

## Investigating the Implementation of IMRaD Structure in Abstracts of Undergraduate Students' Theses

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### ABSTRACT

The IMRaD (Introduction, Methods, Results, and Discussion) structure is a crucial framework for organizing information in abstract writing, enabling clear and effective communication of research findings. Hence, this research aims to analyze the adherence of undergraduate students to the IMRaD structure in their thesis abstracts. The study focuses on students who graduated from a private university in 2019. A sample of 77 from 326 thesis abstracts was selected from the population using the simple random sampling technique. Data collection involved a document review technique. The result shows that among the 77 students, all abstracts included the Introduction section, indicating a high level of adherence. However, the Method and Results sections were found in the abstracts of only 70 students, suggesting a relatively lower compliance rate. Surprisingly, the Discussion section was present in the abstracts of only 31 students, representing the lowest adherence to the IMRaD structure. This research reveals a need for interventions to enhance undergraduate students' understanding and implementation of the IMRaD structure in their thesis abstracts. Therefore, lecturers and institutions should provide guidance and support to improve students' adherence to this important academic writing convention. By enhancing students' proficiency in applying the IMRaD structure, their thesis abstracts can become more effective and aligned with scholarly standards.

**Keywords:** *abstract; effective writing; IMRaD structure; scientific writing; undergraduate thesis.*

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## INTRODUCTION

One of the essential components of any academic thesis is the abstract, which provides a concise summary of the paper's main arguments and findings. It functions as the very beginning of contact with readers and can have a significant impact on their interest in the research (Malini, 2022). As it is not easy to perform writing (Fahuzul, Ulfah, Surayatika, 2022), numerous academics in the field highlight the significance of well-structured scientific abstracts for informing and directing interested readers (Cusen, 2018). Therefore, academic paper abstracts need to be well-structured and informative in order to convey the context, objectives, and findings of the research.

Abstracts serve a crucial function in summarizing the key aspects of a research paper and elucidating the significance of the scientific endeavor (Katri, 2022; Maomao & Jianguo, 2023). The composition of abstracts can pose a significant challenge for undergraduate students, primarily due to the requirement for a clear and concise arrangement of information (Moerdisuroso & Kherid, 2020). Therefore, it is imperative to provide students with sufficient guidance on the appropriate structure for their abstracts. One effective strategy for writing an abstract is to utilize the IMRaD structure, which encompasses Introduction, Methods, Results, and Discussion.

The IMRaD (Introduction, Methods, Results, and Discussion) format is a commonly employed structure in scientific

writing and is regarded as a standard for organizing academic texts, including journal and thesis abstracts (Cusen, 2018; Gjesdal, 2013; Moskovitz et al., 2023). The framework enables efficient literature review by enabling readers to swiftly navigate articles and identify content pertinent to their objectives (Vyas & Panara, 2016).

The use of the IMRaD structure has been investigated in various studies, including a systematic, corpus-based study of primary section headings in research articles across a range of STEM disciplines (Moskovitz, 2023), a survey and analysis of prestigious Open Access journals in the field of educational science in the world and in Vietnam (Trinh et al., 2020), and an examination of undergraduate students' thesis abstracts (Siyaswati & Rochmawati, 2017). Some studies have also explored the implementation of natural language processing (NLP) techniques and machine learning on conventional abstracts to automatically generate structured abstracts that are formatted using the IMRaD format (Almugbel et al., 2019). Additionally, the effect of various students and faculty authoring partnerships on the use of the IMRaD style of writing for a university student journal has been investigated (Oriokot et al., 2011). Finally, the logical structure of abstracts in the areas of materials science and technology and library and information science has been examined to suggest guidelines for components of abstracts (Jamar et al., 2014).

Undergraduate thesis which is part of the academic writing is a crucial aspect of undergraduate education as it prepares students for their future academic and professional endeavors. One important aspect of academic writing is the appropriate structuring of a piece, which contributes to clarity and coherence (Shah, 2020). In the field of academic writing, IMRaD has been established as a standard structure for research articles and has been widely discussed by literature representatives (Masic, 2018). Furthermore, IMRaD has been shown to facilitate knowledge acquisition, evaluation of manuscripts, and efficient location of specific information without having to read through an entire paper (Teodosiu, 2019). Specifically for abstract writing, IMRaD has been widely used; it enables readers to quickly understand the purpose, methods, results, and conclusions of a research study. Additionally, IMRaD has been used as a norm for abstract structure in academic journals, particularly those in the social sciences (Dubova et al., 2020). However, the extent to which undergraduate students implement IMRaD structure in their thesis abstracts remains unclear

Considering the significance of abstracts in research papers and the importance of IMRaD as a framework for organizing information, it is imperative to examine the frequency with which undergraduate students are incorporating the IMRaD structure in their thesis abstracts. Hence, this study aims to analyze the percentage of each IMRaD component

that appears in the abstracts of undergraduate students' theses.

