
Evaluating The Impact of a Practical Data Structures Workbook on Student Performance and Satisfaction

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Abstract. This study evaluates the effectiveness of a specially developed Practical Approach of Data Structures workbook as a learning resource for third-semester Diploma in Information Technology (Digital Technology) students at Politeknik Mersing. Designed by subject lecturers, the workbook aligns closely with the course syllabus and emphasizes hands-on learning through structured exercises on linked lists, queues, trees, and algorithm design. A comparative analysis of academic performance across three semesters revealed a significant improvement in student outcomes, with A+ grades increasing by 14.25% after the workbook's implementation. Survey data from 165 students further supports its effectiveness, showing high satisfaction with the workbook's clarity, relevance, and support for both classroom and independent learning. Literature supports these findings, highlighting that well-designed, syllabus-aligned workbooks enhance student engagement, comprehension, and performance in technical subjects. The workbook's integration into teaching strategies contributed to improved achievement of Course Learning Outcomes (CLOs), particularly among high- and mid-performing students. While the impact on lower-performing students was minimal, the overall results affirm that practical, curriculum-driven resources can significantly enhance learning in information technology education. This study recommends continued use and further development of such materials to support diverse learner needs and improve academic success.

Keywords: Data Structures, Practical Workbook, Student Performance, Student Satisfaction, Course Learning Outcome.

1. INTRODUCTION

Data Structures is a foundational course integrated into the third-semester curriculum of the Diploma in Information Technology (Digital Technology) at Politeknik Mersing. This course is essential for establishing a robust understanding of the mechanisms governing efficient data storage, organization, and manipulation within computational frameworks.

To facilitate the learning process, a specialized textbook authored by experienced faculty members has been developed. This resource is strategically aligned with the current syllabus to ensure practical relevance and pedagogical consistency. The curriculum centers on the theoretical and practical application of primary data structures. Students engage with complex organizational formats and algorithmic techniques to enhance computational efficiency.

Key areas of study include:

- Linear Structures: Implementation and management of Linked Lists and Queues.
- Non-Linear Structures: Hierarchical data representation through Trees.
- Algorithmic Techniques: Comprehensive methods for Sorting and Searching datasets.

Through this rigorous exercise, students develop the analytical capacity to evaluate and select optimal data structures, ensuring that design concepts are both effective and resource-efficient in addressing diverse computational challenges.

Upon completion of the course, students are expected to achieve the following Course Learning Outcomes (CLOs):

CLO 1: Demonstrate an understanding of fundamental data structure concepts and effective techniques for data collection and organization.

CLO 2: Apply appropriate data structure concepts and design efficient algorithms to solve real-world problems.

CLO 3: Utilize various data structures in problem-solving scenarios while demonstrating ethical practices and professionalism.

2. OBJECTIVES

The implementation of the specialized Data Structures textbook at Politeknik Mersing represents a strategic effort to enhance pedagogical delivery and student comprehension. To measure the efficacy of this instructional resource and its alignment with the established curriculum, this study seeks to assess both measurable academic outcomes and the subjective learning experience of the students.

Specifically, the primary objectives of this study are:

- I. **Evaluation of Academic Performance:** To analyze students' academic achievement following the integration of the textbook, with a specific focus on the attainment levels of the Course Learning Outcomes (CLOs).
- II. **Assessment of Student Satisfaction:** To determine student perceptions regarding the clarity, relevance, and utility of the textbook content in facilitating both formal classroom instruction and independent self-study.

3. LITERATURE REVIEW

Substantial academic consensus suggests that the implementation of practical, well-designed instructional materials significantly enhances student learning outcomes, particularly within technical disciplines such as computer science. Previous research by Abaci and Quick [1] indicates that textbooks strictly aligned with course syllabi facilitate more effective and independent study habits. This is consistent with the findings of the current study, in which students highly rated the Practical Approach of Data Structures workbook for its clarity, utility, and relevance to core curriculum topics. Furthermore, Bernard et al. [2] and Moghavvemi et al. [3] demonstrated that the strategic integration of technology and blended learning methodologies leads to superior academic results. In this research, the workbook was utilized as a pedagogical supplement to traditional lectures and assignments; this integrated approach contributed to a 14.25% increase in students achieving A+ grades and a notable performance improvement among mid-level students, as evidenced by the rise in B and B- grades.

