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VALIDITY OF INTEGRAL CALCULUS TEXTBOOK WITH INDONESIAN CULTURAL AND RELIGIOUS VALUES

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ABSTRACT Students' difficulties in understanding Integral Calculus material is one of the factors of low learning outcomes. This research aims to develop an Integral Calculus textbook with nuances of Indonesian culture and religious moderation in accordance with the curriculum in the Tadris Mathematics Study Program at UIN Maulana Malik Ibrahim Malang. The type of research carried out is Research and Development (R&D) with ADDIE (Analysis, Design, Develop, Implementation, and Evaluation) model is used. The instrument used in this research is an expert validation sheet consisting of material validation, learning, design, and moderation religious. The results of expert validation regarding material, learning, design, and religious moderation with percentages of 91.07%; 93,75%; 85% and 90%, respectively, the textbooks are declared valid 86% met the very positive criteria. Based on the validity test and positive student responses, it was concluded that the textbook was valid so it could be used in teaching Integral Calculus.

Keywords: Indonesian culture, integral calculus, religious moderation, textbooks

ABSTRAK Kesulitan mahasiswa memahami materi Kalkulus Integral menjadi salah satu faktor hasil belajar rendah, khususnya di aplikasi integral. Penelitian ini bertujuan untuk mengambangkan buku ajar Kalkulus Integral yang bermuatan nilai budaya Indonesia dan moderasi beragama sesuai dengan kurikulum di Program Studi Tadris Matematika UIN Maulana Malik Ibrahim Malang. Jenis penelitian yang dilakukan Research and Development (R&D). Model pengembangan yang digunakan ADDIE (Analysis, Desain, Develop, Implementation, and Evaluation). Instrumen yang digunakan dalam penelitian ini berupa lembar validasi ahli yang terdiri dari 4 validator yaitu validasi materi, pembelajaran, desain, dan moderasi beragama. Ujicoba terbatas dilakukan kepada 5 mahasiswa untuk mengetahui responnya. Hasil validasi ahli terkait materi 91,07%; pembelajaran 93,75%; desain 85%; dan moderasi beragama 90%. Berdasarkan hasil validasi ahli maka buku ajar dinyatakan valid. Hasil respon mahasiswa terhadap buku ajar dengan persentase sebesar 86% memenuhi kriteria sangat positif. Berdasarkan uji kevalidan dan respon positif mahasiswa maka buku ajar dapat dipergunakan dalam pembelajaran Kalkulus Integral yang bermuatan nilai budaya Indonesia dan moderasi beragama.

Kata-kata kunci: Budaya Indonesia, kalkulus integral, moderasi beragama, buku teks

INTRODUCTION

Calculus is one of the basic materials for Mathematics Education students, Faculty of Tarbiyah and Teacher Training, UIN Maulana Malik Ibrahim Malang. Calculus material is a prerequisite for taking the next course. Therefore, calculus is very important for students to understand in the learning process. Based on the results of the curriculum workshop on 2020, Mathematics Education Departement, UIN Maulana Malik Ibrahim Malang, calculus material is divided into two topis: differential and integral calculus. Differential Calculus discusses the real number system, functions, limits, derivatives and their applications. Integral Calculus discusses integrals and their applications. Understanding integral calculus material will begin by studying differential calculus.

Calculus is used in various areas of life, for example economics, engineering and medicine (Soe Soe 2020). One of the materials taught in integral calculus is Riemann integrals (Purcell, Varberg, and Steven 2010). This material can be applied to other concepts such as geometry and physics, for example to calculate the area under a curve. However, students still find it difficult to learn calculus. Especially integral calculus. Research by Marhayati and Faridah (2018) shows that students make mistakes in solving integral problems. As a result of the Final Semester Examination for the integral calculus course year 2021/2022, Mathematics Education Department students got an average score of 62.87, this shows that their mastery of the integral calculus material is sufficient but still needs to be improved. Furthermore, the results of interviews with students showed that integral calculus material was difficult to understand because the learning resources were in English.