## **METHOD**

The research methodology employed in this study is content analysis, specifically focusing on the thesis abstracts written by undergraduate students. Content analysis is a systematic approach used to analyze and categorize the content of documents, enabling researchers to extract meaningful insights and identify patterns (Dumay & Cai, 2015). In this research, the primary data collection technique was document review, where thesis abstracts were collected from students who graduated from one of Indonesian private university in 2019.

The target population of this research comprised all the thesis abstracts written by students who graduated from a private university in Indonesia in 2019. There were a total of 326 thesis abstracts written by students from various faculties and study programs. To obtain a representative sample for the study, the researcher employed a simple random sampling technique by lottery. The results number of the sampling for each of the study program is presented in table 1

**Table 1. The population and sample of the study**

Faculty	Study Program	Population	Sample
Faculty of Government and Culture (FIPB)	Government Science (IP)	11	6
	Visual Communication Design (DKV)	4	4
Faculty of Teacher Training and Education (FKIP)	English Education (PBI)	3	1
Faculty of Computer	Informatics Engineering	58	10
	Information Systems	63	10
Faculty of Economics	Accounting Management (S1)	48	10
	Management (S2)	71	10
Faculty of Engineering	Civil Engineering	17	6
	Architecture	1	1
	Urban and regional planning	8	6
	Survey and Mapping	11	5
TOTAL		326	77

To initiate the data collection process, the researcher sought permission from the university administration. Once the necessary permits were obtained, the thesis abstracts were gathered according to a predetermined sample. Photographs of the thesis abstracts were taken to facilitate the subsequent analysis. The collected data were then transcribed onto a computer for further examination.

In the analysis phase, each thesis abstract was carefully read and scrutinized to identify the presence and utilization of the IMRaD (Introduction, Methods,

Results, and Discussion) structure. To ensure clarity and organization during analysis, color codes were employed to mark the sections that indicated the use of the IMRaD structure. By conducting this content analysis, the research aimed to comprehensively investigate how undergraduate students from this University implemented the IMRaD structure in their thesis abstracts, shedding light on their adherence to this conventional framework for organizing research information.

## RESULT

The analysis of the total calculation based on the participation of 77 students in this research provides valuable insights into the implementation of the IMRaD structure in thesis abstract writing. The result is presented on the table below

**Table 2 Frequency of IMRaD on Students' Abstract**

	Introduction	Methodology	Result	Discussion
N	77	70	70	31
%	100	90.9	90.9	40.26

In terms of the Introduction section, it is noteworthy that all 77 students included this component in their abstracts, representing 100% adherence to including a clear context and background for their research. This finding indicates a strong understanding among the participants of the importance of setting the stage and informing readers about the research focus and objectives.

The Methodology section also exhibited a high level of inclusion, with 70 students out of the total 77 (90.9%) incorporating this component in their abstracts. This indicates that the majority of students effectively communicated the research design and methods employed in their studies. The high percentage suggests a solid understanding and recognition of the significance of describing the research methodology within the limited space of the abstract.

Similarly, 70 students (90.9%) provided a summary of their research findings in the Results section. This demonstrates a strong compliance rate in effectively communicating the key outcomes of their research. The high percentage suggests that students were able to concisely present their research findings, enabling readers to grasp the main findings and implications.

However, the adherence to the Discussion section was relatively lower, with only 31 students out of the 77 participants (40.26%) including this component in their abstracts. The Discussion section allows for the interpretation and analysis of results, providing insights into the significance and implications of the research findings. The lower percentage suggests that there is room for improvement in incorporating this crucial section within the abstracts.

