

## An Investigation of the Use of the IMRAD Format for Biology Students' Laboratory Reports

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### Abstract

*Academic discourse serves as a platform for the systematic communication of scientific findings, with laboratory reports being a primary type employed by researchers and students. These reports follow specific conventions and formats, ensuring clarity and credibility in scientific communication. This study investigates the organizational structure of English-language Biology laboratory reports, focusing on students' adherence to the Introduction, Methods, Results, And Discussion (IMRAD) model. After compiling a corpus of fifty Biology students' laboratory reports from Ouargla University, Algeria, the researchers adopted a qualitative approach and a thematic analysis of data. The results revealed overall adherence to the IMRAD format, with minor variations, notably variations in subheadings within the Methods section, transitions between sections, and the structure of the Discussion section, reflecting disciplinary norms. These findings suggest opportunities for teachers to explicitly address the nuances of IMRAD structure and writing conventions within the domain of Biology. By comprehending how students apply this model, instructors can design more effective lessons and writing instructions that foster clarity and disciplinary understanding in laboratory report writing. This study emphasizes the importance of exploring the impact of explicit instruction on the quality of student writing and understanding of IMRAD conventions. It is recommended that these variations be further explored in order to enhance the comprehension of students' communication skills, thereby improving their writing quality in the academic landscape. Additionally, this research stresses the importance of exploring the impact of explicit instruction on student writing quality and understanding of IMRAD conventions.*

**Keywords:** *academic discourse, Biology, disciplinary norms, IMRAD model, laboratory reports.*

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## Introduction

In the field of Biology, laboratory reports are essential components of academic discourse and are crucial for disseminating scientific research findings. These reports act as a medium for researchers and students to communicate their experimental designs, results, and conclusions (Penrose & Katz, 2004). The effective communication of scientific findings is not only contingent on the accuracy and validity of results but also depends heavily on the obvious and organized presentation of data within laboratory reports (Swales & Feak, 2004). Thus, ensuring effective scientific communication requires understanding the organizational structure of these reports.

In the sphere of academic discourse, laboratory reports occupy a vital position as they give a thorough account of the research procedures, enabling other researchers to assess, replicate, and build upon the findings (El-Serag, 2012). The organizational structure of laboratory reports plays a fundamental role in facilitating and promoting this communication by offering a standardized framework for presenting research outcomes. Scholars have extensively deliberated on this matter as underscored in the comprehensive discourse by Carter et al. (2007, p. 295) claiming that lab reports “encode a scientific way of knowing in its structure”. The extensively acknowledged IMRAD (Introduction, Methods, Results, And Discussion) model serves as a cohesive framework to structure laboratory reports, assuring uniformity and enhancing understanding across diverse studies. By adhering to the IMRAD model, researchers and students can clearly communicate the purpose of their study, describe the methodology used, present the results obtained, and engage in a critical analysis and interpretation of these results. The logical flow of information in laboratory reports makes it easy for readers to follow the research process, comprehend the rationale of the study, judge the reliability of the findings, and assess their implications.

In the field of Biology, where intricate experiments and analyses are typical, understanding the format of laboratory reports is highly important. The varied nature of biology research calls for clear and organized reporting in order to transfer complex scientific concepts and methodologies adequately. The primary focus of the present study is on the English-language biology laboratory reports organization following the IMRAD model, as it has been proven that it paves the way to disseminate and understand the research conducted on a scientific issue. Pechenik (1993) and Parkinson (2017) stated that a well-organized laboratory report allows researchers to present their work in a succinct and coherent manner facilitating knowledge diffusion, advancing the field, and encouraging researchers' collaboration.

Given that the laboratory report and its organizational structure play a central role in the overall framework of tertiary science, specifically the field of Biology, the examination of scientific laboratory reports written in English by Algerian students at Ouargla University becomes significantly vital. Building upon this necessity and considering the fact that this issue is not widely investigated in the local Algerian context, this research aims at examining the adherence of students to the IMRAD model in this specific context in order to help instructors design their lessons and writing instructions to improve the writing quality in the academic landscape. To this end, this study intends to answer the following research question:

In what ways do Biology students at Ouargla University, Algeria organize sections and subsections in their English-language laboratory reports, following the IMRAD model?