To overcome students' difficulties in understanding integral calculus material, it is necessary to develop learning resources in the form of textbooks that can be used as additional reading material. This is because learning resources can make the learning process easier and improve the quality of learning (Samsinar 2019). Learning resources in the form of textbooks can also improve students' understanding of mathematical concepts (Bien, Daniel, and Taneo 2019).

Textbooks are written works about a particular field that are used in learning for learning goals and objectives and are equipped with teaching tools to assist teaching programs in schools or colleges (Mudlofir 2011). Textbooks help lecturers convey lecture material, helping students achieve competency (Fitria, Arwana, and Lufri 2014). Therefore, textbooks are an important part of learning so lecturers must make textbooks as a source of student learning.

The current integral calculus textbooks are delivered in English (Purcell et al. 2010). Several researchers have developed integral calculus textbooks in Indonesian (Bien et al. 2019; Meilasari and Handayani 2020; Setyawan and Astuti 2021; Shodikin 2017). Bien, Daniel, and Taneo (2019) developed a maple integrated calculus textbook. Setyawan and Astuti (2021) developing a calculus textbook based on a computational thinking approach. Meilasari and Handayani (2020) developing

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textbooks using Macromedia Flash. Isnawati and Oktaviani (2022) developing textbooks that are integrated with Islamic values. Apart from that, there are researchers who are developing geogebra-assisted calculus teaching materials (Erawati, N. K., Sariyasa, & Sadra 2015; Maskar and Dewi 2020). Meanwhile Murni, Helma, and Mirna (2020) develop contextual problem-based teaching materials that aim to increase student activity, motivation and learning outcomes. Of the several existing researchers, there are still few who link calculus textbooks to the culture in Indonesia or the culture of the archipelago.

The association of culture with mathematics is known as Etnomathematics (D'Ambrosio 1985). Several researchers conducted research on the relationship between integral calculus and culture in Indonesia (Busrah and Pathuddin 2021; Suprayo, Noto, and Subroto 2019). Busrah dan Pathuddin (2021) explored volume modeling of solid objects in traditional Makasar food. Suprayo, Noto, dan Subroto (2019) explored calculus in rural farming communities regarding agricultural land. From several studies, it is known that there is an integral concept in Indonesian culture.

An introduction to Indonesian culture and its relationship to mathematics, especially integral calculus, needs to be given to students. Apart from including cultural elements in lectures, the development of religious moderation also needs to be carried out. Instilling cultural values can build an attitude of religious moderation (Lede 2022).

Research on culture and religious moderation has been carried out by several researchers (Aksa and Nurhayati 2020; Azizah 2023; Khoiruddin and Khulwah 2023). Aksa and Nurhayati (2020) researching culture-based religious moderation and cultural wisdom of the Donggo Bima Community. Azizah (2023) analyzing religious moderation in village alms traditions in Lumajang. Khoiruddin and Khulwah (2023) researching religious moderation in local wisdom in the West Coast Community of Lampung Province. Religious moderation will teach tolerance between religious communities, ethnic, national and cultural differences. Tasamuh's religious moderation value contains indicators of respecting others even though they have different beliefs (Solihah 2022).

Based on the description that has been done, it is known that there have been those who have developed calculus textbooks. However, from the existing calculus books, there are no books that integrate with Indonesian culture and religious moderation. Integration with Indonesian culture aims to provide real examples so that students can more easily understand integral applications. Students are also introduced to Indonesian culture and the values contained therein. Through the introduction of Indonesian culture, it is hoped that it can build a moderate religious nature, especially Tasamuh, namely teaching tolerance, differences in ethnicity, nation, and culture. This research is focused on compiling an Integral Calculus textbook with Indonesian culture and religious moderation in accordance with the curriculum of

the Mathematics Education Department at UIN Maulana Malik Ibrahim Malang. This research aims to describe the process of developing an Integral Calculus textbook with nuances of Indonesian culture and religious moderation.