Overall, the analysis of the total calculation reveals a strong adherence to including the Introduction and Results sections in the thesis abstracts, with 100%

and 90.9% compliance rates, respectively. The Methodology section also shows a high level of inclusion, demonstrating that the majority of students effectively described the research design and methods. However, the lower percentage of students incorporating the Discussion section suggests a need for further emphasis and support in integrating this section into the abstracts.

By identifying these trends and variations in the participants' implementation of the IMRaD structure, educational institutions can focus on providing targeted guidance and support to enhance students' abstract writing skills. Emphasizing the importance of the Discussion section and providing strategies for effectively summarizing and analyzing research findings within the abstracts would contribute to improving overall adherence to the IMRaD structure. Furthermore, continuous assessment and feedback on abstract writing skills would help students recognize the significance of each IMRaD component and strive for more comprehensive and cohesive abstracts. Through these efforts, undergraduate students can develop stronger research communication skills and effectively disseminate their findings to the academic community.

#### **Faculty of Government Science and Culture**

The IMRAD analysis was conducted on a sample of 10 thesis abstracts from the

Faculty of Government Science and Culture. The results is presented as below

**Table 3. IMRaD component analysis of faculty of government science and culture**

	Introduction	Methodology	Result	Discussion
A1	√	-	√	-
A2	√	√	√	√
A3	√	√	√	√
A4	√	√	√	-
A5	√	√	√	-
A6	√	√	√	√
A8	√	√	√	-
A9	√	√	√	-
A10	√	-	-	√
Total	10	8	9	4
%	100	80	90	40

The high adherence to the Introduction section suggests that students recognize the importance of providing a clear context and background for their research. It indicates that they are able to effectively communicate the purpose and significance of their study in the abstracts. However, the relatively lower compliance with the Methodology section suggests that students may need more guidance or training in articulating the research methods used in their studies. This finding highlights a potential area for improvement in undergraduate research training, as the methodology is a crucial aspect of any research study.

The higher compliance with the Results section indicates that students are generally capable of summarizing their research findings in the abstracts. However, the lower adherence to the Discussion section suggests that students may face challenges in effectively presenting and

interpreting their results within the abstracts. The Discussion section is an important component that allows readers to understand the implications and significance of the research findings. Therefore, further emphasis should be placed on guiding students in incorporating a concise discussion of their results within the limited space of an abstract.

Overall, these findings indicate a mixed level of adherence to the IMRAD structure in the thesis abstracts of students from the Faculty of Government Science and Culture. While students demonstrate a good understanding of the Introduction and Results sections, there is room for improvement in the inclusion of the Methodology and Discussion sections. This analysis highlights the importance of providing students with clear guidelines and support to enhance their ability to effectively structure and communicate their research findings within the abstracts.

### **Faculty of Teacher Training and Education**

The IMRAD analysis was conducted on a sample of 1 thesis abstract from the Faculty of Teacher Training and Education. The results is presented as below

**Table 4. IMRaD component analysis of faculty of teacher training and education**

	Introduction	Methodology	Result	Discussion
A11	√	√	√	√
Total	10	8	9	4
%	100	80	90	40

The IMRAD analysis was conducted only on a single thesis abstract from the Faculty of Teacher Training and Education. Remarkably, this student successfully included all the components of the IMRAD structure in their abstract. The student's adherence to the IMRAD format demonstrates a high level of understanding and proficiency in organizing their research findings.

**Faculty of Computer Science**

The IMRAD analysis was conducted on a sample of 20 thesis abstracts from the Faculty of Computer Science. The results is presented as below

**Table 5. IMRaD component analysis of faculty of Computer Science**

	Introduction	Methodology	Result	Discussion
A12	√	√	-	-
A13	√	√	√	√
A14	√	√	√	-
A15	√	√	√	√
A16	√	√	√	-
A17	√	√	√	-
A18	√	√	√	-
A19	√	√	√	-
A20	√	-	√	-
A21	√	√	-	-
A22	√	√	√	-
A23	√	√	-	-
A24	√	√	√	-
A25	√	√	√	√
A26	√	√	√	-
A27	√	√	√	√
A28	√	√	√	√
A29	√	√	-	-
A30	√	√	√	-
Total	10	8	9	4
%	100	80	90	40

The results indicate a high level of adherence to the IMRAD structure in the abstracts of this student cohort. All 20 students included the Introduction section in their abstracts, demonstrating a strong understanding of the importance of providing a clear context and background for their research.

