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Developing Data Centralization Interactive Media for 7th Grade Students' Statistical Literacy Using SAC Application

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Abstract

The aim of this research is to develop interactive media that utilizes the Smart Apps Creator (SAC) application with a focus on statistical literacy, especially on data centralization material for grade 7 students. The development of this media follows the steps in the ADDIE model, namely analysis, design, development, implementation, and evaluation. This research involved 25 7th-grade students from SMP Muhammadiyah 3 Depok Sleman as research subjects. The instruments used in this research include interviews, validation questionnaires from material and media experts, and student response questionnaires. Based on research findings, interactive media developed with the Smart Apps Creator (SAC) application is proven to be valid and practical. The results of the material expert assessment were 80% which met the valid category. While the media expert assessment was 81.48% met the very valid category. The practicality criteria were obtained from the results of student responses with a percentage of 79.44% which also fell into the practical category indicating that the media is suitable for use in teaching. Thus, interactive media based on SAC can be an effective alternative to improve student understanding and motivation when studying data centralization material.

Keywords: data centralization, interactive media, smart apps creator, statistical literacy

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INTRODUCTION

Education is a process of developing skills and knowledge that are needed by every human being to obtain their potential. The purpose of education can include training and habituating individuals, thereby improving their abilities, talents, and other competencies. Furthermore, education functions as an instrumental effort that can accelerate the advancement of human potential, enabling individuals to fulfill their given responsibilities, given that the capacity for education is only within humans (Aisyah et al., 2023). Education in the 21st century has undergone significant changes due to advancements in science and technology, which have also transformed learning methods with a more interactive, participatory, and relevant approach (Yusuf et al., 2023). The goal is to meet the demands of the times and to prepare students holistically and inclusively to face future challenges (Triayuningtiyas & Prasetyo, 2024). So that through education, students are given the opportunity to realize and expand their inherent potential abilities.

The rapid development of technology has a major impact on the course of learning activities, the Education Era 5.0 is a continuation of the previous era, namely 4.0. In this era, public attention is more directed at the relationship between humans and technology based on existing cultural values (Sasikirana & Herlambang, 2020). In this era, technology also plays a role in building a more harmonious relationship between

humans and technology, thus creating a more inclusive educational environment that is oriented towards human values. Technology is an important component in learning, functioning as a tool and learning medium (Mukaromah, 2020). In addition, technology enables interactive learning methods to foster student interest and create a fun learning environment (Ariani, 2019).

Statistics material is taught at various levels of education according to the applicable curriculum. Statistics itself refers to the science that includes methods of collecting, presenting, processing, and analyzing data (Zulfikri, 2016). The purpose of statistics is to process data so that it can be arranged and presented in a way that is easier to understand, which in turn helps in decision making. In learning statistics, students are expected to be able to process and present data in a way that makes it easier to understand and analyze(Ramadanti et al., 2021). By mastering the ability to present and analyze data, students can not only apply this knowledge in mathematics lessons, but also in everyday life. The skills relevant to this statistical material are statistical literacy.

This statement is in line with the Indonesian Ministry of Education Regulation Number 24 of 2016, which stipulates basic competencies in statistical materials. These competencies include understanding and calculating data such as average, median, mode, and data distribution to draw conclusions, make decisions, and predict. In addition, the ability to present and solve problems related to data distribution, average, median, and mode values is also part of the learning objectives.

The ability in statistical literacy is very crucial for students. According to Ojose (2011), statistical literacy includes understanding basic mathematical concepts and their application in everyday life. Statistical literacy includes the capacity to understand, analyze, and rigorously evaluate statistical information and data sets (Istiyono & Perdana, 2024). This statistical literacy ability has indicators according to (Yuniawatika, 2018) which include reasoning about data, reasoning about basic statistical concepts, statistical terms, reasoning about collecting and processing data descriptively, translating data and communicating data and results. From the explanation above, it can be concluded that the indicator shows that statistical literacy skills do not only focus on understanding statistical knowledge, but more deeply on reasoning skills. Aang and Muhaemin (2020) also emphasizes statistical literacy as an important skill for students to hone critical thinking skills. This skill includes a person's skills in exploring, evaluating, interpreting, concluding, and predicting statistical-based information.