The importance of hands-on learning activities in mastering complex theoretical concepts is emphasized by Kosmas and Zaphiris [4]. The workbook's practical exercises on linked lists, queues, and trees provided the necessary experiential learning that likely drove improved outcomes. Additionally, Msafiri et al. [5] noted that student satisfaction is directly linked to the accessibility and clarity of learning materials. This was corroborated by the survey results in this study, where an overwhelming majority of participants reported that the workbook was intuitive for independent use and contained clear instructions. Such features are critical for fostering autonomous learning outside the formal classroom environment.

Conversely, Bećirović [6] observed that the benefits of technology-based educational tools are not distributed equally across all student cohorts. In the current study, lower-performing students did not exhibit significant improvement, suggesting a requirement for targeted interventions, such as supplemental tutoring, simplified conceptual breakdowns, or personalized learning strategies. Finally, Samala et al. [7] and Kimmons and Rosenberg [8], [9] underscored the necessity of continuous iterative improvement of educational tools to meet evolving student

needs. These perspectives support the recommendation to further refine the workbook to ensure its efficacy for a broader range of learners.

In summary, existing literature reinforces the premise that practical, syllabus-aligned resources—such as the Data Structures workbook—significantly enhance both student performance and satisfaction. These findings underscore the pedagogical value of structured materials in technical education and suggest that ongoing refinements are essential to support diverse learner profiles effectively.

4. RESEARCH METHODOLOGY

This study utilizes a quantitative descriptive research design to evaluate the efficacy and perceived utility of the Practical Approach of Data Structures workbook. The primary focus is to assess academic performance by measuring attainment of Course Learning Outcomes (CLOs) and to measure student satisfaction with the resource's role in supporting both classroom instruction and autonomous study.

4.1 Participants and Sampling

The study population comprised third-semester students enrolled in the Diploma in Information Technology (Digital Technology) program at Politeknik Mersing who had completed the Data Structures (DFC30233) course. A purposive sampling technique was employed to select students across two academic cycles: Session I 2023/2024 and Session II 2023/2024. A total of 165 valid responses were collected. Participation was entirely voluntary, and strict anonymity was maintained to ensure the integrity of the data.

4.2 Research Instrument and Validation

The primary data collection tool was a structured, web-based questionnaire administered via Google Forms. To ensure content validity, the instrument was reviewed by senior faculty members and subject matter experts to confirm that the items accurately reflected the course syllabus and pedagogical objectives.

The questionnaire utilized a tripartite structure:

Demographic Profile: Capturing gender, academic session, and class identification.

Workbook Evaluation: Assessing frequency of use, ease of independent navigation, clarity of instructions, syllabus alignment, and overall perceived utility using a 5-point Likert scale and dichotomous (Yes/No) items.

Qualitative Feedback: An open-ended section for subjective student recommendations.

4.3 Data Sources for Academic Performance

Academic performance data were sourced directly from the Summary Course Outcome Review Report (CORR), retrieved from the Polytechnic Record System (SPMP). This official institutional repository provided objective metrics on student achievement across three specific CLOs, allowing for a comparative analysis of performance trends following the introduction of the workbook.

