

## The development of reflection among future biology teachers in the process of methodological training

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### Abstract

Methodical training is most effective, especially in biology, as in any field of education. It is important to determine the place of methodological education in pedagogical learning. It aims to form the opinions of future biology teachers about the methodological approach. In this study, which was developed at the University of Educational Sciences, studies were carried out for better education with students who teach biology. The methodological training of future biology teachers implies the acquisition of certain methodological knowledge. A qualitative method was used in this study, which was carried out with students who teach biology. The opinions of the pre-service teachers were detailed. Ethical approval was obtained from the university for this study, which was applied to 112 biology graduate candidates. The findings obtained from the research conducted with the content analysis method are stated and explained. From the research, it was

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concluded that the methodological approach is especially important for biology and that the arguments of the methodological approach should be understood in detail. It is included in the students' results that the education subjects in the given university are prepared according to the access method.

Keywords: Education, methodology, teaching, content, biology teaching;

## 1. Introduction

Strategy is defined as the path followed to achieve something or the follow-up of a plan to achieve a goal. Teaching strategy, on the other hand, is the method that helps students achieve their learning goals (Başkıran-Ödün & Korkmaz, 2020; Ferdosipour & Musavi, 2022). Among the main examples of instructional strategies are the strategies of teaching by presentation, teaching by invention and research-based teaching strategies (Aykol, Ünver, Reha, & Baysal, 2021; Bahri, Palennari, Hardianto, & Andi, 2021; Demirel, 2017).

A factor in the success of educational programmes is the chosen learning and teaching model (Antropova, Vlasov, & Kasyanenko, 2019; Demirel, 2015). In light of this information, it was planned to measure the learning outcomes aimed at by the programme with the courses prepared according to the 5E learning cycle, by applying the research-based learning strategy in accordance with the students that the programme wants to train and the teaching strategy it proposes (Aykol et al., 2021). In addition to critical thinking, problem-solving skills are among the most important skills to be developed in the 21st century (Wahyudiati, Irwanto, & Ningrat, 2022). The present state of methodological science leaves a lot to be desired. Although there are different reasons for this, most of the fault lies with the teacher himself. Future biology teachers should plan their professional development to better prepare them and to better understand this purpose. In order to correctly organise the methodological education of students, it is necessary to rely on various parameters. With the help of modern educational technology, a process is being developed for better methodological training of future biology teachers (Salimova, 2019). One of the most important tasks in the preparation of the future biology teacher is the formation of readiness to use interactive programmes as one of the basic knowledge competencies that make it necessary to develop current biology teaching methods. The subject and professional cycle is the system of training the future biology teacher for higher education (Aminjonova, 2021).

The current state of methodological science encompasses many aspects. Although the reasons for this vary, most relate to the teachers themselves. Future biology teachers should develop a continuing education process to better understand and achieve goals for improving methodical education. In order to organise students' methodical training in time, it is necessary to rely on several criteria. With the help of modern educational technologies, a process is being developed to develop a methodology for improving the methodological preparation of future biology teachers (Demchenko, Maksymchuk, Bilan, Maksymchuk, & Kalynovska, 2021; Djalolovich, Kodirovich, Ruziboevich, & Islomovna, 2021).

Methodological training of future teachers is one of the main elements of professional competence, which combines all other parts and provides adequate preparation for future

educational activities (Aminjonova, 2021; Sayfullayeva, Tosheva, Nematova, Zokirova, & Inoyatov, 2021). The methodical training of the future biology teacher is interpreted as the targeted acquisition of methodical knowledge and guidance in the context of educational biology lessons and the methodical tasks related to solving them. The method of teaching biology at universities is based on the fact that the school continues to work on a new curriculum focused on the best possible world experience. The current programme focuses primarily on wildlife studies, rather than wildlife studies on shows (storyboards and positive codes) and monitors. Laboratory observations have almost disappeared from school practice and educational experiments have ceased. In fact, school biology has recently lost its ‘connection with nature’ and this has had a significant impact on the education and lives of children (Çelik, 2019; Odilova, 2020).