METHODS

This development research uses the ADDIE (Analysis, Design, Develop, Implementation, and Evaluation) model. There are five stages in the ADDIE model. The first stage is Analysis, namely analyzing the needs of the product to be developed. The second stage is Design, namely planning the model and product content being developed. The third stage is Development, namely the implementation of product development. The fourth stage is Implementation, namely the feasibility trial stage. The final stage is Evaluation, namely the interpretation and evaluation of the results of product development and testing. The five stages of ADDIE are shown in Figure 1.

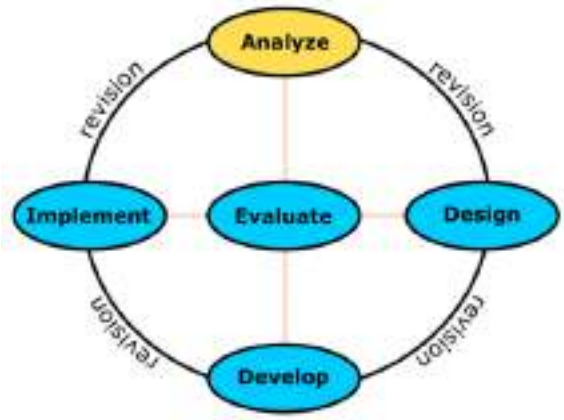

Figure 1. ADDIE Development Stages (Branch 2009)

This study was conducted at the Mathematics Education Department at UIN Maulana Malik Ibrahim Malang. Some of the tools used in this research are: 1) Material Validation Sheet: this instrument contains the appropriateness of the material prepared in the teaching materials, as well as the suitability of the material in calculus with cultural content and religious moderation. Each aspect of the material validation sheet is developed into a question item and compiled in the form of a questionnaire to be filled in by a material expert; 2) Learning Validation Sheet: this instrument contains questions related to the suitability of textbooks in terms of their use in learning. Each aspect of this instrument was developed into a questionnaire and completed by mathematics learning experts; 3) Design Validation Sheet: this instrument contains the attractiveness and effectiveness of the appearance of the integral calculus teaching materials being developed. The aspects contained in the validation sheet are then arranged into question items in a questionnaire and filled in by design experts/media experts; 4) Religious Moderation Validator: this instrument contain aspects from religious moderation such as religious tolerance, religious harmony, etc.

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This research collects data using a Validation Questionnaire. Questionnaires are prepared and used to validate the material, learning and design of the product being developed. Questionnaires are used during product validation and testing. The questionnaire assessment score is based on the scoring guidelines (Sugiono 2010) as shown in Table 1 below.

Table 1. Questionnaire Scoring Guidelines

Score	Answer Assessment
4	Very good
3	Good
2	Not good
1	Very Bad

Next, the data collected from the questionnaire results determines the percentage of eligibility for each aspect using the following formula

$$x_i = \frac{S}{S_{max}} \times 100\%$$

Information:

S_{max} = Maximun Score

$\sum S$ = Total Score

x_i = Percentage of each statement item

Next, the average percentage of all respondents is calculated using the following formula:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Information:

$\bar{x}$ = final percentage average

x_i = validity value of each statement item

n = the number of respondents

Next, the percentage obtained is interpreted to determine validity (Sugiono 2010) based on Table 2 below.

Table 2. Validity Interpretation Criteria

No	Percentage	Qualification
1	$80\% \leq \bar{x} \leq 100\%$	Valid
2	$60\% \leq \bar{x} < 80\%$	Valid enough
3	$50\% \leq \bar{x} < 60\%$	Less Valid
4	$< 50\%$	Invalid

To analyze the results of student responses on the readability test, the percentage of student responses was calculated.

$$P = \frac{F}{N} \times 100\%$$

Information:

P = Percentage

F = Total number of respondents

N = Total students

The results of the percentage of student responses were analyzed by adjusting the positive criteria (Supriyadi 2013) results as in Table 3.