Furthermore, the Methodology section was present in the abstracts of 19 out of the 20 students, suggesting a high compliance rate in articulating the research methods used in their studies. This finding indicates that students in the Faculty of Computer Science possess a good grasp of describing their research methodology within the abstracts.

In terms of the Results section, 16 students provided a summary of their research findings in their abstracts. While this indicates a relatively lower compliance rate compared to the Introduction and Methodology sections, it still reflects a considerable majority of students effectively communicating their research outcomes.

However, the adherence to the Discussion section was relatively lower, with only 6 out of the 20 students incorporating this component in their abstracts. The Discussion section is crucial as it allows students to interpret and analyze their results, highlighting the significance and implications of their research findings.

These findings suggest that while students in the Faculty of Computer Science

excel in including the Introduction and Methodology sections in their abstracts, there is room for improvement in incorporating the Results and Discussion sections. Emphasizing the importance of summarizing research findings and providing an interpretative discussion within the limited space of an abstract could help enhance adherence to the IMRAD structure in these sections.

Overall, the IMRAD analysis of the thesis abstracts from the Faculty of Computer Science highlights a generally strong adherence to the IMRAD structure, particularly in the Introduction and Methodology sections. However, attention should be given to further encouraging students to include the Results and Discussion sections in their abstracts. By providing clear guidelines and support, students can effectively communicate their research findings, enhancing the overall quality and clarity of their abstracts.

**Faculty of Economics**

The IMRAD analysis was conducted on a sample of 27 thesis abstracts from the Faculty of Economics. The results is presented as below

**Table 6. IMRAD component analysis of faculty of Economics**

	Introduction	Methodology	Result	Discussion
A32	√	√	√	-
A33	√	√	√	-
A34	√	√	√	-
A35	√	√	√	-
A36	√	√	√	-
A37	√	√	√	-
A38	√	√	√	√

A39	√	√	√	√
A40	√	√	√	-
A41	√	√	√	√
A42	√	√	√	-
A43	√	√	√	-
A44	√	√	√	-
A45	√	√	-	-
A46	√	√	√	√
A47	√	√	√	√
A48	√	√	√	-
A49	√	√	√	-
A50	√	√	√	-
A51	√	√	√	√
A52	√	√	√	√
A53	√	√	√	√
A54	√	√	√	√
A55	√	√	√	√
A56	√	√	√	-
A57	√	√	√	-
A58	√	√	√	-
Total	27	27	26	10
%	100	100	96	37

The results indicate a high level of adherence to the IMRAD structure in the abstracts of this student cohort. All 27 students included the Introduction section in their abstracts, demonstrating a strong understanding of the importance of providing a clear context and background for their research.

Additionally, the Methodology section was present in the abstracts of all 27 students, indicating a high compliance rate in articulating the research methods used in their studies. This finding suggests that students in the Faculty of Economics possess a good grasp of describing their research methodology within the abstracts.

In terms of the Results section, 26 students provided a summary of their research findings in their abstracts. This reflects a majority of students effectively

communicating their research outcomes and complying with the IMRAD structure. However, the adherence to the Discussion section was relatively lower, with only 10 out of the 27 students incorporating this component in their abstracts. The Discussion section is crucial as it allows students to interpret and analyze their results, highlighting the significance and implications of their research findings.

These findings suggest that while students in the Faculty of Economics excel in including the Introduction and Methodology sections in their abstracts, there is room for improvement in incorporating the Results and Discussion sections. Emphasizing the importance of summarizing research findings and providing an interpretative discussion within the limited space of an abstract could help enhance adherence to the IMRAD structure in these sections.

Overall, the IMRAD analysis of the thesis abstracts from the Faculty of Economics indicates a generally high adherence to the IMRAD structure, particularly in the Introduction and Methodology sections. However, attention should be given to encouraging students to include the Results and Discussion sections in their abstracts. By providing additional guidance and support, students can effectively communicate their research findings and enhance the overall quality and clarity of their abstracts.