In the real word, the level of statistical literacy among students is still quite low. Research conducted by Maryati (2021) shows that students at the junior high school level face various difficulties. Problems that are often encountered include errors in interpreting graphs or diagrams, difficulties in processing and understanding data related to bar charts or pie charts, and confusion when asked to calculate the average presented in a table due to a lack of understanding of the procedure. Maryati (2021) also revealed that the level of statistical literacy of students had not reached the minimum completion criteria, with the percentage still relatively low in each indicator, especially the skill of calculating the results of statistical data processing.

One of the topics studied by grade VII students in statistics material is the measure of data centralization, which includes basic concepts such as mean, median, and mode. Statistics is an important foundation that prepares students to study mathematics at a higher level (Surya, 2017). Therefore, understanding statistics is very important for students, however, when practicing it, students mostly have difficulty learning the material on data centralization measures, which has an impact on low student learning

outcomes. Some of the indicators that cause low mathematics learning outcomes are the obstacles faced by students in the learning process and their lack of understanding of the concept of data centralization measures. In addition, low learning outcomes are also influenced by the learning approach applied by teachers, which often makes students feel bored and fed up. The uninteresting teaching can reduce students' interest and reduce their focus on learning, especially when the media and learning aids used are limited. As a result, the learning process becomes monotonous and less varied. To create a fun learning experience for students, careful planning is needed regarding various learning elements.

One of the crucial factors in learning is selecting media that suits the characteristics of the students. In general, children are more interested in activities involving digital technology (Iksan & Djuniadi, 2017). This can be used to increase students' motivation and interest in learning. In order to realize this, multimedia is one alternative. Multimedia is a combination of media such as text, images, sound, and video that are used to change abstract material into something more real with the help of certain tools. One type of multimedia is the use of applications in teaching media. Users have the freedom to combine creative elements such as text, images, audio, and video taken from reliable sources. Therefore, in order for information to be well understood, learning media must prioritize effectiveness, efficiency, and validity.

The integration of digital tools and innovative pedagogical approaches has revolutionized modern education, particularly in enhancing literacy, numeracy, and critical thinking skills. Recent studies underscore the transformative potential of technology-enhanced learning. For example, Hartanto et al. (2020) developed digital modules to advance human and technology literacy, demonstrating their efficacy in creating dynamic and accessible learning environments. Complementing this, Prasetyo and Atsila (2022) designed problem-based electronic worksheets for mathematics, highlighting how digital resources can engage students in active learning and conceptual mastery.

Numeracy, increasingly recognized as a cornerstone of critical thinking (Jain & Rogers, 2019; Rahayu et al., 2021), is being redefined through interdisciplinary applications. Rosnelli and Ristiana (2023) emphasize the role of independent curricula in enhancing students' literacy and numerical competence, while Connolly et al. (2023) advocate for cross-curricular professional development to embed numeracy across disciplines. These efforts align with broader trends in educational technology, such as block programming. Triayuningtiyas and Prasetyo (2024), for instance, created Scratch-based interactive media for teaching algebra, illustrating how visual programming can demystify abstract concepts for middle school students.

The intersection of numeracy and digital fluency extends beyond classrooms. Völkel et al. (2017) demonstrated that tablet-based training programs can cultivate emergent literacy and mathematical skills in preschoolers, suggesting early exposure to technology lays a foundation for future learning. Meanwhile, Sepriliani et al. (2022) contextualized numerical problems using real-world scenarios (e.g., religious events during the pandemic), bridging theoretical knowledge with practical application—a approach echoed in PISA-based assessments.

Beyond education, mathematical models are pivotal in addressing societal challenges. Cheng et al. (2022) analyzed rumor propagation dynamics under media coverage. Similarly, Zuo et al. (2023) explored vaccination decision-making using benefit-cost analysis, showcasing numeracy's role in public health. These studies reflect

the ubiquity of quantitative reasoning in diverse fields, from epidemiology (Cheng et al., 2022) to environmental systems analysis (Marsili-Libelli, 2016).

This introduction synthesizes key themes from the literature: the synergy of digital and numeracy skills in education, the importance of contextualized learning, and the far-reaching applications of mathematical modeling. The subsequent sections will expand on these ideas, drawing on empirical evidence to outline future directions for research and practice.