Table 3. Positive Criteria

No	Percentage	Criteria
1	$85\% \leq P \leq 100\%$	Very Positive
2	$70\% \leq P < 85\%$	Positive
3	$50\% \leq P < 70\%$	Less Positive
4	$P < 50\%$	Not Positive

FINDING AND DISCUSSION

Development of an Integral Calculus textbook using the ADDIE model stages. The following is an explanation of each stage.

Analysis

Researchers conducted observations on 82 students of the Mathematics Education Department, 2nd semester of the 2021/2022 Academic Year. Based on the results of the final semester exam, students got an average score of 62.87. This shows that students' understanding of integral calculus material is 62.87% with a letter grade of C. Based on the results of interviews with 34 students, it is known that their difficulty in understanding calculus material is because the learning resources or textbook used are in English or its translation. Moreover, the problems given are based on those in the textbook. Students have not been invited to solve problems in real/cultural contexts that can be found in everyday life.

Design

At this stage, the activities are consist of: (a) determining the study materials and course outcomes that in accordance with curriculum; (b) preparing the materials and questions that is arranged based on supporting sources such as electronic books, scientific articles and other supporting sources; (c) designing the content of the textbook that consist of three parts such as: 1) Introduction Section that consists of introduction section and table of content; 2)Contents Section that consists of

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several materials which are equipped with practice questions and student projects with cultural nuances and religious moderation; 3)Closing that consists of bibliography, author's identity and back cover; (d) preparing the supporting application components such as Geogebra and Canva; (e) preparing the questionnaire for validation instruments and student responses.

Development

At this stage, the product developed was an *Integral Calculus* textbook that integrates Indonesian cultural values and religious moderation. The textbook is organized into three main parts: (1) Introduction, which includes the front cover and chapter introductions; (2) Content section, which contains materials, example problems, practice questions, and student projects; and (3) Closing section.

- Introduction

The introductory section includes a cover that visually represents the title and content of the book. Figure 1 shows the prepared front cover.

Figure 1. Front Cover

This section also contains a table of contents and an introduction page for each chapter. These introductory pages were designed to present real-life contexts relevant to the topics in each chapter.

Content Section

The main content section presents materials, sample problems, practice exercises, and student projects, which are enriched with elements of Indonesian culture and religious moderation. The incorporation of cultural and moderation elements was contextually aligned with each topic, ensuring that mathematical concepts remain accurate and intact. Figure 2 shows an example of the cultural context found in Chapter 3, specifically regarding applications of integrals to find the surface area of a solid of revolution.

This chapter includes integral applications for determining the area under a curve, the volume of a solid of revolution, arc length, and surface area. One cultural element introduced in this section is the use of *kendi*, a traditional Javanese water jug often featured in ceremonial events. Its curved shape makes it ideal for integration problems.

Figure 2. Introduction to Chapter 3

Figure 3(a) highlights the cultural values represented by the *kendi*, while Figure 3(b) demonstrates its use in calculating the area under a curve.

Figure 3(a). The Cultural Value of Kendi

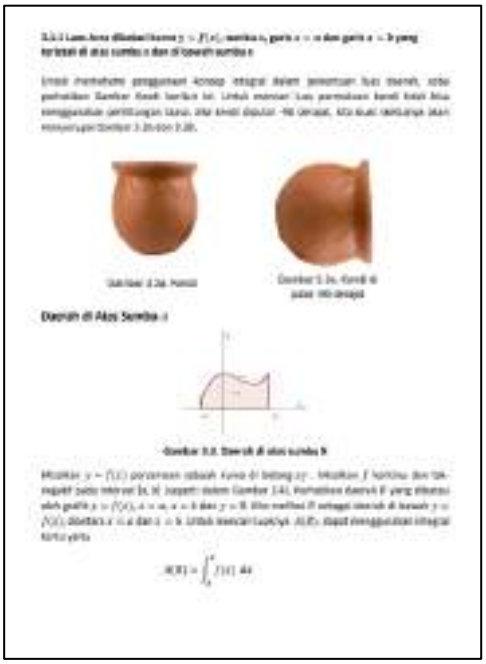

Figure 3(b). The Use of Kendi in Determining Area under a Curve

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In addition to cultural content, religious moderation is also integrated. For example, the Tengger community in Bromo is highlighted for its religious diversity and harmony. The concept of population growth within this community is modeled using exponential integrals.