In the light of this research question, this paper examines the proposition of whether students in the Biology program at Ouargla University, Algeria adhere to the IMRAD model when writing laboratory reports. It explores how these reports incorporate nuanced adjustments shaped by the specific demands of the discipline.

By examining Algerian biology students' adherence to the IMRAD format in structuring their laboratory reports, this article aims at making a substantial contribution to improve students' writing and organizing skills of scientific papers, mainly laboratory reports in the Algerian context. It may provide researchers with an adequate picture about scientific writing practices in the field of Biology, particularly for non-native English speaking researchers to improve their practice in using English as a medium to communicate their research findings. Additionally, since this research will illuminate the writing strategies employed by both researchers and students in writing this genre, this understanding can empower educators to develop targeted English for Specific Purposes (ESP) writing support programs that cater to the specific needs of biology students seeking to publish scientific papers in English. By providing focused assistance in ESP, these programs can equip students with the language skills and knowledge of academic writing conventions required for effective communication in their scientific field. This enhanced communication ability will empower students to effectively convey their research findings and ultimately enhance their academic performance.

## **Literature Review**

### **Academic Discourse as a Medium for Disseminating Research Findings**

According to Nair and Nair (2014, p. 14), "communication is crucial to the development of science". Because previous scientists and researchers regularly reported their findings, the entire world is aware of their work. Writing or speaking about research aids in the clarification of the obtained ideas and the presentation of research within a larger context. As a result, sharing research findings is an essential component of the research process. As a matter of fact, unless the findings are effectively shared, a research project is not deemed finished. The best-known method of accomplishing this step is through a well-written academic discourse that adequately presents the investigation. Hyland (2009) confirms this point considering that "academic discourse refers to the ways of thinking and using language which exists in the academy. Its significance, in large parts, lies in the fact that complex social activities like educating students, demonstrating learning, disseminating ideas, and constructing knowledge rely on language to accomplish" (Hyland, 2009, p. 17). He regards academic discourse as the dominant mode of education and knowledge transfer. A major type of academic discourse used among researchers investigating scientific issues to present their findings is the laboratory report.

Laboratory reports are of great importance in the researcher's academic journey. Pechenik (1993) asserts that "if you are contemplating a career in research, be assured that learning to write effective research reports now is an investment in your future. As a laboratory technician or research assistant, you will often be asked to share what you have obtained from your research. If you eventually pursue a research M.S. or PhD, you will find that a graduate thesis is essentially a large laboratory report" (pp. 144-145). Pechenik's assertion justifies the need for learning how to write and organize laboratory reports for both researchers' personal academic achievements and knowledge proliferation. In fact, in their academic career, students hardly ever need to be skilled storytellers and writers of personal narrative. What they actually need is to improve their ability to convey academic knowledge and research findings. More importantly, students' ability to create academic writing of at least a passable quality within the framework of academic discourse expectations frequently determines their success as university students who will be future researchers (Hinkel, 2003). Thus, successful written academic discourse, especially in the scientific disciplines, is highly valued as professional preparation.

## **Laboratory Reports**

Investigation and experimentation are the heart of science education. Students are encouraged to investigate, form hypotheses, and test their theories both in the classroom and out in the real world. Students are expected to discuss and report their processes and outcomes as they engage in scientific inquiry. Within a biological laboratory report, which is one of the different genres prevalent in scientific disciplines, students are required to write and organize their reports according to the writing norms of this discipline in order to meet the intended communicative purposes.

The student laboratory report, which summarizes experimental work, is the most common genre of instructional writing among students studying science and engineering (Gardner & Nesi, 2013). Disciplines within the sciences, including physics, biology, engineering, and chemistry are most likely to incorporate laboratory reports into their assignments as a way to share certain work results. Since genres are specific uses of language for a special and specialized context. Numerous scholars like Swales & Feak (1994) and Bhatia (2004) consider science student laboratory reports as a type of genre which is designed specifically for the purpose of planning and summarizing scientific inquiries conducted in science laboratories and beyond. Based on what is stated above, it can be concluded that a report's practical goal is to provide a thorough summary of the findings. Students should be able to explain what they did, why they did it, and how. Colleagues in the field "should learn something from the results" (Artus et al., 2016, p. 5) because laboratory reports are viewed as "the appropriate way to express and share empirical findings" (Parkinson, 2017, p. 2). This highlights the necessity to present the research findings following an organizational structure that is ample and digestible for the scientific community.