Smart Apps Creator (SAC) is software designed to create interactive teaching media based on Android (Nadeak & Rangkuti, 2024). The SAC application also facilitates users, including educators, to efficiently develop Android-centric educational resources (Almukarramah et al., 2023). This application is very user-friendly because it does not require programming skills. The results of SAC can be saved in application format. The advantage of SAC lies in its various easy-to-use features, including the ability to add animations, images, and quizzes (Wardhani & Lathifah, 2021). In addition, other advantages include its ease of use for students, because it can be downloaded and run offline without requiring a stable internet connection. By using the Smart Apps Creator application, it is hoped that the learning process can be more interesting and useful, providing experiences that cannot be found in textbooks.

Based our interview on October 13, 2024, with the Grade 7 teacher of SMP Muhammadiyah 3 Depok Sleman, it was obtained information that teachers usually use inquiry, discovery, problem solving learning models as well as lectures, questions and answers, assignments and group work activities only. Meanwhile, teachers are at the learning stage with excel learning media after students understand the concept of mathematics. Therefore, it is necessary to use additional media in the teaching and learning process in the classroom so that students do not get bored in learning mathematics. In the data centering material, teachers usually only explain the material in the textbook by explaining it on the board and some students have low abilities in the data centering material caused by a lack of understanding of the concept of data centering material. This condition causes students to feel bored quickly and less interested in the material taught by the teacher. As a result, the level of student participation in learning tends to be passive, especially due to the lack of interactive learning media in data centering materials.

Based on our observations, students will be more motivated and interested in mathematics lessons if teachers use learning media that support the learning process. On the other hand, the author noted that this school had not yet improved its SAC-based teaching media, which prompted the researcher to design this development so that it could be applied directly to teaching. Thus, researchers hope that schools and teachers can have the same enthusiasm in using similar learning media. The presence of this interactive learning media is expected to be one of the solutions to increase student involvement and motivation while learning.

Some previous research has been conducted by Uliyandari and Sutarno (2023) using the SAC to develop interactive mathematics learning media. This study discusses the use of interactive multimedia, especially based on SAC which can encourage students to learn more actively and effectively and appropriately in mathematics learning in the classroom. However, this study has some differences in the material, research subjects, and research location, where the material used is data centralization and uses the SAC application. This study needs to be done because of the need for interactive media for the SAC application to attract students' motivation and interest in learning data centralization material in class.

RESEARCH METHOD

This study is an R&D using the ADDIE development model consisting of 5 stages, namely analysis, design, development, implementation, and evaluation. This study took place at SMP Muhammadiyah 3 Depok Sleman, with the testing subjects involved were the VII D classroom students. SMP Muhammadiyah 3 Depok Sleman is a private junior high school under Muhammadiyah organzation. It is a leading Islamic school in the Special Region of Yogyakarta, Indonesia.

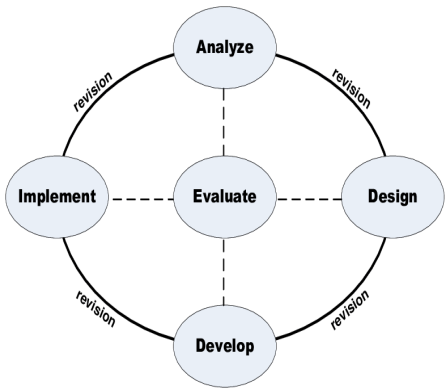

Figure 1. ADDIE Flowchart (Rachman et al., 2024)

We follow the flowchart of ADDIE as presented in Figure 1. The first stage is Analysis. The analysis stage is the stage of knowing and seeking information related to problems that have been found in the field and analyzing the mathematics learning of students used in class VII of SMP Muhammadiyah 3 Depok Sleman.

The second stage is Design. This design stage is the stage of designing a product that will be developed based on the needs that has been concluded previously in the analysis stage. This development uses an application named SAC. In the data centering, the material that be will discussed is the mean, mode, median, histogram, and related concept. The first step in this process is to design the media framework and elements used as an instrument to collect the data. The elements needed are validation sheets involving media experts, material experts, and teaching experts, as well as student responses.