Figure 4(a) shows the representation of religious moderation within the Tengger community, and Figure 4(b) shows the use of exponential integrals to model the growth of the Muslim population.

Figure 4(a). Religious Moderation of the Tengger Community

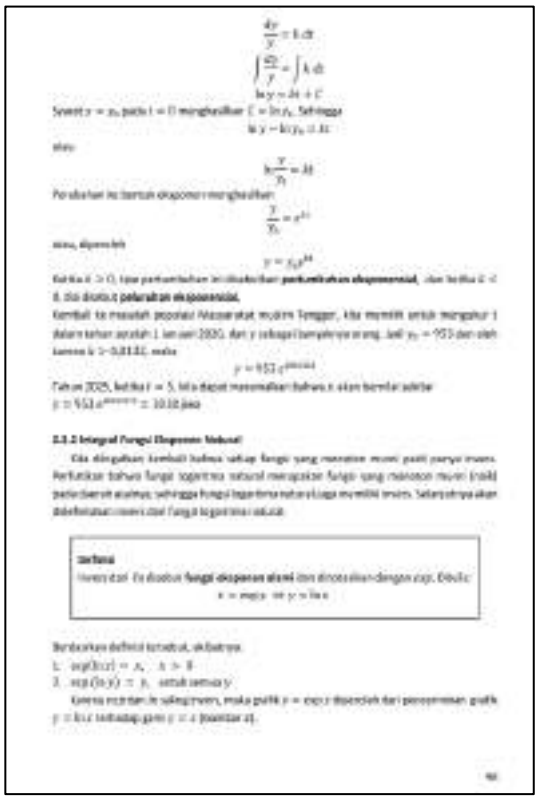

Figure 4(b). The Use of Exponential Integral in Modeling Muslim Population Growth

The closing section includes a bibliography, index, and author profiles.

Validation and Revisions

Validation of the textbook was conducted by four expert reviewers in the fields of content, learning, media design, and religious moderation. The validators were affiliated with UIN Maulana Malik Ibrahim Malang, SITI Ibnu Sina Malang, and Wisnu Wardhana University. The validation results are shown in Table 4.

Table 4. Textbook Validation Results

No	Validator Type	Percentage (%)
1	Material	91.07
2	Learning	93.75
3	Design	87.50
4	Religious Moderation	90.00
	Average	**90.85**

All validation scores exceeded 80%, indicating that the textbook met the "valid" criteria in all assessed aspects. Based on the feedback provided, several revisions were made:

1) the cover was redesigned to better reflect the contents,
2) learning outcomes were added to each chapter,
3) cultural and moderation content was enhanced, and
4) typographical errors were corrected.

Figure 6(a) and Figure 6(b) display the changes made to the cover before and after revision.