### Faculty of Engineering

The IMRAD analysis was conducted on a sample of 18 thesis abstracts from the Faculty of Engineering. The results is presented below

**Table 7. IMRaD component analysis of faculty of Engineering**

	Introduction	Methodology	Result	Discussion
A59	√	√	√	-
A60	√	-	√	√
A61	√	√	√	√
A62	√	-	√	√
A63	√	√	√	√
A64	√	-	√	√
A65	√	√	√	-
A66	√	√	-	√
A67	√	√	√	-
A68	√	√	√	-
A69	√	√	√	-
A70	√	√	√	-
A71	√	√	√	-
A72	√	√	√	-
A73	√	-	-	√
A74	√	√	√	-
A75	√	√	√	-
A76	√	√	√	√
A77	√	√	√	√
Total	18	14	16	8
%	100	77	88	44

The results indicate varying levels of adherence to the IMRAD structure among the students in this cohort. All 18 students included the Introduction section in their abstracts, demonstrating a strong understanding of the importance of providing a clear context and background for their research.

However, the Methodology section was present in the abstracts of only 14 out of the 18 students, indicating a lower compliance rate in articulating the research methods used in their studies. This finding

suggests that there is room for improvement in effectively describing the research methodology within the abstracts among students in the Faculty of Engineering.

In terms of the Results section, 16 students provided a summary of their research findings in their abstracts. This indicates a relatively high compliance rate and demonstrates that the majority of students effectively communicated their research outcomes within the limited space of the abstract.

The adherence to the Discussion section was relatively lower, with only 8 out of the 18 students incorporating this component in their abstracts. The Discussion section is important as it allows students to interpret and analyze their results, highlighting the significance and implications of their research findings.

These findings suggest that while students in the Faculty of Engineering demonstrate a good understanding of including the Introduction and Results sections in their abstracts, there is room for improvement in incorporating the Methodology and Discussion sections. Emphasizing the importance of clearly describing the research methodology and providing an interpretative discussion of the results within the abstracts could help enhance adherence to the IMRAD structure in these sections.

Overall, the IMRAD analysis of the thesis abstracts from the Faculty of Engineering highlights both strengths and areas for improvement. While the

Introduction and Results sections are generally well-represented, there is a need to focus on enhancing the inclusion of the Methodology and Discussion sections. By providing additional guidance and support, students can effectively structure and communicate their research findings within the abstracts, improving the overall quality and coherence of their work.

## **DISCUSSION**

The findings of the IMRaD analysis, as observed across different faculties, resonate with established principles in academic writing, which have been echoed by various scholars. Malini (2022) emphasizes the critical role played by abstracts as the initial point of engagement with readers, underlining their potential to significantly influence interest in the research. This aligns with the 100% adherence to the Introduction section across all faculties, signifying a shared awareness among students regarding the importance of establishing a clear context for their research.

The high levels of adherence to the Methodology and Results sections, particularly in faculties such as Computer Science and Economics, align with the scholarly discourse advocating for well-structured scientific abstracts. Cusen (2018) and Vyas & Panara (2016) argue that structured abstracts, such as those following the IMRaD format, facilitate efficient literature review and enable readers to swiftly navigate and identify relevant content. These findings suggest

that students in these faculties have internalized the significance of conveying research methods and key findings succinctly, as advocated by academic literature.

Nevertheless, the challenge of incorporating the Discussion section, observed across all faculties, aligns with the broader literature discussing the difficulty of crafting concise yet comprehensive abstracts (Moerdisuroso & Kherid, 2020). The lower inclusion of the Discussion section suggests a common struggle among students in providing interpretative elements within the limited space of an abstract.

The exceptional case in the Faculty of Teacher Training and Education, where a single student successfully included all IMRaD components, underscores the potential for students to grasp and apply the IMRaD structure effectively. This supports the assertion that providing students with sufficient guidance on appropriate abstract structure is imperative (Moerdisuroso & Kherid, 2020). It also highlights the need for tailored support in different faculties, as emphasized by Dubova et al. (2020), Oriokot et al. (2011), and others who stress the importance of recognizing and addressing discipline-specific challenges.

In conclusion, the consistent need for improvement in integrating the Discussion section, as identified across various faculties, emphasizes the importance of targeted interventions in undergraduate education. Faculty-specific workshops,

mentorship programs, and ongoing assessment mechanisms, as advocated by Masic (2018) and Shah (2020), can contribute to refining students' abilities to effectively structure and communicate their research findings within the constraints of an abstract.

## CONCLUSION

This research aimed to investigate the implementation of the IMRaD (Introduction, Methodology, Results, and Discussion) structure in the thesis abstracts written by undergraduate students. Through an analysis of thesis abstracts from various faculties, namely the Faculty of Government Science and Culture, Faculty of Teacher Training and Education, Faculty of Computer Science, Faculty of Economics, and Faculty of Engineering, the study provided insights into the extent to which students adhered to the IMRaD structure.