## ***The Structure of the Student Laboratory Report***

Since students' laboratory reports, in this paper specifically biology laboratory reports, reflect the logic of a scientific claim, they are very likely to follow a special content-organizing structure. For McMillan (2012), within the science's main body, the student or researcher initiates by articulating the aim of the investigation, contextualizing the work within a broader scientific framework (introduction). Subsequently, the procedure is detailed (methods), followed by the presentation of findings (results) and their interpretation (discussion). He adds, "As a student of biology, you will use the same organizational method for research projects and laboratory reports" (p. 61). From McMillan's (2012) claim, it can be deduced that biology students' laboratory reports are likely to follow the IMRAD organizational format that provides a structured skeleton for organizing the findings of scientific studies. However, Kalaskas (2013) concludes from his study that "students' feelings of frustration towards laboratory reports are caused by being unsure of how a laboratory report is organized and structured, and why it matters in science in the first place" (p. 115). This underscores the importance of the student laboratory report and its structure as a subject of investigation.

## **The IMRAD Format as a Laboratory Report Model of Organization**

For researchers in general and students of scientific fields in particular, the three most important foreign language writing skills for effective academic writing are "discourse and information organization, standard written English, since it is the international language of science, and vocabulary" (Hinkel, 2003, p. 20). That is to say, the organizational structure and the quality of writing, mainly in English, are important tools in the students' toolbox, enabling them to effectively generate data and communicate their results (Schimel, 2012). This is especially important when their writings are presented to readers who often read in a manner that is not linear, but rather "modular", where they "skip around, seeking specific information in predetermined sections" (Sollaci & Pereira, 2004, p. 366).

Indeed, today, the majority of scientific papers, including laboratory reports, adopt the IMRAD format as the standard plan, which represents the acronym formed from the initial letters of the words Introduction, Methods, Results, And Discussion (Nair & Nair, 2014). The term IMRAD refers to a format or a pattern instead of the words embodied by the abbreviation. Nair & Nair (2014, p. 14) claim that "with the American National Standards Institute adopting the term as the standard, first in 1972 and again in 1979, it has become the choice of most scientific papers and research journals".

The IMRAD organizational structure dictates the content of each section in order to convey appropriately the communicative purpose of the scientific paper; in this article it is the student laboratory report in the domain of Biology.

*Introduction (I):* in this section, students include a background of the study, explain the addressed problem and the key concepts involved in the experiment. In addition to clearly stating the research hypothesis and objectives, this part also can include a short literature review about what has been done on the topic.

*Methods (M)*: this section's goal is to clearly and concisely explain the performed action, data analysis procedures, and the way they were presented. This section should contain all the details required for another researcher to evaluate the study or replicate the experiment since the Methods section is considered as "the narrowest part of the research paper or the laboratory report" (Swales & Feak, 2004, p. 156). It is important to note that the subheadings within this part may differ based on the discipline for which students are writing or the chosen experimental design (Sollaci & Pereira, 2004).

*Results (R)*: the new knowledge is offered in this section, which makes up the paper's main body. It is worth mentioning that the Introduction and Methods sections aim to explain why and how the researcher arrived at the information presented in this part, while the Discussion section will then clarify its significance. The Results section content, which delineates the paper's worth, must be presented in "an absolutely clear manner in just the right number of words" (Nair & Nair, 2014, p. 20).

*Discussion (D)*: this is the last section of the paper, preceding references or any appendices. It is the section where students elaborate on whether their hypothesis was confirmed or not, and where they dedicate efforts to elucidating the significance of their findings for the reader by locating the results within the existing literature.

In general, it is agreed on that the IMRAD model offers a consistent blueprint that directs researchers and students to address a number of issues that are necessary for comprehending a scientific study in an organized manner.