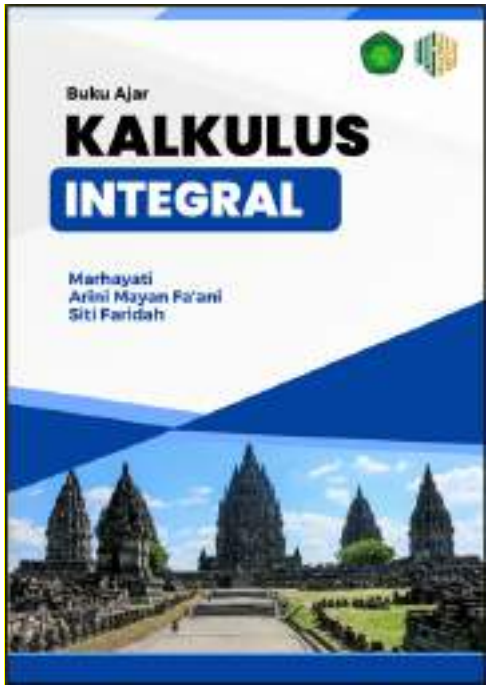

Figure 6(a). Cover Before Revision

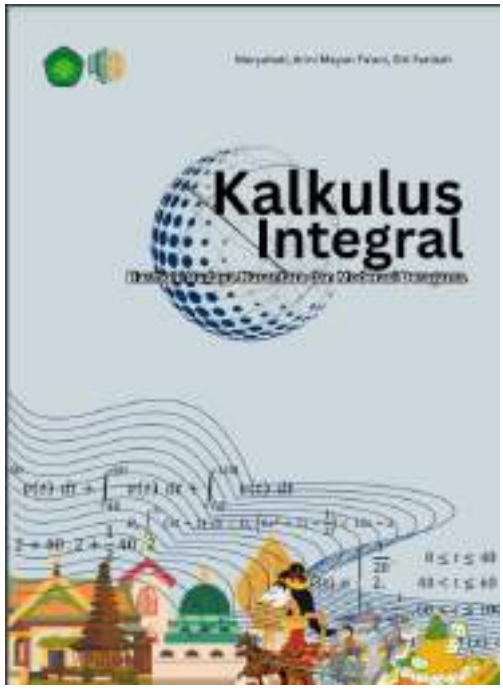

Figure 6(b). Cover After Revision

Learning outcomes were also added to the beginning of each chapter. **Figure 7(a)** and **Figure 7(b)** illustrate this revision.

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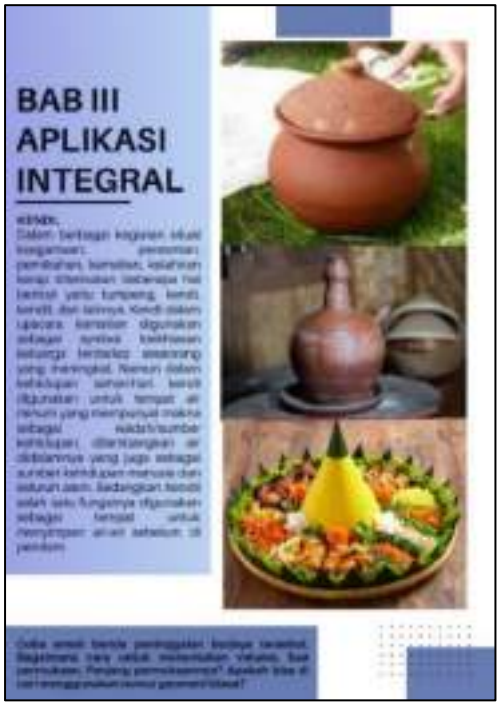

Figure 7(a). Chapter 3 Before Revision

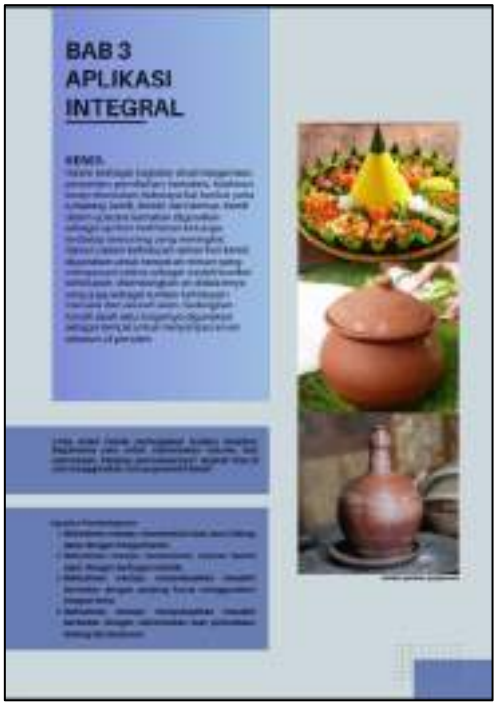

Figure 7(b). Chapter 3 After Revision

Implementation

Following the validation stage, a limited trial was conducted involving five third-semester students from the Mathematics Education program. The aim of this trial was to evaluate the readability and student reception of the developed textbook. Table 5 presents the results of the student response assessment.