5. RESULTS & DISCUSSION

Table 5.1 Demographic Information (Gender)

Gender	Total	Percentage	Semester
Male	90	45.45%	3 (Three)
Female	75	54.55%	
Total Respondent	165	100%	

Table 5.2 Demographic Information (Session)

Session	Total	Percentage	Semester
Session I 2023/2024	85	51.52%	3 (Three)
Session II 2023/2024	80	48.48%	
Total Respondent	165	100%	

5.1 Analysis based on objective number one:

➤ **To evaluate students' academic performance after using the book based on the CLO achievement.**

To assess the effectiveness of the Practical Approach of Data Structures workbook, a comparative analysis of students' academic performance was conducted across three consecutive semesters. The aim was to determine the extent to which the workbook influenced the achievement of Course Learning Outcomes (CLOs).

Semester Breakdown:

- **Session II 2022/2023 (Before Using Workbook)**

The workbook was not yet implemented. Students relied primarily on lecture notes and general reference materials.

Total student : 40

- **Session I 2023/2024 (First Semester Using Workbook)**

The workbook was introduced as a core reference material for both classroom and independent learning.

Total student : 178

- **Session II 2023/2024 (Second Semester Using Workbook)**

The workbook was further embedded into teaching strategies, with lecturers integrating activities directly from the book into assignments and assessments.

Total student : 40

Table 5.3 Student's Grade

Grade	Without Workbook	With Workbook (Avg)	Change
A+	5.0%	19.25%	↑ 14.25%
A	80.0%	57.45%	↓ 22.55%
A–	7.5%	9.95%	↑ 2.45%
B+	5.0%	5.05%	↑ 0.05%
B	0.0%	5.70%	↑ 5.70%
B–	0.0%	0.85%	↑ 0.85%
C+	2.5%	0.55%	↓ 1.95%
C	0.0%	0.0%	No change
C–	0.0%	1.25%	↑ 1.25%
D+, D	0.0%	0.0%	No change

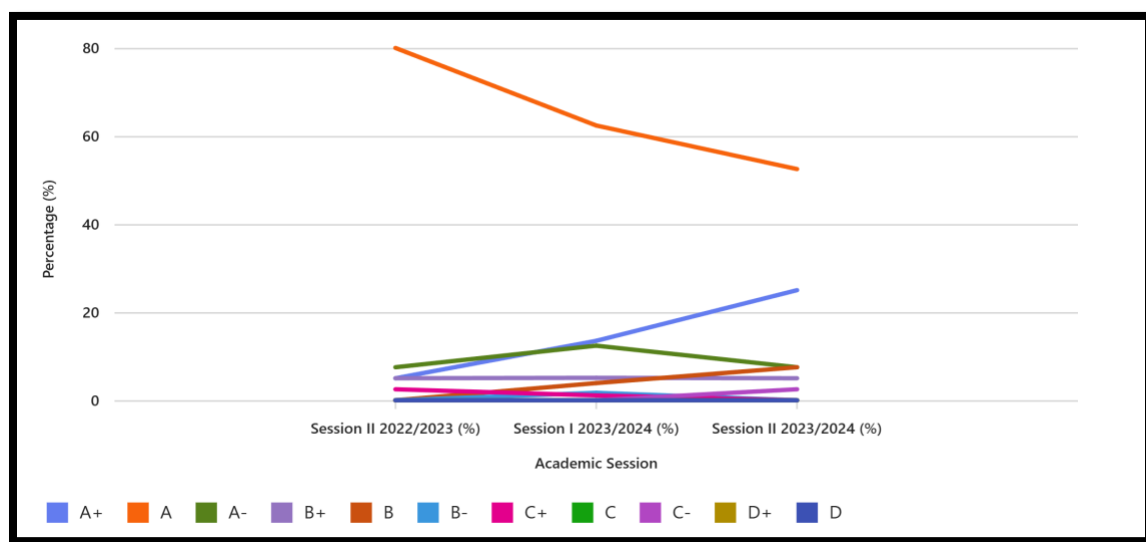


Figure 5.1 Student's performance chart

Chart Highlights:

- A+ grades show a strong upward trend.
- A grades are gradually declining.
- Other grades like A–, B, and C– show fluctuations.
- Lower grades (C, D, etc.) remain minimal or stable.