### **Non-native English Speaking Students' Challenges in their Scientific Writing Practice**

Non-native English-speaking students face various challenges when writing their scientific research papers. These difficulties entail challenges in constructing literature reviews and in citation conventions (Li et al., 2023), English and academic self-efficacy (Wang et al., 2017), linguistic expression complexities in scientific writing (Lu et al., 2019), and the additional difficulty of writing articles in a second language (Hanauer & Englander, 2011). Moreover, non-native English speakers face hurdles pertaining to information literacy (Lu et al., 2019; Zhao & Mawhinney, 2015). Overall, non-native English speaking students find themselves in a less favorable position within the sphere of international publishing due to these challenges (Yang et al., 2021).

Considering the Algerian educational system's shift towards incorporating English in educational institutions and research writings, it is of paramount importance to raise the issue that non-native English speaking students may face multifarious challenges not only in expressing their research in English but also in organizing their scientific papers, including lab reports due to disciplinary requirements. As students strive to accurately communicate their ideas, methods, and findings in English, which is neither the language of their specialization nor their native language, language proficiency becomes increasingly important (Schimel, 2012). On top of that, they are confronted with the task of successfully navigating the specific demands and anticipated standards within the field of study, for instance, in Biology, the manner in which laboratory reports are structured and organized can differ across scientific disciplinary norms.

## **Empirical Research on Laboratory Reports**

The organization of laboratory reports in the field of Biology has a pivotal role in enhancing communication within scientific research. Although extensive research has been carried out on scientific writings, there is a relative dearth of studies specifically devoted to examining the organizational structure of laboratory reports, especially in the Algerian context. Mosquera & Quevedo-Hidalgo's (2020) investigation of the difficulties faced by researchers in the presentation of their written laboratory reports in science education offers insightful information about the format of reports. They found that some sections like the introduction, the methods, the results, and the discussion frequently exist in student reports. In addition, they raise the issue of students' difficulty in articulating these sections. However, they do not address the way non-native English speaking students organize the sections following the IMRAD model. Another study was conducted by Vieira et al. (2019) on the discussion section of scientific research articles in different scientific domains. Although their research was not focused on laboratory reports specifically, it did shed light on the organizational characteristics and variations in scientific texts, leaving a gap in comprehending the modifications and adaptations found in laboratory report discussion sections. Additionally, Parkinson (2019) contends that students of sciences use personal pronouns in their laboratory reports to refer to themselves and they utilize obligation/necessity modal verbs to indicate their actions and decisions arising from the necessities of the experimental work. Despite the fact that the study offers valuable data about the grammatical features of laboratory reports, it does not particularly address how non-native English speaking students organize their laboratory reports.

On reviewing and examining the results obtained from some prior studies, it becomes apparent that the existing body of research highlights how scientific texts are generally structured, how disciplinary practices differ, and how writing assignments affect students' learning. Yet, the literature conveying these issues is scarce to the best of the researchers' knowledge. Consequently, more research is required, with a specific emphasis on the organizational structure of English-language laboratory reports and its variations within the IMRAD format in order to communicate proficiently research results within the scientific community.

## **Method**

### **The Research Approach**

The researchers adopted a qualitative approach to gain in-depth insights about the organizational structure of the English-language laboratory reports written by students of Biology in Ouargla University. This type of approach typically focuses on the systematic portrayal and the examination of the characteristics of a phenomenon or a subject in a detailed manner (Creswell & Creswell, 2017). It enables deep examination of a certain instance or cautiously selected cases (Gilbert & Stoneman, 2015).

## **The Corpus of the Study**

The corpus of the study consisted of fifty laboratory reports that were written in English by students at Ouargla University, Algeria during this specific academic year 2022-2023, because during previous years students at Algerian universities predominantly relied on the French language in their scientific writings, but from this year they started adopting the English language in their writings. For the purpose of creating a balanced corpus and ensuring the credibility and reliability of the research results, a random selection was made of an equal number of laboratory reports from Biology sub-disciplines taught at Ouargla University. To clarify further, ten laboratory reports were chosen randomly from Agricultural Sciences, Microbiology, Marine and Continental Hydrobiology, Biochemistry, and Plant Biotechnology. By using a diverse corpus, the study aimed at capturing a wide range of writing practices and organizational patterns that emerge across various contexts and different disciplines. The length of reports varied, ranging roughly from 6 to 10 pages, depending on the type of research, the type of discipline, the scope of investigation, the level of detail required, the experimental design adopted, and the specific guidelines provided to students.