The content of methodological training includes the following components:

- cognitive (methodological competences),
- active and operational (experience and competences),
- personal (reasons for pedagogical activity, values and professional roles).

The methodical formation of the students simultaneously attracts the attention of each one of them. One of these sections is the intensive methodical work of students, the methodical development of technical education, the formation of values, the professional qualities of great teachers, creative skills, methodical assessment and motivation to act methodically (Hrytsai, Diachenko-Bohun, Grynova, Grygus, & Zukow, 2019; Stepaniuk, 2011). The methodological training of the future biology teacher, interpreted as the specific acquisition of knowledge and methodological skills and their analysis in the context of methodological tasks related to the school biology lesson. Competence in biology and other natural sciences involves understanding the goal. The responsibilities of the school biology programme are its presentation together with educational content, topics, formats, methods, teaching skills, pedagogical competences, the ability of biology teachers to use this knowledge in practice and the methodical formation of future needs preparation (Hrytsai et al., 2019).

Competency in biology and other natural sciences includes the goals and objectives of the school biology course, curriculum content, textbooks, forms, methods, teaching methods, teaching materials and the ability to apply this knowledge in practice and influences the formation of the future biology teacher and methodical education (Nehm, 2019). On the other hand, since the educational institution fulfils the social order of the society, a serious justification is needed for the question ‘why teach biology’ and what kind of biological education is needed for the modern student who lives in the era of environmental crisis and for maintaining health due to the rapid spread of various human diseases. Future biology teachers have the task of choosing didactically appropriate content of teaching material from the achievements in various fields of biology, medicine and agricultural sciences (McDonald, Roberts, Koeppe, & Hall, 2022; Robeva, Jungck, & Gross, 2020).

Analysing methodological studies in biology in recent years, the four main methods identified are as follows: what to teach, whom to teach and how to teach. For this reason, the teaching of biology should be investigated in isolation rather than as a complex problem. Most researchers pay special attention to teaching materials, i.e., teaching. The basic point of the methodology – teaching

– has in many cases been wrongly reflected or evaluated by researchers in the context of subjective matters, without justifying the psychological and physiological data that would justify the need to use the proposed method in age group and learns a certain subject or part of a subject (Miharja, Hindun, & Fauzi, 2019). The methodological training of future specialists is considered a system that includes the purpose and objectives, subjects, form, resources, methods and technologies of teaching students. This system represents the next level of professional training for future biology teachers and has its own function and structure. The goal of methodological education is the methodological preparation of future biology teachers for their professional activities in the school biology education system (Maksymchuk et al., 2020). It is time to move from declarative statements about the methodology's close connections with pedagogy, psychology and age physiology to its practical applications. This does not mean that the future teacher must not only conduct research on human psychology or physiology, but must also use the richest data of educational psychology and age physiology when explaining methodological innovations (Aini, Rachmatullah, Harliadi, & Ha, 2020; Mutanen & Uitto, 2020).

In the general content of the biology subject, we should know the laws, theories, processes, principles, hypotheses and experiments; we should be able to apply the applications of the biology course in your daily life and know some of the contributing scientists; learn about biology and science in the field of biology in the history of science; actively participate and evaluate relevant discussions; ready to propose new ideas and carry out original research using the knowledge, skills and competences acquired in the biology course; and create functional projects, complex and original models and inventions, knowledge of technologies, inspiration with living beings and similar innovations (Atalay, 2019; Seref Guryuva, 2019). We should be able to evaluate the impact of science and technology on the lives of people and other living things, to comprehend the necessity and importance of having ethical values in scientific research and public life and to act in accordance with these values. They should be able to make informed judgments on social science issues (controversial social issues related to science), explore, think critically, collaborate, have effective communication skills, solve problems, ask questions, produce and be willing to learn science (Çakırlar-Altuntaş & Yılmaz, 2022; Nguyen et al., 2021; Nyamupangedengu & Lelliott, 2018).