The third stage is Development. The SAC-based teaching media is enhanced for data centering materials. After the product is completed, the next step is to validate it by media experts, material experts, and teaching experts to assess the effectiveness, efficiency, and validity of the product. Validation data is then collected and analyzed to ensure whether the developed product is in line with the needs of students. Based on suggestions and input from the validators, researchers will carry out revisions to the learning media.

The fourth stage is Implementation. At this stage, the learning media that has been developed is applied to class VII students of SMP Muhammadiyah 3 Depok Sleman to evaluate the suitability and effectiveness of its use. Students will be asked to fill out a response questionnaire to assess the feasibility of the teaching media that has been developed. After that, the researcher will carry out a recapitulation of the results of the collected questionnaire data.

This final stage is related to formative evaluation activities which are useful for assessing the suitability of the media, which are carried out by media expert validators, material experts, learning experts, teachers and students.

The data analysis used is qualitative descriptive analysis and quantitative analysis. Qualitative descriptive analysis is based on the results of field study instruments as the needs of the media to be developed. This instrument includes interviews, input and suggestions from validators, teachers and students. On the other hand, quantitative analysis is obtained from expert validation findings and student response questionnaires, namely assessment scores on the validity questionnaire and the practicality of developing interactive media with the SAC application, data centralization measurement material.

The data analysis process stage takes place after all the required data has been collected. In data analysis to assess the level of validity and practicality of learning media, the Likert test is used. The research guideline used is the Likert scale. The Likert scale is a measurement method to assess attitudes, opinions of individuals and groups (Sugiyono, 2015). This assessment will be stated on a scale of 5, 4, 3, 2, and 1. The assessment guidelines are presented in Table 1.

Table 1. Likert scale

Category	Score
Strongly Agree (SA)	5
Agree (A)	4
Quite Agree (QA)	3
Disagree Less (DL)	2
Strongly Disagree (SD)	1

In this research, the instrument used is a questionnaire to assess validity, which includes a product assessment sheet by material experts, media experts, and a questionnaire to measure student responses. The validity and practicality of interactive media products developed with the SAC application based on statistical literacy on data centralization measurement material are analyzed based on the assessment findings of product experts and material experts at the development stage, as well as student response questionnaires at the implementation stage. The calculation of the final value of the validation results takes place with the formula presented in Equation 1 (Islam & Fahmi, 2019):

$$X = \frac{F}{N \times I \times R} \quad (1)$$

where: X = validity percentage
F = total of all responses
I = total of questions in the questionnaire
R = total of respondents

Furthermore, evalution from the experts can be observed based on the validity criteria as listed in Table 2 (Darma & Putra, 2020).

Table 2. Interpretation of validity

Percentage (%)	Category
$80 < X \leq 100$	Strongly valid
$60 < V \leq 80$	Valid
$40 < V \leq 60$	Not enough
$20 < V \leq 40$	Poor
$0 \leq X \leq 20$	Not valid

If all aspects listed in the questionnaire get an average percentage of at least more than 60%, then the media falls into the valid or strongly valid category (Hidayatul et al., 2018).

The processing of questionnaire data filled out by students was carried out using the same method as in the analysis of the learning media validation sheet. The results of the questionnaire were then analyzed to monitor how practical the media that had been developed was. Interpretation of the level of practicality of the media by students can be observed in Table 3.

Table 3. Practical interpretation from students' response

Percentage (%)	Category
$80 < X \leq 100$	Very practical
$60 < V \leq 80$	Practical
$40 < V \leq 60$	Not enough
$20 < V \leq 40$	Poor
$0 \leq X \leq 20$	Not practical

(Darma & Putra, 2020)

If all aspects listed in the questionnaire get an average percentage of at least more than 60%, then the media falls into the practical or very practical category (Hidayatul et al., 2018).

RESULTS AND DISCUSSION

The results of this development research are in the form of interactive teaching media that is enhanced with the help of the SAC application. This media contains a series of materials about circles for grade VII students. The creation of this interactive media refers to the ADDIE model, including 5 basic stages: analysis, design, development, implementation, and evaluation. The following is an explanation of the findings from each stage:

Analysis

This stage, takes place with interviews with teachers to identify problems that arise in the teaching stage and the media used during classroom learning activities. Based on interviews, teachers generally use inquiry, discovery, problem-solving learning models, as well as lecture methods, questions and answers, assignments, and group work. Excel learning media is used after students understand the concept of mathematics, but the lack of media variation makes students quickly bored and less active, especially in data centering material. Researchers see that the use of interactive media, such as Smart Apps Creator, can increase student motivation and involvement. Therefore, the development of interactive learning media is expected to be implemented in schools to increase learning effectiveness.