## **Data Analysis**

The study employed an inductive thematic analysis to analyze the corpus. One crucial feature of thematic data analysis lies in its ability to enhance the validity of the analysis, attributed to its accessibility, transparency, and flexibility (Braun & Clarke, 2006). The analysis of the corpus followed Braun and Clarke's (2006) six-phase framework. The analysis was devoted to identifying patterns, variations, and adaptations within the organizational structure of students' laboratory reports, following the IMRAD model.

## **Ethical Considerations**

Participants received detailed information about the investigation aim. Informed consent to the use of laboratory reports was obtained from all participants. Students agreed to provide their reports for analysis, supporting the aim of the research. The ethical principles of research were strictly respected throughout the whole research process to guarantee the confidentiality and anonymity of the participants. The laboratory reports utilized in the analysis were cautiously anonymized, eliminating any identifying information that might jeopardize the students' privacy.

## **Results and Discussion**

The themes and sub-themes that emerged from the analysis process are presented in Table 1 below. Detailed explanations, exemplifications and discussions are provided for each theme and sub-theme.

Table 1

*Themes and sub-themes emerging from data analysis*

| Theme                                                                  | Sub-themes                                   |
|------------------------------------------------------------------------|----------------------------------------------|
| Adherence to the IMRAD Model                                           | Variations in Section Length                 |
| Variances in Subheadings within the Laboratory Reports Methods Section | Labelling Subheadings                        |
| Transitions between Sections                                           | The Arrangement of Subheadings               |
|                                                                        | The Use of Linking Phrases                   |
|                                                                        | Referencing Previous Sections                |
| Structure of the Discussion Section                                    | Data Analysis and Interpretation             |
|                                                                        | Locating Findings in the Existing Literature |
|                                                                        | Stating Limitations                          |

### **Adherence to the IMRAD Model**

Students of Biology at Ouargla University structure their laboratory reports according to the IMRAD pattern. That is to say, they start their reports with an Introduction followed by the Methods, Results, and Discussion sections, which is in line with Artus et al.'s (2016) instructions concerning writing and organizing laboratory reports. In the Introduction section, students briefly presented background information about the research variables, stated the research question, the hypothesis, and the objectives as well as clarifying the key scientific concepts involved in the experiment. Next, they gave a thorough account of the experimental design and materials used, and the experimental steps in the Methods section. Then, they clearly and concisely presented the findings of the experiment, including the data, the figures, and the statistical analyses in the Results section. Finally, they devoted the Discussion section to explaining and discussing the findings, incorporating them within the existing body of knowledge and addressing any limitations in addition to drawing conclusions about the studied issue. With this content organization, they support Swales & Feak's (2004) assertion regarding the writing of the content of these sections. Moreover, with the adherence to the IMRAD pattern in structuring their reports, students of Biology at Ouargla University ensured a logical flow of information that enables readers to navigate the report effortlessly, in accordance with Sollaci & Pereira's (2004) claim.

However, although students generally adopt the IMRAD model, a clear difference can be detected. This difference can be traced back to disciplinary conventions and specificities.

### **Variations in Section Length**

Some fields of Biology such as Agricultural Sciences prioritize and value the experimental process of research due to the sensitivity and research nature in this field in which pieces of research are likely to be replicated by researchers, if necessary, in order to

find solutions to uncovered issues addressed by this domain. Thus, providing sufficient explanation about the methodological and experimental protocol paves the way for researchers to decide which conditions should be changed in the intended research (Nair & Nair, 2014). Hence, in this case, the greater length of the Methods section in the students' laboratory reports, highlighting all the steps adopted in the methodological phase. One illustrative example of a laboratory report conforming to this observation is a detailed description of the adopted experimental design to investigate the quality of dates in stocks in the Ouargla region. This part includes a "presentation of the study context, description of stocks, justification of choice, sample collection, attack rate of dates in stock, physio-chemical study, PH determination, electrical conductivity determination, and simulation test of favorable conditions for pest installation in storage location" (students' laboratory reports, Agricultural Sciences, Ouargla University, 2023). It should be noted that the students who are working in such fields of Biology amplified the clarification of the selected experimental designs.