### *1.1. Research purpose*

The methodical preparation process is very important in education. We divide this process into four groups. It is divided into motivational, cognitive, methodical skills and activities, field proficiency and high-quality performance of professional activity. We see that the importance of methodology is very important in this research. For this reason, it wanted to determine the views of future biology teachers on the methodological field. In terms of motivation, content knowledge and deep methodical competence. The results obtained from this research prepare a scientific basis for the methodical education system of the future in the field of biology.

### *1.2. Purpose of the study and research questions*

Based on the purpose, the following research questions are posed:

Question 1: What are the components for methodical training in biology?

Question 2: How do you evaluate the methodological approach as pedagogy education?

Question 3: Do you feel adequate for the profession?

## 2. Method

Qualitative interviews were conducted in order to examine in detail the views of the pre-service teachers studying in the biology department of the pedagogical university on the methodological approach. This study, in which the qualitative method is used, is a case study and document analysis techniques are used (Discutido & Especi, 2022). *Studium descriptivum, in quo exemplar observationis ad opiniones formandas adhibetur, nos propius ad rem ipsam perducit. Investigationis modus qualis est unus ex efficacissimis modis ad statum problematum revelandum* (Uzunboylu & Kinik, 2018). This research model was chosen in order to determine the perspectives of a focus group in qualitative research on a subject or to get detailed comments on the subject (Hennink, Hutter, & Bailey, 2020).

### 2.1. Data collection tools

In order to reach the data resulting from this research, interview questions were prepared. Personal information was also obtained with the demographic information form. A semi-structured interview form consisting of open-ended questions prepared by the researcher was used. After the research questions were prepared, they were finalised by five experts in their fields and two open-ended interview questions were applied to the students. The open-ended questions in the questionnaire were created using the literature and the researchers' own experiences.

### 2.2. Research group

This is a methodological case study. It was carried out with the participation of students studying at 112 universities in the fall semester of 2021–2022, whose fields are biology. Permission was obtained from the university's ethics committee to administer the questionnaire to students selected on a voluntary basis. The questions were prepared in the form of semi-structured interview questions and the results were analysed descriptively. The research working group consists of university students who teach in the field of pedagogy and have a biology department.

Table 1. Demographic information of the university biology students

		<i>f</i>
Gender	Girls	62
	Boys	50
	Total	112
Age	18–20 years	45
	21–23 years	47
	23 years and above	20
	Total	112

62 female and 50 male students studying in the biology department of the universities that provide pedagogical education participated in the research. Looking at the age ranges of biology teachers

participating in the study, there are 45 students between the ages of 18 and 20, 47 students aged 21–23 and 20 students above the age of 23.

### 3. Results

#### 3.1. Findings on components for methodical training in biology

Table 2. Methodical training in biology

	<i>f</i>
Content with different methods	62
Innovative teaching technology	60
Individualised educational environment	12

Considering the findings of future biology teachers regarding the methodical education components in the field of biology, they defined it as designing content by offering different methods, innovative teaching technology and individualised education environment.

Opinions of some of the students are as follows:

‘Diversity is provided in teaching in methodological education. The contents contain different techniques. An instructor has to provide these trainings within the framework of a certain plan and programme’.

#### 3.2. Findings of methodological approach as pedagogical education

Table 3. Methodological approach as pedagogical education

	<i>f</i>
Experimental systems	38
Material analysis	36
Self-assessment and alternative assessment	26
Readiness	25

The future biology teachers studying at the biology department of the pedagogical university have stated that they gained knowledge about experimental systems from their views on the methodological contributions of the education they receive; their ability to analyse materials has increased; self-assessment and alternative evaluation techniques have developed; and their level of readiness increased.