There is a significant improvement in top-tier academic performance among students who used the Data Structure Workbook, as evidenced by a 14.25% increase in A+ grades. This suggests that the workbook may have played a crucial role in helping high-achieving students excel even further. Additionally, there appears to be a redistribution of grades, with a notable 22.55% decrease in A grades. This shift likely indicates that some students who previously scored A have now moved up to A+, or their performance has diversified across other grade categories.

The workbook also seems to have provided better support for mid-tier students, as reflected in the increases in B and B– grades. This improvement implies that the workbook may have helped students who were struggling to grasp core concepts, enabling them to achieve better results. However, the data shows a minimal impact on lower-performing students, with grades C and D remaining largely unchanged. This could mean that while the workbook

was effective for most students, additional interventions might be needed to support those at the lower end of the performance spectrum.

5.2 Analysis based on objective number two:

- To determine students' satisfaction with the book's content and usefulness in supporting classroom learning and self-study.

The survey results provide valuable insights into students' perceptions of the book's effectiveness, usability, and alignment with their learning needs. Below is a structured analysis and discussion of the findings, highlighting key takeaways and their implications.

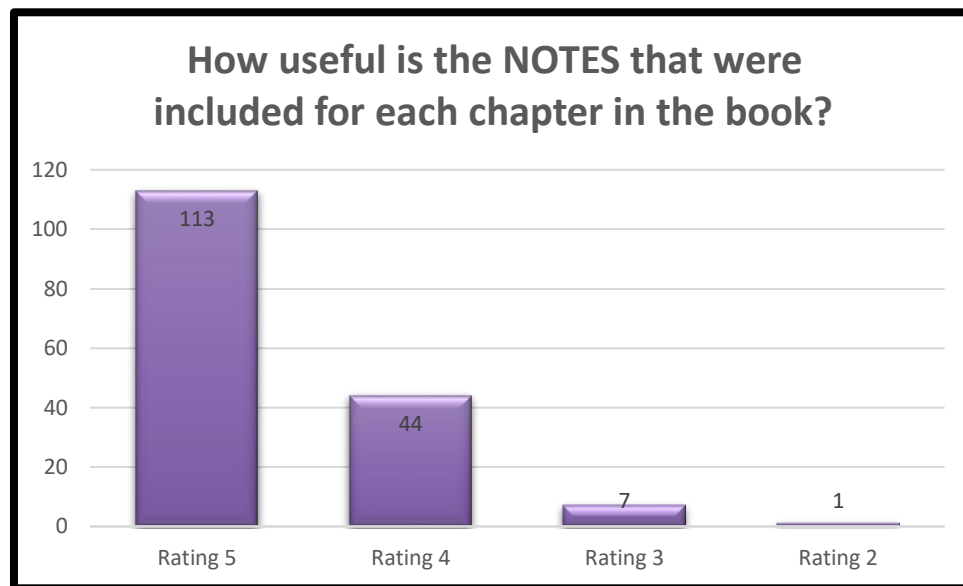


Figure 5.2 Chart based on the question “How useful is the NOTES that were included for each chapter in the book?”

The overwhelming majority of students (157 out of 165) rated the chapter notes as either "Very Useful" or "Useful," indicating that the notes are a highly effective resource. The minimal number of low ratings suggests that the notes are well-received and likely contribute significantly to students' comprehension and retention of material. The inclusion of chapter notes should be maintained and potentially expanded.