Design

This stage takes place with the design of the product to be developed, namely the creation of a storyboard used before converting teaching media to digital format, the researcher first creates a storyboard to visualize each display that will appear in the media as well as the design of the SAC application display in the form of a screen cover, menu screen, learning achievement screen and learning objectives based on the Merdeka curriculum, material screen, quiz screen, and bibliography screen.

Development

After the media creation process with the SAC application is complete, which indicates that the media product has been produced. The researcher continued with the validation process of material experts and media experts on the SAC application. Validation took place with an instrument that had been approved by the mathematics education lecturer at Ahmad Dahlan University. The material expert validation assessment sheet includes 22 indicators and the media expert validation includes 27 indicators. The purpose of this validation is to get input from validators who are experts in their fields and to ensure that the application is suitable for use in research. After validation, the SAC application that has been developed is then improved and perfected based on suggestions and input from the validators. In this study, validator I is a mathematics education lecturer at Universitas Ahmad Dahlan, while validator II is a mathematics education teacher at SMP Muhammadiyah 3 Depok Sleman. Several recommendations and responses were obtained from the results of the evaluation of the material and media validation questionnaire carried out by the validator.

In this stage, we also got various feedback from the experts. The feedbacks were the followed up by several adjustment to the media. In the expert review, experts argued that the topics of central data measurement should also include the single data, instead of only grouped data. They also suggested to highlight the learning outcome which relates to the media. Therefore, we made an adjustment to the learning objective as presented in Figure 2.

Figure 2. Experts' feedback to highlight the relevant learning outcome, before highlighted (a) and after highlighted (b); and to add the single data topic into the media, before added (c) and after added (d).

Furthermore, experts also suggested to adjust the concept map of the media, to ensure that the students could follow the learning better since the sequence of the topic is more appropriate. They also suggested to add the references of the media at the end (See Figure 3).

(a) (b)

Figure 3. Experts' feedback to re-order the concept map into a more approriate sequence (a) and adding the references (b).

The other issues also came up in terms of media appearance, especially the use of font type and layout. Experts believed that we have to set up more clean and tidy. They also suggested that we have to be consistent in using the appropriate font-type when writing the mathematics equation (See Figure 4).

(a) (b)

Figure 3. Experts' feedback to make the line justified (a) and use the Ms Equation to write equations, symbols, and the other mathematics expressions (b).

After the adjustment, we also asked the experts to evaluate and score the validity in terms of content and media characteristics. The evaluation results from content experts is available in Table 4.

Table 4. Material expert validation results

No	Aspect	Validators		Sum	Percentage	Category
		1	2			
1.	Content validity	37	36	73	81.11%	Strongly valid
2.	Readability	12	12	24	80.00%	Valid
3.	Presentation	20	20	40	80.00%	Valid
4.	Statistical literacy skills	20	19	39	78.00%	Valid
	Total Score			176		
	Average Score				80.00%	Valid

Table 4 presents the validation results on various aspects of the assessment by material experts, where the aspect of content feasibility consisting of 9 statements received a total score of 73 with a percentage of 81.11%, which is classified as very valid. Meanwhile, the linguistic aspect which includes 3 statements was also evaluated and received a total of 24 with a percentage of 80% in the valid category, the aspect of presentation feasibility with 4 statements received 40 with a percentage of 80% in the valid category, and the aspect of statistical literacy skills with 5 statements received 39 with a percentage of 78% in the valid category. The questionnaire data listed in Table 4 from all aspects listed with a percentage of 80% can be concluded to be included in the valid category, in accordance with the explanation of expert validation showing that the teaching material meets the valid category in terms of content.

The results of the validation by media experts are presented in Table 5.