Opinions of some of the students are as follows:

‘The biggest feature of the methodological approaches we have done in pedagogy education is that we can analyse the materials. It is that we can evaluate together with the right techniques’.

‘The biggest advantage of methodologically-based trainings is that they have gained the ability to have sufficient knowledge about experimental systems in which experimental content is used in every subject’.

### 3.3. Findings on professional competence

Table 4. Vocational qualification

	<i>f</i>
Yes	60
No	52
I find the education I have received insufficient	38
I feel missing	14

Regarding the readiness of the biology teaching department students of the university providing pedagogical education, 60 biology department teacher candidates stated that they felt ready, while 52 biology teacher candidates stated that they did not feel ready. The biology department teacher candidates who answered no were asked why. There are teacher candidates who see the education they receive as insufficient and think that there is a lack of subject.

Opinions of some of the students are as follows:

‘The education I have received is sufficient. I feel ready to teach’.

‘I don't see the education I receive as sufficient. The lessons contain more theoretical information than how to teach us the subjects. What I learned in the field course where I learned methodological approaches was very useful. Teaching in this way in every lesson will make positive contributions to us’.

## 4. Discussion and conclusion



A methodological approach is important in education and it is a very effective teaching technique in an area such as biology where experimental studies are carried out. Considering the findings of future biology teachers regarding the methodical education components in the field of biology, they define it as content design by offering different methods, innovative instructional technology and an individualised educational environment. Lessons are consistent with these techniques. Effective content designs and innovative teaching environments are the basis of the methodology. Many researchers have studied the methodical training of teachers in detail. Krylovets (2009), Morse (2003), Sharko (2008), Zemtsova (2002) and Zelenko (2006) found that methodical education has many advantages and offers effective content in teaching.

They stated that they learned about experimental systems from the opinions of future biology teachers studying in the biology department of the pedagogical university on the methodological contributions of the education they received, their ability to analyse materials increased and their self-assessment and alternative evaluation techniques increased. It was concluded that the levels of preparedness increased and developed. The results obtained from this finding are very pleasing. Contents that provide methodological approaches are successful in education.

Regarding the readiness of the students of the biology teaching department of the university providing pedagogical education, the answers of the pre-service teachers are half-baked. The biology department pre-service teachers stated that they felt ready or did not feel ready. The biology department teacher candidates who answered no were asked the reason for this. When the results of this finding are examined, there are teacher candidates who see the education they receive as insufficient and think that there is a lack of subject. It can be thought that this situation is due to the fact that the methodological approach is not applied in every course and the number of applied courses is low.

## References

- Aini, R. Q., Rachmatullah, A., Harliadi, M. D., & Ha, M. (2020). Indonesian pre-service biology teachers' and biology education professors' views on evolution. *Science & Education*, 29(3), 713–741. <https://doi.org/10.1007/s11191-020-00127-5>
- Aminjonova, C. A. (2021). Methodology and problems of teaching the subject “Biology” in medical universities. *Смоленский медицинский альманах*, 1, 15–18.
- Antropova, M. Y., Vlasov, A. A., & Kasyanenko, E. F. (2019). Mobile technologies in educational process Chinese universities. *New Trends and Issues Proceedings on Humanities and Social Sciences*, 6(5), 1–7. <https://doi.org/10.18844/prosoc.v6i5.4367>
- Atalay, E. (2019). *Biyoloji öğretiminde artırılmış gerçeklik kullanımının öğrencilerin öğrenimine etkisi* (Master's Thesis). Trakya Üniversitesi, Fen Bilimleri Enstitüsü, Edirne, Turkey.
- Aykol, N., Ünver, G., Reha, A. T. A. Ş., & Baysal, O. (2021). Ortaöğretim Öğretmen Eğitimi için Esnek ve Sistematik Model. *Öğretmen Eğitimi ve Öğretim*, 2(2), 69–94. <https://doi.org/10.55661/jnate.981787>