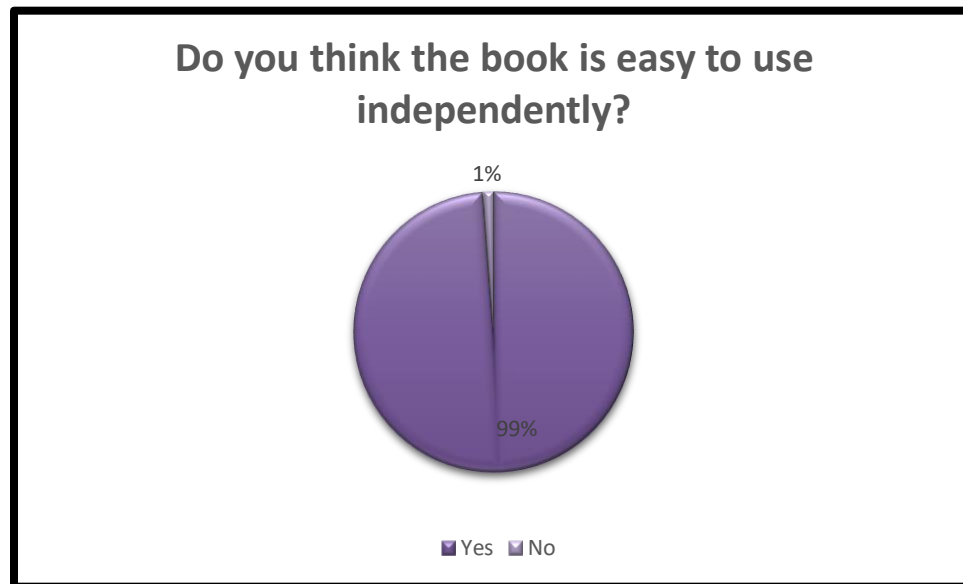


Figure 5.3 Chart based on the question “Do you think the book is easy to use independently?”

Nearly all respondents (163 out of 165) found the book easy to use independently. This is a strong indicator that the book is well-structured, clear, and accessible for self-study, which is critical for student success outside the classroom. The book's design and layout are effective for independent learning.

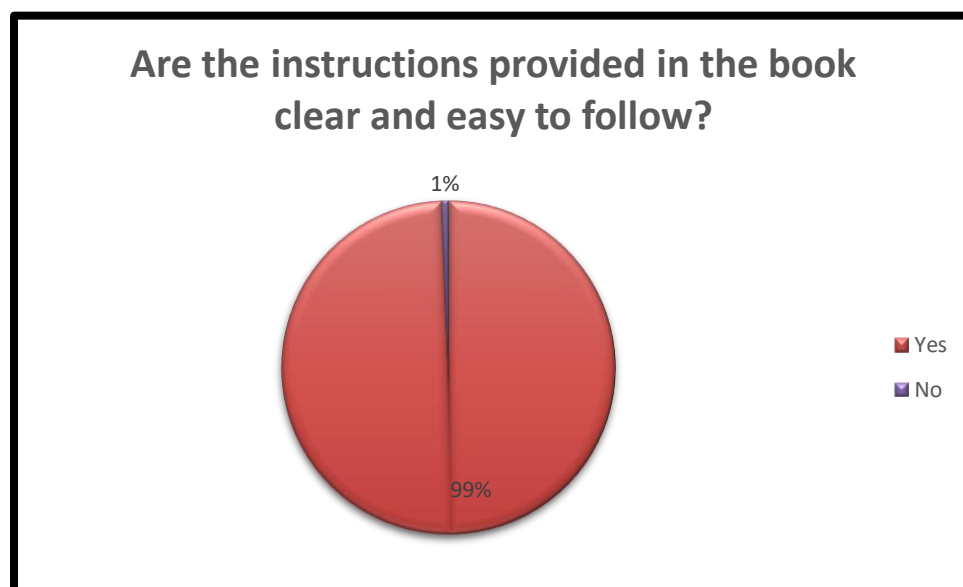


Figure 5.4 Chart based on the question “Are the instructions provided in the book clear and easy to follow?”

Almost everyone (164 out of 165) agreed that the instructions in the book are clear. This shows the book does a great job of explaining things in a way that's easy to understand. Clear instructions help students stay focused on learning instead of trying to figure out what to do. The way the book is designed to teach is very effective. Only one person gave a negative response, which could be looked into, but overall, no big changes are needed.