Overall, the stated variation can be justified by disciplinary norms and the unique features of the research because it was observed in laboratory reports rather than other genres of different domains of Biology. Adherence to the IMRAD model assures a clear and coherent communication of scientific findings, while the slight difference displays the flexibility needed to accommodate disciplinary factors.

### **Variances in Subheadings within the Laboratory Reports' Methods Section**

The examination of the Methods section revealed differences in the subheadings within Biology laboratory reports in Ouargla University. Variations are noticed at the level of labelling and arrangement of subheadings, reflecting diverse options in the experimental approaches and different research objectives.

#### ***Labelling Subheadings***

Students of Biology across different subfields in Ouargla University employed a variety of labels for the Methods section subheadings. The frequently used subheadings observed in the corpus are Materials and Apparatus, Biological Materials / Experimental Design, Experimental Protocol, Experimental Site, Preparation of the Experiment / Data Collection Procedures, Data Collection Phases / Experimental Measurements, Statistical Analysis, Exploitation of the Results (students' lab reports, Microbiology, Biochemistry, Plant Biotechnology, Marine and Continental Hydrobiology, Ouargla University, 2023). Therefore, variations are extensively detected in the language and the terminology used to label the stated subheadings. The current researchers noticed that the labels vary with the change in the type of biological discipline that students are working on. The aforementioned findings align with Council's (2009) claim that the type of scientific discipline can somewhat influence the wording of headings and subheadings when researchers report their research outcomes.

## **The Arrangement of Subheadings**

In the context of this research, the arrangement of subheadings of the Methods section in the laboratory reports denotes the sequential order of several subsections or categories. The analysis revealed that the arrangement of these subheadings varies in Biology reports. In the process of writing scientific papers, including laboratory reports, the sequence of headings and subheadings of sections can differ. This variability, as suggested by Swales & Feak (2004) and McMillan (2012), is influenced by many factors, mainly the researchers' and the students' experimental design or the focus of their research. To illustrate, in the analyzed corpus, students of Marine and Continental Hydrobiology started the Methods section of their laboratory reports with the sample preparation and experimental design, followed by subheadings dedicated to data collection procedures and research tools, concluding with statistical measurements and data interpretation. By contrast, other students in the same field but with different research objectives adopted a distinct order, starting with data collection, moving to sample preparation, and experimental design, finishing with analytical methods. The different arrangements of subheadings mirror the unique decision-making process and research objectives of individual students. Different experimental designs or research objectives can necessitate a different sequencing of subheadings to assure clarity and logical flow within the Methods section.

## **Transitions between Sections**

Essentially, coherence and the flow of ideas in laboratory reports are greatly influenced by the use of transitions between sections. Therefore, transitions are essential to guide readers in their understanding of reports and roadmap the organization of them (Hyland, 2008; Swales & Feak, 1994). Students confirm this viewpoint by demonstrating a skillful use of transitions between sections of their Biology laboratory reports. They make use of linking phrases and they reference the previous sections of their reports.

## **The Use of Linking Phrases**

Students of Biology in Ouargla University displayed a good use of linking phrases to create seamless transitions between sections. The connecting words act as guideposts that logically direct readers through the whole report. By using words and phrases such as 'moreover, in addition, also, furthermore, in contrast...', they can establish relations and demonstrate the interconnectedness of different sections. Some examples from the corpus are "in addition, the results of the experiment are...", "moreover, the sample of the research demonstrated a quick reaction to the used reagent", "besides, the methods opted for discussing the results will highlight the significance of the research as a whole" (students' laboratory reports, Microbiology, Biochemistry, Plant Biotechnology, Ouargla University, 2023).

