

## CHAPTER V

### CONCLUSION AND SUGGESTIONS

#### 4.1 Conclusion

Based on the result of the research and discussion that has been described, it can be concluded that:

1. The majority of Biology Education pre-service teachers at Universitas Negeri Medan perceive themselves as moderately proficient in TPACK components, including Technological Knowledge (TK), Pedagogical Knowledge (PK), and Content Knowledge (CK). Most students rated their abilities in the middle category, reflecting a general confidence in integrating technology, pedagogy, and content knowledge. However, this self-assessment varied, indicating the need for further development in their perceived competencies.
2. The understanding of TPACK among these pre-service teachers showed significant variation. While a substantial portion demonstrated a "Very Good" or "Good" understanding, a notable percentage had only an "Enough" level of understanding, with smaller groups categorized as "Less Good" and "Bad." This discrepancy between perception and actual understanding suggests some students might overestimate their TPACK skills, emphasizing the need for enhanced instructional strategies within the teacher education program to deepen both theoretical and practical knowledge of TPACK.
3. The analysis of lesson plans created by Biology Education pre-service teachers at Universitas Negeri Medan revealed a high level of effectiveness in integrating TPACK principles. All assessed components of the lesson plans were categorized as "Very Good," indicating that students are proficient in applying TPACK in structured tasks such as lesson planning. This reflects the strong support and guidance provided by the teacher education program, ensuring that pre-service teachers can effectively incorporate technology, pedagogy, and content knowledge into their classroom practices. These conclusions highlight

the importance of continuous and integrated TPACK training in teacher education programs to better prepare Biology Education pre-service teachers to meet the challenges of modern education.

## **4.2 Suggestions**

Based on the conclusions above, suggestions that can be submitted are as follows:

- 1 To enhance the understanding and application of TPACK among Biology Education pre-service teachers at Universitas Negeri Medan, expanding the research methodology is crucial. Implementing a longitudinal study would help track changes in TPACK perception, understanding, and implementation from the start of the teacher education program through the early years of teaching careers. This approach would identify critical stages for targeted interventions. Additionally, incorporating qualitative methods such as interviews and focus groups would provide deeper insights into the reasons behind pre-service teachers' perceptions and understanding of TPACK, complementing the quantitative data and offering a more comprehensive view of their experiences and challenges.
- 2 Broadening the comparative and contextual analysis is essential. Conducting comparative studies with other universities in Indonesia or internationally could benchmark TPACK competencies and identify unique strengths or areas for improvement specific to Universitas Negeri Medan's program. Evaluating the availability and use of technological resources in both the teacher education program and the schools where pre-service teachers conduct their practicum would provide crucial context for their TPACK competencies and highlight any resource gaps that need addressing.
- 3 Enhancing training and support mechanisms is vital for improving TPACK integration. Investigating the impact of targeted workshops, hands-on training sessions, and other interventions focused on specific TPACK components can identify effective strategies for competency improvement. Furthermore, identifying and analyzing the barriers pre-service teachers face in implementing

TPACK in their lesson plans and classroom practices would help design targeted interventions to overcome these challenges, thereby enhancing their ability to integrate technology, pedagogy, and content knowledge effectively. Analyzing the implementation of TPACK during student teaching practicum periods would provide practical insights into how well pre-service teachers apply their knowledge in real classroom settings. Including faculty perspectives on TPACK integration challenges and successes could offer valuable insights for program improvement. By addressing these areas, future research and program enhancements can provide a more comprehensive understanding of TPACK integration in teacher education, contributing to the ongoing improvement of teacher preparation programs.