Table 5. Student Response Results

Assessment Aspect	Percentage (%)	Information
Interest	83.3	Very Positive
Material	88.0	Very Positive
Language	86.7	Very Positive
Average	**86.0**	**Very Positive**

The average percentage of student responses was 86%, indicating a highly positive reception. Most responses were in the "agree" and "strongly agree" categories. Feedback provided included suggestions to correct several typographical errors and to incorporate more real-life contextual problems to increase student motivation in learning.

Evaluation

Based on the validation results from material, learning, design, and religious moderation aspects, the textbook achieved an average score of 89.94%, indicating

a high level of validity. In addition, the average percentage of student responses during the trial was 86%, reinforcing that the textbook is positively received and suitable for use in instruction.

The development of this textbook was motivated by students' difficulties in understanding integral calculus concepts, particularly in applying integration to calculate area and the volume of solids of revolution. These challenges are often rooted in a lack of conceptual understanding. As supported by Bien et al. (2019), integrating concept-oriented textbooks can improve students' comprehension. Furthermore, Radmehr and Drake (2020) emphasized that meaningful questions during learning and assessment activities help students better grasp integral applications.

To enhance student understanding, contextual problems relevant to daily life must be provided. Studies by Busrah and Pathuddin (2021) explored integral calculus in modeling and volume using traditional Makassar snacks, while Suprayo, Noto, and Subroto (2019) examined the application of integration in determining the area of agricultural land.

Integrating integral calculus with Indonesian cultural elements promotes inclusive learning. To aid conceptual understanding, examples such as *tumpeng* and *kendi* are utilized—both of which reflect the ethnomathematics approach outlined by Kristiyani and Ernaningsih (2024). These cultural artifacts can serve as effective visual tools for teaching concepts of area and volume using integration.

Incorporating cultural context also serves to introduce values of religious moderation. Studies such as Language and Page (2024) investigated religious moderation through the *tumpeng pungkur* tradition. Similarly, Aksa and Nurhayati (2020) examined cultural and local wisdom-based religious moderation. Through culturally integrated learning, students not only gain mathematical understanding but also develop tolerance, interfaith harmony, and mutual respect—values that align with the goals of religious moderation.

Culture in Indonesia is deeply rooted in values of religious tolerance. The contextual integration within the textbook reflects both mathematical substance and the spirit of religious moderation. Several researchers have also addressed the role of local wisdom in fostering these values (Azizah, 2023; Diantika & Cahyani, 2022; Khoiruddin & Khulwah, 2023). With such content, students' cultural and spiritual literacy is expected to increase, encouraging a tolerant and inclusive outlook in line with the concept of *tasamuh* (tolerance) among diverse religious and cultural communities (Putri & Witro, 2022).

CONCLUSIONS AND RECOMMENDATIONS

The Integral Calculus textbook that incorporates Indonesian cultural elements and religious moderation was developed based on the ADDIE development model, which includes the stages of analysis, design, development, implementation, and

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evaluation. The textbook was validated by experts in the fields of content, learning, design, and religious moderation, yielding scores of 91.07%, 93.75%, 85%, and 90%, respectively. These results indicate that the textbook fulfills the criteria for validity in all assessed aspects. In addition, student response results showed an average percentage of 86%, categorized as very positive. This suggests that the textbook is well-received and considered appropriate for use in classroom instruction.

The development of this textbook is highly relevant to the context of Integral Calculus learning in Mathematics Education programs in Indonesia. The integration of cultural themes and religious moderation not only enriches the content but also supports the internalization of national values and the development of student character. By presenting mathematics in real-life contexts that are familiar and meaningful, the textbook bridges cognitive understanding with moral and cultural awareness.

Looking ahead, further research could explore the effectiveness of this textbook in enhancing students' mathematical problem-solving abilities and their understanding of religious moderation through classroom-based experimental studies. In addition, future development may include the creation of student activity sheets that align with the textbook, to provide more structured and contextualized learning experiences.

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