The findings revealed varying degrees of compliance with the IMRaD structure among the different faculties. In terms of the Introduction section, a high level of adherence was observed across all faculties, indicating students' recognition of the importance of providing a clear context and background for their research. The majority of students included this section in their abstracts, enabling readers to grasp the main focus and objectives of their studies.

The Methodology section, which outlines the research design and methods employed, exhibited slightly lower

adherence rates. While students in some faculties, such as the Faculty of Teacher Training and Education and Faculty of Computer Science, demonstrated a commendable inclusion of the Methodology section, there is still room for improvement in other faculties. Emphasizing the significance of describing the research methodology within the abstracts would contribute to enhancing adherence to the IMRaD structure.

The Results section, summarizing the key findings of the research, displayed a relatively high level of compliance among students in most faculties. This indicates that students were able to effectively communicate their research outcomes within the limited space of the abstract. However, there were variations across faculties, suggesting the need for consistent guidance and support to ensure students' consistent inclusion of this important section.

On the other hand, the Discussion section, which allows for the interpretation and analysis of results, showed lower levels of adherence across all faculties. While some students incorporated this section in their abstracts, the majority did not. Encouraging students to provide an interpretative discussion of their results within the abstract would enhance the overall quality and completeness of their research communication.

The implications drawn from the total score data provide valuable insights into the implementation of the IMRaD structure in undergraduate students' thesis

abstracts. Firstly, the high percentage of participants including the Introduction, Methodology, and Results sections indicates that students possess a strong understanding of the foundational elements required in abstract writing. This suggests that educational institutions have been successful in imparting knowledge and emphasizing the importance of these sections in research communication.

However, the lower percentage of participants incorporating the Discussion section highlights an area for improvement. The Discussion section plays a critical role in presenting the interpretation and implications of research findings. Its limited inclusion suggests a need for enhanced emphasis on the significance of this section during the research process. Educational institutions should focus on providing additional guidance and support to students in effectively integrating the Discussion section within the constraints of an abstract.

Moreover, the variations observed across different faculties shed light on the potential influence of disciplinary factors on abstract writing. Understanding these variations can guide faculty-specific interventions to address any shortcomings in implementing the IMRaD structure. Faculty-specific workshops, mentorship programs, and writing resources can be tailored to meet the specific needs and challenges faced by students in each discipline.

Overall, this research highlights the importance of promoting and training

undergraduate students in the use of the IMRaD structure for writing their thesis abstracts. The IMRaD framework provides a systematic and effective approach to organize research information and facilitate clear communication of key elements within a concise abstract.

The findings of this study contribute to the understanding of the current practices in abstract writing among undergraduate students. By identifying areas of improvement, educational institutions can focus on providing comprehensive guidance and support to students, emphasizing the significance of adhering to the IMRaD structure in their abstracts.

It is recommended that faculty members and instructors play an active role in training students on the IMRaD structure, emphasizing its importance and benefits. Workshops, seminars, and writing support programs can be organized to enhance students' knowledge and skills in abstract writing. Furthermore, integrating the IMRaD structure into the undergraduate curriculum would ensure that students receive early exposure and practice in utilizing this framework effectively.

The research also highlights the need for ongoing assessment and monitoring of students' abstract writing skills. This could be achieved through regular evaluations and feedback sessions, providing students with valuable insights for improvement. By continuously assessing and enhancing abstract writing skills, students will be

better prepared to effectively communicate their research findings to a wider audience.

In conclusion, this research emphasizes the significance of the IMRaD structure in undergraduate thesis abstract writing. The findings demonstrate the varying levels of adherence to the IMRaD components across different faculties, indicating the need for targeted interventions and support. By emphasizing the importance of each section and providing comprehensive guidance, universities can enhance students' understanding and implementation of the IMRaD structure. This, in turn, will contribute to improved research communication and the dissemination of valuable knowledge in the academic community

#### **AUTHOR CONTRIBUTION STATEMENT**

All authors, AP, BU, RH, conceived and designed the study. AP devised the main conceptual idea and took and analyzed the data with input from BU and RH. BU contributed to the manuscript writing, revising, and responding to the review process of the journal.

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