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METHODOLOGICAL FOUNDATIONS FOR DEVELOPING TEACHING COMPETENCE OF FUTURE BIOLOGY TEACHERS IN TEACHING PRACTICE

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ABSTRACT

The effectiveness of biology education in schools is predominantly contingent upon the preparedness of future educators to convert biological knowledge into significant learning experiences during their pedagogical practice. This article validates the methodological principles for enhancing the pedagogical competence of pre-service biology teachers during school-based teaching practice. Teaching competence is viewed as a comprehensive construct encompassing subject-matter mastery, pedagogical content knowledge, methodological literacy, communicative abilities, and a reflective disposition towards ongoing professional development. The objective of the study is to develop and empirically validate a practice-oriented model that enhances these components within the practicum. A mixed-methods design was utilized, integrating theoretical literature analysis, diagnostic evaluation of competency levels, and a pedagogical experiment involving control and experimental groups of biology majors. The findings demonstrate that intentional organization of practice, explicit assessment criteria, and collaboration between university supervisors and school mentors substantially improve the pedagogical proficiency of prospective biology educators.

KEYWORDS

Teaching competence, future biology teachers, biology education, teaching practice, practicum, methodology.

INTRODUCTION

Biology as an academic discipline is essential in cultivating scientific literacy, ecological awareness, and responsible attitudes toward health and the environment. Nonetheless, in numerous educational systems, a gap persists between contemporary standards for biology education and the actual readiness of novice educators to facilitate inquiry-based, student-centered learning in classrooms. University curricula frequently offer robust theoretical frameworks in biology and general pedagogy; however, the transition from theory to practice during the school practicum is not consistently facilitated. Consequently, pre-service teachers often replicate conventional, teacher-centered methodologies, depend significantly on textbooks, and emphasize the transmission of factual information rather than facilitating the active cognitive engagement of students.

These inconsistencies underscore the necessity for definitive methodological foundations to steer the enhancement of teaching competence, particularly within the realm of pedagogical practice. In this article, teaching competence is defined as the capability of a prospective biology educator to design, implement, and evaluate lessons that incorporate biological concepts, age-appropriate psychology, didactic methodologies, and contemporary pedagogical technologies. Pedagogical content knowledge is given special attention. This is the knowledge of biology that is linked to knowledge of the problems that most students have, how to explain things well, how to do experiments, and how to see things. The research problem is to determine how the practicum can be intentionally structured to transform it into a genuine environment for developing teaching competence rather than merely a formal obligation.

The research was carried out at a pedagogical university, involving third- and fourth-year biology majors engaged in their teaching practicum. There were 68 students in the study, with 34 in the control group and 34 in the experimental group. The duration of practice and the number of lessons taught at school were the same for both groups, but the content and structure of the practicum were different. The control group adhered to the conventional model, wherein students primarily observed lessons conducted by seasoned educators, developed individualized lessons aligned with the school curriculum, and received general descriptive feedback. The experimental group took part in a specially designed teaching practice model that was meant to help them improve their teaching skills in a clear and organized way.

The model integrated theoretical preparation, supervised practical engagement, and methodical reflection. Before they started their practicum, students looked at the curriculum requirements, common lesson plans, and biology textbooks, and then worked together to come up with competence-based goals for their practicum. During the active practice stage, they planned and taught lessons that included problem-based questions, experiments, working with biological objects, and digital visualizations. University supervisors and school mentors gave focused tutoring on how to meet lesson goals, choose content, use methods, and interact with students. Daily lesson analysis, individual reflective diaries, and group seminars where students talked about problems and successful strategies were all ways to get students to think about what they had learned. Data were gathered through observation protocols, expert evaluations of lesson plans and delivery, self-assessment questionnaires, and the analysis of reflective texts. We used descriptive statistics and comparative analysis to look at the

differences between the two groups at the start and end of the practicum.

Expert assessment of lesson plans revealed that the experimental group more consistently aligned learning objectives with curriculum standards and chose content that emphasized fundamental biological concepts rather than discrete facts. Observations of lessons showed that the pre-service teachers in the experimental group used a wider range of teaching methods and planned learning activities that made students come up with hypotheses, observe, classify, and draw conclusions. They changed the way they asked questions from closed factual ones to open ones that made people think and explain. There was more back-and-forth between students, and the teacher was more sure of themselves and had a clear goal in mind.

Reflective diaries demonstrated that students progressively examined not only their actions during lessons but also the rationale behind their chosen methods and the impact on pupils' learning and motivation. They identified specific pedagogical issues more often and suggested practical solutions for subsequent lessons. Self-assessment data corroborated an increasing sense of professional responsibility and a willingness to enhance their pedagogical skills beyond the formal stipulations of the practicum.

The results confirm the initial hypothesis that teaching practice can be an effective way to improve teaching skills if it is based on clear methodological principles. The competence approach made sure that all of the practicum activities were connected to specific competence components. This helped students understand why they were doing each task and keep track of their own progress. The activity and contextual approaches facilitated the integration of theoretical knowledge with practical school scenarios, as pre-service teachers addressed genuine pedagogical challenges, tailored biology content to particular classes, and navigated unforeseen difficulties during lessons. The reflective approach, implemented via diaries and group discussions, converted experience into professional learning by fostering critical analysis and self-correction.

The collaboration between university supervisors and school mentors was a key factor in the model's success. Collaborative planning of observation objectives, lesson prerequisites, and feedback mechanisms established a cohesive pedagogical environment that facilitated the student teacher's development. This aligns with research indicating that collaboration between universities and schools is essential for effective teacher education and the enhancement of pedagogical content knowledge in science. Focusing on biology as a separate subject was also important. When working with experiments, biological collections, models, and digital simulations, we had to make different methodological choices than we did in other subjects. Students learned how to plan safe and useful experiments, how to use visual aids responsibly, and how to include health and environmental education in their lessons through guided practice. These characteristics emphasize the imperative of subject-specific methodological foundations in biology teacher education programs.

The research indicates that the methodological framework for enhancing the pedagogical competence of prospective biology educators during their teaching practice must encompass a synthesis of competence, activity, contextual, and reflective approaches, underpinned by robust collaboration between universities and educational institutions. A practicum model based on these principles allows pre-service teachers to turn what they know about biology into real-life situations, understand how biology is taught, and learn how to plan, teach, and analyze lessons in a way that will stick with them. Systematic reflection and well-organized mentoring assist students in surmounting initial uncertainty and establishing a responsible professional stance.

The findings indicate practical ramifications for curriculum developers and teacher trainers. Teaching practice should not be confined to mere observation and disjointed instruction of isolated lessons; it must be designed as a comprehensive pathway with explicit competence-based objectives, standards, and mechanisms for feedback. Subsequent research may concentrate on the longitudinal monitoring of graduates who have undergone this practicum model, in addition to modifying the methodology for application in other domains of science education. Nonetheless, this study offers a methodological framework that can facilitate the enhancement of biology teacher education and elevate the quality of biology instruction in schools.

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