

*A critical examination of studies investigating Quantum Physics*

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Lab reports are an essential part of scientific research and communication. They allow researchers to share their findings with others, inspire new research, and contribute to the overall advancement of knowledge in their field. However, lab reports can also be daunting, especially for those who are new to the scientific writing process. To make a lab report effective, it should be clear, concise, and accurate. It should present the data and results in an organized and logical manner that is easy to understand. This includes a detailed methodology section that explains the procedures used and any equipment or materials involved. Additionally, a good lab report should also include relevant visuals, such as graphs or charts, to help illustrate the data and results. These visuals should be well-designed and labeled appropriately for ease of interpretation. Overall, the goal of a lab report is to effectively communicate the research process, results, and conclusions to other researchers in the field. A well-crafted lab report should accomplish this by being thorough, accurate, and easy to understand. Through a rhetorical analysis of three lab reports, namely Mashhadi (1996), Mashhadi and Woolnough (1997), and Niedderer (1997), this thesis aims to evaluate their strengths and weaknesses and ultimately determine which report stands out as the most effective in presenting data and concepts, with Mashhadi (1996) lacking in visual aids and Mashhadi and Woolnough (1997) lacking in detailed explanations, while

Niedderer (1997) strikes a balance between the two and provides a comprehensive understanding of the subject matter.

Mashhadi, A. (1996, November). "*Cognitive Mapping of Advanced Level Physics Students' Conceptions of Quantum Physics*" is a good example of a well-structured report, with a clear and concise introduction, methodology, results, and conclusion sections. The report provides a detailed description of the experiment and the procedures followed, which makes it easy for readers to understand the study. For example, see Mashhadi, (1996, page 3, paragraphs 1–3). The abstract describes a study on students' understanding of quantum physics using a map metaphor to represent their conceptual framework. The methodology used in the study is scientific and rigorous. This style of writing is appropriate for a lab report because it is concise, clear, and objective. In scientific writing, it is important to present information in a straightforward and organized manner to allow the reader to easily understand the study and its findings. This report still needs to be improved. The text describes a study that investigated the grouping of statements on quantum phenomena. The writer uses technical language to explain the process used to analyze the data, including the use of a multidimensional scaling program to represent the structure in a proximity matrix as a geometrical model. Figure 1 shows the location of statements on quantum phenomena in a 3-dimensional space generated by MDS. The writer notes that Dimension 1 is the most influential, followed by Dimension 2, and Dimension 3 is the weakest (page 9, paras. 1–4). However, the text lacks visuals such as diagrams or charts to illustrate the process and findings of the study. This can make it difficult for readers to fully understand the concepts presented, particularly those who are not familiar with the technical

language used. Visuals can aid in comprehension by providing a clear representation of the data and the process used to analyze it. Without visuals, readers may struggle to fully grasp the findings and implications of the study.

Mashhadi, A., & Woolnough, B. (1997, June). "*Dualistic Thinking Underlying Students' Understanding of Quantum Physics*" is well-structured and includes all necessary components. The abstract provides a concise summary of the report's purpose, methodology, and results. For example (Mashhadi & Woolnough, 1997, page 3, paragraphs 1-3) The abstract describes an investigation into changes in students' conceptions during physics instruction, using a theoretical perspective that integrates existing frameworks of cognition, cognitive states, and cognitive processes in physics. The authors present a case study of a high school student's learning processes in quantum atomic physics and describe his conceptual growth as a "federation" of several connected conceptions. The authors use technical language and specialized terminology and cite previous research to contextualize their investigation. However, the report could benefit from more detailed explanations of the methodology and results. Additionally, the language used is overly technical and difficult to understand, making it challenging for the reader to follow. For example on (page 9, paragraphs 1-2), when it discusses The passage employs overly technical language, making it challenging for the reader to follow. It discusses the role of concepts in cognitive processes and argues that concepts are used to create networks of meaning. The author uses Lewis's (1973) metaphor of knowledge as a "string bag" rather than a hierarchy to suggest that knowledge is a complex web of interconnected ideas. The second part of the paragraphs discusses the definition of understanding and how it is measured, but the language remains dense

and difficult to understand. Overall, the passage would benefit from more accessible language to help readers better follow the complex ideas presented.

Niedderer, H. (1997, March 22). "*Learning Pathways in High-School Level Quantum Atomic Physics*". is the best of the three reports, as it includes all the elements of a good lab report. The report has a clear and concise introduction, a detailed methodology section, and provides visual aids to support the data and results. For example, in Niedderer, H. (1997, page 2), the abstract argues that understanding people's experiences of the world around them is more important than their articulated beliefs. It contrasts Western dualistic thinking with Asian non-dualistic thought and notes that quantum physics has a dual nature. The abstract also highlights a study that found evidence of dualistic thinking among students studying quantum physics. This clear, concise, and objective writing style is well-suited for lab reports, as it prioritizes factual information over personal opinions or biases. It emphasizes scientific rigor and focuses on key points to effectively communicate research findings. The report also explains the terms and concepts used in the study, making it easy for readers to understand the results. In the report (page 7, section 2.3), the text provides a clear and concise explanation of Carl's third conception of the atom, also known as the quantum model. It uses scientific language and technical terms, as well as analogies and metaphors, to help readers visualize complex concepts related to atomic structure. For example, the possibility field is described as a radial field that points in every direction, which helps readers imagine the three-dimensional nature of the field. Similarly, the idea of the electron existing as a "state electron" is compared to a particle that only becomes real when it is localized, making it easier for readers to understand the quantum nature of electrons. The text is an effective example of scientific writing that uses both good visuals and

good wording to help the reader understand and follow the lab reports easily. Overall, Lab Report #3 is an excellent example of a well-structured and informative lab report.

In conclusion, the evaluation of three lab reports investigating quantum physics highlights the importance of clear communication in scientific writing. While all three reports present well-structured arguments, Niedderer's (1997) report stands out as the most effective due to its balance of detailed explanations and relevant visuals. It provides a comprehensive understanding of the subject matter, making it easier for readers to follow the study's procedures and findings. Mashhadi (1996) report lacks relevant visuals to aid comprehension, while Mashhadi and Woolnough's (1997) report include overly technical language, making it difficult for readers to follow. A well-crafted lab report should be clear, concise, and accurate, with a thorough methodology section and relevant visuals to support the data and results. The goal of a lab report is to effectively communicate the research process, results, and conclusions to other researchers in the field, and this can be achieved through clear and accessible language, logical organization, and visual aids.

References:

- Mashhadi, A. (1996, November). *Cognitive Mapping of Advanced Level Physics Students' Conceptions of Quantum Physics*. <https://eric.ed.gov/?id=ED414195>
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