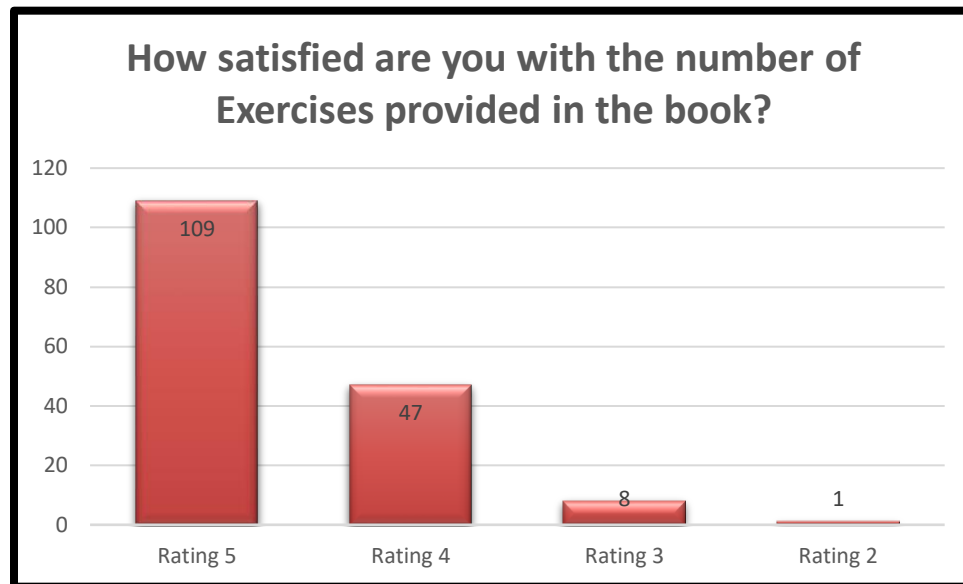


Figure 5.5 Chart based on the question “How satisfied are you with the number of Exercises provided in the book?”

The majority of students (156 out of 165) were satisfied or very satisfied with the number of exercises, indicating that the book provides ample practice opportunities. The small number of neutral or dissatisfied responses suggests that the quantity meets most students' needs.

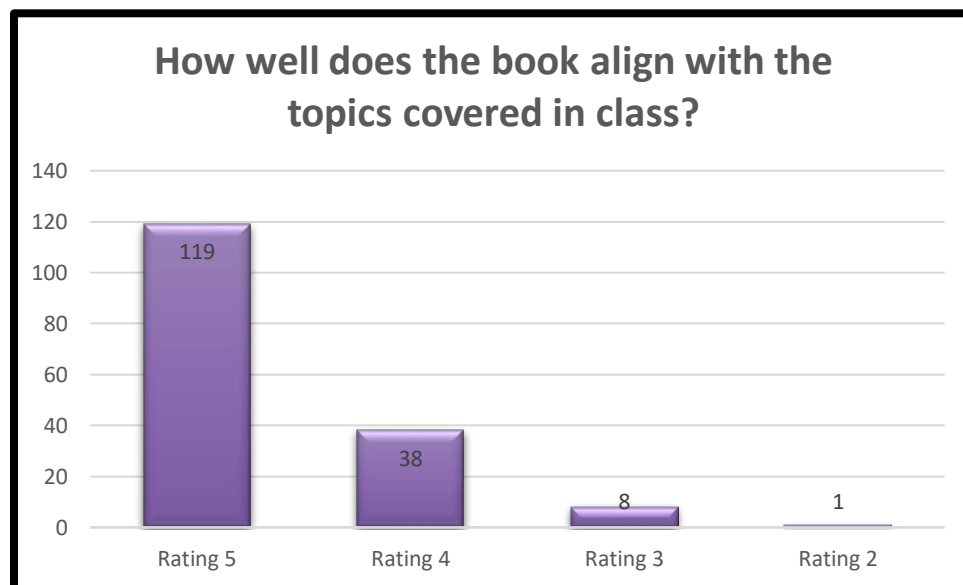


Figure 5.6 Chart based on the question “How well does the book align with the topics covered in class?”

