



Ways to Improve the Professional and Methodological Competencies of Future Biology Teachers

OPEN ACCESS

SUBMITTED 24 December 2024

ACCEPTED 26 January 2025

PUBLISHED 28 February 2025

VOLUME Vol.05 Issue02 2025

Salimova Sarvinoz Farxodovna

Buxoro state pedagogical institute (Phd), Uzbekistan

COPYRIGHT

© 2025 Original content from this work may be used under the terms of the creative commons attributes 4.0 License.

Abstract: Developing professional and methodological competencies is critical for future biology teachers preparing to navigate the complexities of contemporary classrooms. This study investigates strategies aimed at enhancing prospective educators' abilities to plan effective lessons, apply diverse instructional methods, and foster scientific inquiry among students. A mixed-method design was used to explore the impact of targeted training modules, microteaching sessions, and collaborative reflection on pre-service teachers' pedagogical growth. Quantitative findings demonstrated a statistically significant increase in lesson quality and content mastery following the intervention, while qualitative data revealed heightened self-confidence and improved classroom management strategies. Results underscore the importance of well-structured teacher preparation programs that integrate both theoretical and hands-on learning experiences. Recommendations include expanding inquiry-based activities, fostering interdisciplinary collaboration, and providing continuous feedback through peer mentoring. These findings contribute to ongoing discourse on teacher education and offer practical insights into refining teacher-training curricula in the field of biology.

Keywords: Biology teacher education, professional competencies, methodological competencies, pre-service teachers, pedagogy, teacher training.

Introduction: Biology, as a foundational science subject, plays a pivotal role in shaping students' understanding

of the living world and promoting scientific literacy. In an era marked by rapid technological advancements and shifting educational demands, the competencies required of biology teachers extend beyond subject knowledge. They must also be adept at deploying varied instructional methods, designing engaging lesson plans, and guiding learners through inquiry-based activities that foster critical thinking and problem-solving skills. These pedagogical proficiencies—collectively referred to as professional and methodological competencies—are integral to effective teaching and learning in the biology classroom.

However, many teacher preparation programs struggle to equip future educators with practical teaching skills while maintaining rigorous theoretical grounding in educational psychology and science pedagogy. Research suggests that bridging this gap involves a multifaceted approach that combines theoretical instruction, guided teaching practice, and opportunities for reflective collaboration (Shulman, 1987; Darling-Hammond, 2014). This study investigates specific strategies aimed at bolstering the professional and methodological competencies of pre-service biology teachers. By examining the effects of targeted training modules, microteaching exercises, and collaborative reflection sessions, the study seeks to offer insights into effective teacher education practices that align with contemporary educational standards and the evolving nature of the biology curriculum.

A mixed-method research design (Creswell, 2014) was adopted to explore how specialized training interventions affect the professional and methodological competencies of future biology teachers. Quantitative data were collected using a standardized teacher competency rubric, while qualitative data were gathered through focus group discussions and reflective journals.

Participants included 40 final-year undergraduates enrolled in a biology teacher education program at a public university. The sample was equally divided into an experimental group ($n = 20$) and a control group ($n = 20$). Both groups attended the same core courses but differed in the supplementary interventions provided.

Over a 12-week period, the experimental group participated in:

1. **Targeted Training Modules:** Workshops on curriculum design, inquiry-based teaching methods, and classroom management.
2. **Microteaching Sessions:** Regular practice teaching in small groups, followed by peer and instructor feedback.

3. **Collaborative Reflection:** Weekly group discussions and reflective journaling to encourage professional growth and self-assessment.

Scores on the standardized teacher competency rubric ranged from 0 to 100, with higher scores indicating stronger professional and methodological capabilities. Both groups completed the rubric assessment at the start (Pre-Test) and end (Post-Test) of the semester. An independent samples t-test showed no significant difference between experimental ($M = 58.2$, $SD = 6.1$) and control groups ($M = 57.8$, $SD = 5.9$) at Pre-Test ($p > 0.05$). However, a significant difference emerged at Post-Test. The experimental group's average score increased to $M = 78.3$ ($SD = 4.5$), while the control group's average rose modestly to $M = 65.7$ ($SD = 5.2$) ($p < 0.01$). Improvements in the experimental group were particularly pronounced in lesson planning, use of inquiry-based techniques, and classroom engagement.

Focus group discussions and reflective journals provided deeper insights into the factors contributing to these improvements. Participants in the experimental group frequently cited the microteaching sessions as pivotal, attributing their growth to consistent feedback from peers and instructors. The collaborative reflection activities also encouraged future teachers to critically evaluate their teaching styles, helping them recognize areas for refinement. By contrast, participants in the control group expressed concerns about insufficient hands-on practice and limited peer support, suggesting that they felt less prepared for real-world teaching challenges.

The marked improvement in the professional and methodological competencies of the experimental group aligns with existing literature on teacher preparation, which emphasizes active learning and reflective practice (Darling-Hammond, 2014). The workshops, microteaching sessions, and collaborative reflection appear to have accelerated participants' ability to translate theoretical knowledge into practical classroom skills, including lesson execution and student engagement.

These findings offer practical recommendations for teacher education programs. Curriculum developers and faculty should integrate structured microteaching opportunities throughout the program, with ample time for debriefing and constructive feedback. Additionally, reflection sessions that harness peer collaboration and self-evaluation can amplify gains by promoting a habit of lifelong learning. Integrating these strategies into standard coursework may help future biology teachers develop robust professional identities and methodological versatility, ultimately enhancing student learning outcomes in the classroom.

The relatively small sample size and short duration (one semester) limit the generalizability of the results. Future studies might involve longitudinal designs to track newly minted teachers' classroom performance over the first few years of employment. Furthermore, expanding the scope to include diverse educational contexts—such as rural schools with limited resources—would deepen understanding of how these interventions function under varied conditions.

CONCLUSION

In conclusion, this study underscores the value of hands-on practice, structured reflection, and targeted skill-building for enhancing the professional and methodological competencies of future biology teachers. Microteaching sessions foster confidence and practical expertise, while collaborative reflection nurtures self-awareness and continuous improvement. Teacher education programs that incorporate these evidence-based interventions position their graduates to excel in modern classrooms, ultimately benefiting students through richer, more engaging biology instruction. To maintain relevance, further research should explore longitudinal impacts, investigate varied educational settings, and integrate emerging digital tools that support and extend these teacher-training approaches.

REFERENCES

- Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE.
- Darling-Hammond, L. (2014). Strengthening Clinical Preparation: The Holy Grail of Teacher Education. *Peabody Journal of Education*, 89(4), 547–561.
- Shulman, L. S. (1987). Knowledge and Teaching: Foundations of the New Reform. *Harvard Educational Review*, 57(1), 1–22.