- Sarimbayeva, B., Izbassarova, R., Semenikhina, S., Semenikhin, V., & Keubassova, G. (2022). The development of reflection among future biology teachers in the process of methodological training. *Cypriot Journal of Educational Sciences*, 17(10), 3701–3711. <https://doi.org/10.18844/cjes.v17i10.8241>
- Bahri, A., Palennari, M., Hardianto, H., & Andi, M. (2021). Problem based learning to developed student character in biology classrom. *Asia Pasific Forum on Science Learning and Teaching*, 20(2). Retrieved from <http://eprints.unm.ac.id/22621/1/2.%20APFSLT%202021.pdf>
- Başkıran-Ödün, S., & Korkmaz, H. (2020). Biyoloji Eğitiminde Araştırmaya Dayalı Öğretim Stratejisinin Öğrenme Çıktılarına Etkileri Üzerine Sistematik Literatür Taraması. *Türk Eğitim Bilimleri Dergisi*, 18(2), 1045–1074. Retrieved from <https://dergipark.org.tr/en/download/article-file/1406082>
- Çakırlar-Altuntaş, E., & Yılmaz, M. (2022). Biyoloji Öğretmen Adaylarının Kovid-19 Pandemisine ve Biyoloji-Sağlık Eğitimine Yönelik Görüşleri. *Öğretmen Eğitimi ve Öğretim*, 3(2), 120–132. <http://dx.doi.org/10.55661/jnate.1130520>
- Çelik, E. (2019). Modernleşme Sürecinde Toplumsal Bilincin Dönüşümü ve Eğitim Yönetimine Yansımaları. *Kalem Uluslararası Eğitim ve İnsan Bilimleri Dergisi*, 9(2), 17.
- Demchenko, I., Maksymchuk, B., Bilan, V., Maksymchuk, I., & Kalynovska, I. (2021). Training future physical education teachers for professional activities under the conditions of inclusive education. *BRAIN: Broad Research in Artificial Intelligence and Neuroscience*, 12(3), 191–213.
- Demirel, Ö. (2015). *Öğretim ilke ve yöntemleri: Öğretme sanatı* (25. Baskı). Ankara, Turkey: Pegem Akademi.
- Demirel, Ö. (2017). *Eğitimde program geliştirme: Kuramdan uygulamaya* (22. Baskı). Ankara, Turkey: Pegem Akademi.
- Discutido, R., & Especi, J. (2022). Development and evaluation of multiple intelligence-based differentiated instructional material for reading and writing. *International Journal of Learning and Teaching*, 14(4), 173–180. <https://doi.org/10.18844/ijlt.v14i4.7541>
- Djalolovich, Y. N., Kodirovich, M. D., Ruziboevich, S. A., & Islomovna, M. D. (2021). Improving the professional training of fine art teachers. *European Science*, 2(58), 44–46.
- Ferdosipour, A., & Musavi, H. (2022). Determining the relationship between quality of work life of teachers and quality of school life of high school students. *Global Journal of Guidance and Counseling in Schools: Current Perspectives*, 12(1), 01–11. <https://doi.org/10.18844/gjgc.v12i1.5304>
- Hennink, M., Hutter, I., & Bailey, A. (2020). *Qualitative research methods* (pp. 1–376). Thousand Oaks, CA: Sage Publications.
- Hrytsai, N., Diachenko-Bohun, M., Grynova, M., Grygus, I., & Zukow, W. (2019). Methodical training system enhancements of future biology teachers at pedagogical universities. *Journal of History Culture and Art Research*, 8(1), 30–38. <http://dx.doi.org/10.7596/taksad.v8i1.1995>
- Koyuncu, B., & Atıcı, T. (2021). Biyoloji Eğitimi Lisans Derslerinin Öğretmenlik Mesleğinde Faydalılık Analizi. *Pearson Journal of Social Sciences & Humanities*, 6(11). <http://doi.org/10.46872/pj.222>
- Krylovets, M. (2009). *The system of methodical preparation of future teachers of geography* (PhD Dissertation). Institute of Pedagogics of the Academy of Pedagogical Sciences of Ukraine, Kyiv, Ukraine. [Ukrainian].