The high ratings for alignment (157 out of 166) indicate that the book closely mirrors the topics covered in class, which is crucial for reinforcing classroom learning. The minimal dissatisfaction suggests that the book is well-integrated with the curriculum.

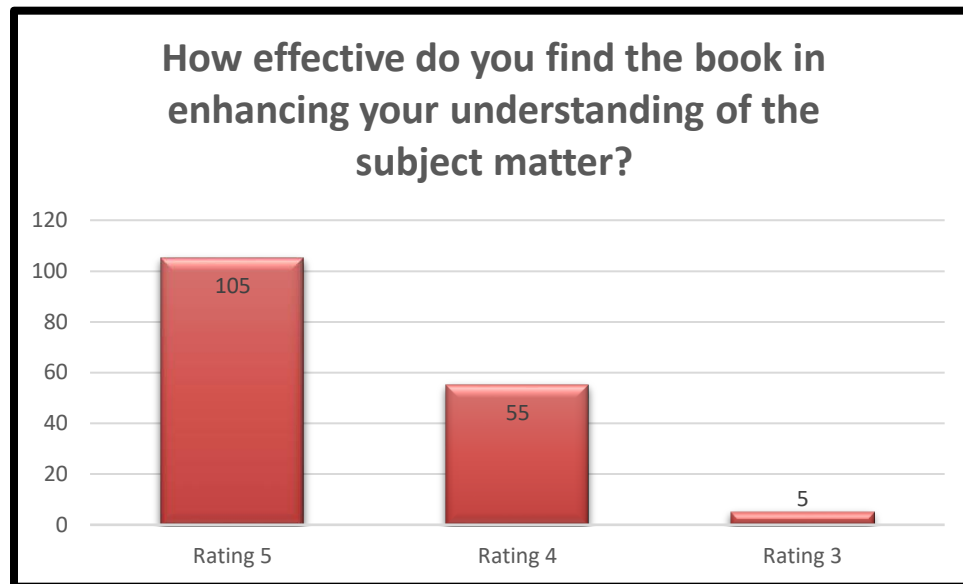


Figure 5.7 Chart based on the question “How effective do you find the book in enhancing your understanding of the subject matter?”

The vast majority (160 out of 165) rated the book as effective or very effective in enhancing their understanding of the subject. This is a testament to the book's pedagogical quality and its ability to support learning outcomes. The book successfully enhances student comprehension. The neutral responses may indicate areas where additional support or alternative explanations could be beneficial.

6. CONCLUSION

The implementation of the Practical Approach of Data Structures workbook has had a positive and measurable impact on student learning outcomes in the Diploma in Information Technology (Digital Technology) program at Politeknik Mersing. The comparative academic performance analysis across three semesters clearly shows a significant improvement in top-tier grades, particularly a 14.25% increase in A+ achievements after the workbook was introduced. This suggests that the workbook effectively supports high-performing students in reaching their full potential.

Moreover, the redistribution of grades from A to A+ and the rise in B and B– grades indicate that the workbook also benefits mid-tier students, helping them strengthen their understanding of core concepts. While the impact on lower-performing students was minimal, the overall grade trends reflect a positive shift in academic achievement.

Survey responses further validate the workbook's effectiveness, with the majority of students expressing high satisfaction regarding its clarity, alignment with the syllabus, and usefulness for both classroom and independent learning. The workbook's design—featuring structured exercises, clear instructions, and syllabus-aligned content—proved to be a key factor in enhancing student engagement and comprehension.

In conclusion, the study confirms that a well-designed, practical workbook aligned with course learning outcomes can significantly enhance student performance and satisfaction in technical subjects like data structures. This supports the continued use and further development of such resources to improve teaching and learning in Information Technology education.

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