attainable.	9. 3.64	10. Excellent
	11. 4. The learning outcomes are relevant to the topics of each lesson of the modules.	12. 3.64	13. Excellent
	14. 5. The learning outcomes take into account the needs of the students.	15. 3.64	16. Excellent
17. Content	18. 1. The content of each lesson is directly relevant to the defined learning outcomes.	19. 3.79	20. Excellent
	21. 2. The content of each lesson is simple and easy to understand.	22. 3.79	23. Excellent
	24. 3. The topics of each lesson are fully discussed in the learning modules/YouTube videos.	25. 3.71	26. Excellent
	27. 4. The topics are supported by illustrative examples, and the practice tasks are suited to the level of the students.	28. 3.64	29. Excellent
	30. 5. Each topic is given equal emphasis in the lesson.	31. 3.79	32. Excellent
33. Format and Language	34. 1. The format/layout is well-organized, which makes the lessons more interesting.	35. 3.71	36. Excellent

	37. 2. The language used is easy to understand.	38. 3.7 1	39. Excellent
	40. 3. The language used is clear, concise, and 41. motivating.	42. 3.7 1	43. Excellent
	44. 4. The mathematical symbols used are well- 45. defined.	46. 3.7 1	47. Excellent
	48. 5. The instructions in the learning 49. modules are concise and easy to follow.	50. 3.7 1	51. Excellent
52. Presentation	53. 1. The topics are presented in a logical and sequential order.	54. 3.6 4	55. Excellent
	56. 2. The lessons of the modules are presented in a unique and original form.	57. 3.5 7	58. Excellent
	59. 3. The learning activities are presented clearly.	60. 3.6 4	61. Excellent
	62. 4. The presentation of each lesson is attractive 63. and interesting to the students.	64. 3.5 7	65. Excellent
	66. 5. Adequate examples are given to each topic.	67. 3.5 7	68. Excellent
69. Usefulness	70. 1. The learning modules motivated me to study History of Mathematics.	71. 3.6 4	72. Excellent
	73. 2. The learning modules helped me master the topics at my own pace.	74. 3.6 4	75. Excellent
	76. 3. The learning modules allowed me to use my time more efficiently.	77. 3.7 1	78. Excellent
	79. 4. The learning modules developed my analytical thinking and reasoning skills in solving problems in History of Mathematics.	80. 3.6 4	81. Excellent
	82. 5. The learning modules served as a supplementary material that can catered my needs in learning the History of Mathematics.	83. 3.7 9	84. Excellent
	85. Average	86. 3.6 9	87. Excellent

When judging the content of learning modules, student participants came to the same conclusions as experts. Table 5 shows that participants gave the materials an average of 3.69 out of 4, which means excellent. It can be seen from the table that the participants also assessed that the learning outcomes are simple to comprehend (1.1), well-planned, formulated, and organized (1.2). They also strongly agreed that the learning exercises helped them understand the topic thoroughly. They also decided that each lesson's topic is directly related to the established learning outcomes (2.1) and is straightforward and easy to comprehend. (2.2). They also generally agreed that each topic receives equal emphasis (2.3). Finally, they generally decided that the learning modules functioned as supplemental material that met my needs in understanding mathematics history (5.5). The participants gave all of these mentioned learning modules' aspects an average of 3.69, which is excellent. The remaining modules' aspects were also rated excellent, with a mean average ranging from 3.57 to 3.71.

The participants' responses to the generated traditional modules are consistent with Prastowo's (2013) findings, which stated that modules are educational resources that are systematically organized so that users can learn freely, with or without the help of a teacher. In a study, Nardo (2017) specifically investigated the effect of modular instruction on learner autonomy. She discovered that well-designed modules enabled students to progress through their learning tasks with their teacher's minimal and even no assistance.

As shown in the findings, the developed traditional modules were beneficial in learning History of Mathematics topics. The results indicate that students approve of the modules' learning outcomes, content, format, language, presentation, and usefulness.

CONCLUSION

The researcher measured the mean ratings from all six experts' first and second evaluations. The researcher calculated ICC with the average-measures, absolute-agreement, 2-way mixed-effects model using 95 percent confidence interval for traditional module intra-rater reliability resulted to -0.215 to 0.694, and the estimated

ICC is 0.360, indicating "poor" reliability". The "poor" intra-rater reliability shows variability in observational judgments by six experts for traditional modules. This shows that experts' observations disagree on typical modules' features.

On the other hand, the traditional modules' first evaluation's mean inter-rater agreement was ranged from 63.33 percent on its usefulness to 83.33 percent on its objectives. The traditional modules' second rating's mean inter-rater agreement ranged from 83.33 on its usefulness to 90%. on its content. This means that all experts agreed that traditional modules' objectives are precise, quantifiable, and attainable and that each lesson's themes are thoroughly conveyed but they are divided into the module's other features, particularly presentation and usefulness. The expert's evaluation of the traditional modules showed significant inter-rater agreement, indicating that the six experts consistently gave the learning module's many components a very satisfactory rating, increasing the module's acceptability.

Traditional learning modules also had a statistically significant impact on Mathematics Major History of Mathematics course participants. Participants found the learning modules adequate. It is recommended that additional instructional approach be developed further for use in the enhanced version of the traditional modules.

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