## Referencing Previous Sections

Students demonstrated the ability to connect the current section to previous sections in their laboratory reports. By referencing sections of reports, they ensure continuity and progression between several parts of the text. This can be done, for instance, by referring to the discussion section when stating the implications of the research or building upon the introduction section in the discussion section. Some instances of this in the corpus are "with previous research mentioned above in the report, this result indicates that ...", "basing on the findings discussed in the discussion section, the conclusion now will provide some implications" (students' laboratory reports, Microbiology, Biochemistry, Ouargla University, 2023).

In total, students' use of effective section transitions in Biology laboratory reports in Ouargla University improves the text's smooth flow and comprehensibility since they pave the way to the logical progression of ideas and indicate the relationship of various sections to one another in the report.

## The Structure of the Discussion Section

The discussion section has a decisive role in research papers, including laboratory reports, because this is the section "where the authors explain meanings of results, state whether or not the hypothesis is confirmed, interpret the results in the light of known facts, and show the importance and the value of the work" (Nair & Nair, 2014, p.21). That is why "it is the longest part of the report" (Pechenik, 1993, p.151). Students generated a consistent structure of the Discussion section of their laboratory reports, validating the standpoint of the aforementioned scholars. A notable trend observed among students of Biology at Ouargla University is their inclination to focus the Discussion section of their reports on the following:

## Data Analysis and Interpretation

In this part, students discussed their research results and explained their significance in relation to their research question and hypothesis. The level of detail and the depth of analysis change depending on the complexity of the results and the objectives of the whole work. Some examples found in the students' laboratory reports include statements such as "the obtained data run counter to the suggested hypothesis", "analysis of data revealed that there is a negative correlation between pest quantity and date well state", "the results obtained are significant in improving the used products to test this phenomenon" (students' laboratory reports, Biochemistry, Plant Biotechnology, Marine and Continental Hydrobiology, Ouargla University, 2023).

## Locating Findings within the Existing Literature

Students, in their reports, provided contexts and made connections with the larger body of scientific knowledge by discussing how their findings related to or diverged from those of earlier studies. To exemplify this point, the following are some extracts from the

analyzed corpus: "the PH obtained in the present study for Deglat=5.6 is close to the PH obtained by Munier (1973)", "compared to Berhanu (2020), our results are superior", "our results support those obtained by El Hacı et al. (2017)" (students' laboratory reports, Plant Biotechnology, Biochemistry, Plant Biotechnology, Ouargla University, 2023).

### ***Stating Limitations***

Students of Biology tended to conclude their reports' Discussion sections by declaring the limitations of their studies, acknowledging their awareness of them and signposting to further research. For instance, they wrote "one limitation of our research is the small size which may prevent the generalizability of findings", "further research is needed using another research method", "the use of this instrument in our research may cause bias, thus we call for replicating this study using another research instrument" (students' laboratory reports, Biochemistry, Plant Biotechnology, Agricultural Sciences, Ouargla University, 2023).

Simply put, students of Biology in Ouargla University effectively communicate their findings, discuss them in relation to previous research and acknowledge the limitations of their studies by using a well-structured framework in the Discussion section of their reports.

In essence, the investigation of laboratory reports, as one type of academic discourse, produced in the university context, written by Algerian students of Biology at Ouargla University offered insightful details about the organizational structure and writing conventions within the scope of scientific communication. The research results are in accordance with the work of Milard & Tanguy (2018), Pangesti et al. (2023), Kumar (2023), and Moskovitz et al. (2023) in the field of STEM research papers, which validate that biology research writings predominantly adhere to the IMRAD format. The findings of the current research showed that although the IMRAD model is generally followed, there exist some variations due to disciplinary requirements as norms can differ across various academic disciplines, aligning with Parkinson (2013) and Nair & Nair (2014)'s claims regarding this point. The different subheading arrangements in the Methods section reflect the students' several experimental approaches and objectives. Additionally, transitions between sections are essential for establishing coherence, preserving reports' logical flow, and enhancing their readability. These outcomes support Popova et al.'s (2017) assertion that the IMRAD model encourages modular reading, simplifying the navigation process for readers. The use of linking words, making references to earlier sections and integrating each section within the overall context of research are all skills that students of Biology at Ouargla University exhibit. Lastly, the Discussion section, which includes the analysis of results, integration with prior literature, and discussion of limitations, reveals patterns in the structure and in the content of their reports.