Table 5. Media expert validation results

No	Aspect	Validators		Amount	Percentage	Category
		1	2			
1.	Graphic Quality	52	56	108	83.08%	Strongly valid
2.	Display Design	59	53	112	86.15%	Strongly valid
	Total Score			220		
	Average Percentage				81.48%	Strongly valid

Table 5 shows the validation results on several aspects in the media expert assessment, where the graphic quality aspect, consisting of 13 statements, obtained a total score of 108 with a percentage of 83.08%, classified as very valid. For the display design aspect, the total statements assessed were up to 14 with a percentage of 86.15%, included in the valid category. Overall, based on the questionnaire data presented in Table 5, all aspects assessed produced an average percentage of 81.48%, so it can be concluded that the media tested is classified as very valid, in accordance with the expert validation explanation showing that the teaching material meets the very valid category in terms of media. interactive media with the developed SAC application is declared "valid" and suitable for use in terms of media.

Implementation

At this stage, the interactive media that has been developed is applied to the learning process to see its effectiveness. After that, students are asked to fill out a questionnaire to provide responses regarding the use of interactive media based on the SAC application in the data centralization measurement material. This trial involved 25 grade VII students at SMP Muhammadiyah 3 Depok, Sleman. The results of the student response questionnaire can be observed in Table 6.

The information obtained the validity of some aspects in the assessment of material experts, namely the linguistic aspect with 2 statements getting 203 and a percentage of 81.20% with a very practical category, the aspect of interest with 2 statements getting 194 with a percentage of 77.60% in the practical category, the aspect of content with 2 statements getting a total of 193 with a percentage of 77.20% in the practical category, the aspect of ease of use of media with 2 statements getting 203 with a percentage of 81.20% in the very practical category, the graphic aspect with 5 statements getting 489 with a percentage of 78.24% in the practical category and the aspect of benefits with 5 statements getting 704 with a percentage of 80.46% in the very

practical category. The questionnaire data listed in table 8 from all aspects listed with a percentage of 79.44% falls into the very practical category, according to the explanation of practicality showing that the learning media meets the very practical category.

Table 6. Students' response on questionnaire results

No	Aspect	Amount	Percentage	Category
1.	Readability	203	81.20%	Strongly practical
2.	Interest	194	77.60%	Practical
3.	Content	193	77.20%	Practical
4.	Ease to use	203	81.20%	Strongly practical
5.	Graphic	489	78.24%	Practical
6.	Benefit	704	80.46%	Strongly practical
	Total score	1,986		
	Average percentage		79.44%	Practical

Evaluation

In the final stage of development, the main objective of this stage is to assess the validity and quality of the media that has been created. Evaluation includes validation of media, materials, and student responses to assess the feasibility of the media developed. This dimension serves as an important reference point regarding previously developed media, following improvements informed by input, advice, and criticism provided by validators, as well as feedback from students.

CONCLUSION

Based on the results and discussions of the ongoing research, this research produced a product in the form of interactive media developed with the Smart Apps Creator (SAC) application, which focuses on statistical literacy in the data centralization measurement material for grade 7 students who follow the Merdeka curriculum. The product development process adopts the ADDIE model which includes five main stages, namely analysis, design, development, implementation, and evaluation.

Interactive media utilizing the Smart Apps Creator device based on statistical literacy in the data centralization measurement material for grade VII students of SMP Muhammadiyah 3 Depok Sleman was declared valid with a percentage of assessment index results from material experts of 80%. Meanwhile, the percentage of assessment index from media experts was 81.43% which met the very valid category.

In addition, the trial on students showed a positive response with a percentage of 80.28% which also fell into the practical category indicating that the media was worthy of being used in learning. Thus, interactive media based on SAC can be an effective alternative to develop students' understanding and motivation when studying data centralization measurement material.

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DECLARATION

Author Contribution

All authors contribute in the research process, such as collecting the data, analyzing the data, and writing the manuscript. All authors approved the final manuscript.

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This research did not receive any funding.

Conflict of Interest

Both authors affirm that they have no conflicts of interest.

Ethics Declaration

We, the authors, affirm that this study was conducted in full adherence to ethical research standards and the guidelines established by our institution. Moreover, we secured all necessary approvals from the appropriate agencies for data collection. We wholeheartedly endorse the International Journal on Emerging Mathematics Education (IJEME) for its unwavering commitment to upholding exemplary professional ethics and maintaining integrity in all our scholarly pursuits.

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