### **Conclusion, Recommendations, and Limitations**

The purpose of the present study was to investigate thoroughly the adherence of students of Biology in Ouargla University to the IMRAD model in organizing their laboratory

reports as a major type of academic discourse to disseminate the research findings. The findings of the study indicated that the students of Biology in Ouargla University adhere to the IMRAD pattern in their English-written laboratory reports while some variations exist within the subheadings, transitions between sections, and the structure of the Discussion section that reflect the impact of disciplinary conventions.

The research results emphasize the necessity of teaching the IMRAD format to students, particularly those in scientific fields who use English in their specialities. This widely used framework effectively organizes and disseminates scientific research. The observed variations, influenced by disciplinary norms, underscore the necessity for pedagogical approaches and training tailored to specific conventions and requirements in various fields. Increasing students' awareness of these differences plays a crucial role in enhancing their scientific communication and writing skills, consequently contributing to improved academic performance.

The study has some limitations. First, the focus of this investigation was only on the discipline of Biology; hence, its results cannot be generalized to other scientific disciplines that also need to be investigated to gain a complete picture of the topic. In light of the aforementioned, the results are firmly placed in the highly politicized English language landscape and the new policies of enforcing English as a medium of instruction in the Algerian institutions of higher education. Consequently, these results can benefit researchers and policy makers in similar contexts. Furthermore, in this research, the researchers examined only the organizational structure of laboratory reports and did not explore other aspects of scientific writing such as the linguistic and the rhetorical features of laboratory reports. Therefore, further studies can broaden the investigation to examine a variety of aspects in order to improve the writing practices of students in the scientific community, thereby ensuring effective knowledge dissemination and science communication.

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# Istraživanje upotrebe IMRAD formata za laboratorijske izveštaje studenata biologije

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## Apstrakt

*Akademski diskurs služi kao platforma za sistematsku komunikaciju naučnih nalaza, pri čemu su laboratorijski izveštaji primarni tip koji koriste istraživači i studenti. Ovi izveštaji prate specifične konvencije i formate, obezbeđujući jasnoću i kredibilitet u naučnoj komunikaciji. Ova studija istražuje organizacionu strukturu laboratorijskih izveštaja iz biologije na engleskom jeziku, sa fokusom na pridržavanje studenata modela Uvod, Metode, Rezultati i Diskusija (IMRAD). Nakon sastavljanja korpusa od pedeset laboratorijskih izveštaja studenata biologije sa Univerziteta u Uargli, Alžir, istraživači su primenili kvalitativni pristup i tematsku analizu podataka. Rezultati su pokazali opšte pridržavanje IMRAD formatu, sa manjim varijacijama, posebno u podnaslovima u odeljku Metode, prelazi između odeljaka i strukturi odeljka Diskusija, što odražava disciplinarne norme. Ovi nalazi ukazuju na mogućnosti da nastavnici eksplicitno obrade nijanse IMRAD strukture i pisanja u oblasti biologije. Razumevanjem načina na koji studenti primenjuju ovaj model, instruktori mogu osmisliti efikasnije lekcije i instrukcije u pisanju koje podstiču jasnoću i disciplinarno razumevanje u pisanju laboratorijskih izveštaja. Ova studija naglašava značaj istraživanja uticaja eksplicitnih instrukcija na kvalitet studentskog pisanja i razumevanje IMRAD konvencija. Preporučuje se da se ove varijacije dalje istraže kako bi se poboljšalo razumevanje komunikacionih veština studenata, čime bi se unapredio kvalitet njihovog pisanja u akademskom kontekstu. Pored toga, ova istraživanja ističu važnost istraživanja uticaja eksplicitnih instrukcija na kvalitet studentskog pisanja i razumevanje IMRAD konvencija.*

**Ključne reči:** akademski diskurs, biologija, disciplinarne norme, IMRAD model, laboratorijski izveštaji.