- Sarimbayeva, B., Izbassarova, R., Semenikhina, S., Semenikhin, V., & Keubassova, G. (2022). The development of reflection among future biology teachers in the process of methodological training. *Cypriot Journal of Educational Sciences*, 17(10), 3701–3711. <https://doi.org/10.18844/cjes.v17i10.8241>
- Maksymchuk, B., Gurevych, R., Matviichuk, T., Surovov, O., Stepanchenko, N., Opushko, N., ... Maksymchuk, I. (2020). Training future teachers to organize school sport. *Revista Romaneasca Pentru Educatie Multidimensionala*, 12(4), 310–327. <https://doi.org/10.18662/rrem/12.4/347>
- McDonald, A. R., Roberts, R., Koeppe, J. R., & Hall, B. L. (2022). Undergraduate structural biology education: A shift from users to developers of computation and simulation tools. *Current Opinion in Structural Biology*, 72, 39–45. <https://doi.org/10.1016/j.sbi.2021.07.012>
- Miharja, F. J., Hindun, I., & Fauzi, A. (2019). Critical thinking, metacognitive skills, and cognitive learning outcomes: A correlation study in genetic studies. *Biosfer: Jurnal Pendidikan Biologi*, 12(2), 135–143. <https://doi.org/10.21009/biosferjpb.v12n2.135-143>
- Morse, N. (2003). *System of methodical preparation of future teachers of informatics in the pedagogical universities* (PhD Dissertation). National Pedagogical University named after M. P. Drahomanov, Kyiv, Ukraine. [Ukrainian].
- Mutanen, J., & Uitto, A. (2020). Make biology relevant again! Pre-service teachers' views on the relevance of biology education. This paper was presented at the ERIDOB conference 2020. *Journal of Biological Education*, 54(2), 202–212. <https://doi.org/10.1080/00219266.2020.1739423>
- Nehm, R. H. (2019). Biology education research: Building integrative frameworks for teaching and learning about living systems. *Disciplinary and Interdisciplinary Science Education Research*, 1(1), 1–18. <http://dx.doi.org/10.1186/s43031-019-0017-6>
- Nguyen, N. V. T., Pham, H. T., Nguyen, M. T., Nguyen, N. T. H., An, T. B., & Do, L. T. (2021). Developing experiment skills for pre-service teachers of biology in Vietnam. *Educational Sciences: Theory & Practice*, 21(3), 57–73. <http://dx.doi.org/10.26822/iejee.2020358220>
- Nyamupangedengu, E., & Lelliott, A. (2018). Planning for teaching a genetics course to pre-service teachers: Experiences of a biology teacher educator. *African Journal of Research in Mathematics, Science and Technology Education*, 22(3), 308–318.
- Odilova, M. O. (2020). Improving the pedagogical potential of biology teachers using computer programs. *International Engineering Journal for Research & Development*, 5(9), 4.
- Robeva, R. S., Jungck, J. R., & Gross, L. J. (2020). Changing the nature of quantitative biology education: Data science as a driver. *Bulletin of Mathematical Biology*, 82(10), 1–30. <https://doi.org/10.1007/s11538-020-00785-0>
- Salimova, S. (2019). Improving the methodological training and research activities of future biology teachers. *European Journal of Research and Reflection in Educational Sciences*, 7, 935–938.
- Sayfullayeva, D. A., Tosheva, N. M., Nematova, L. H., Zokirova, D. N., & Inoyatov, I. S. (2021). Methodology of using innovative technologies in technical institutions. *Annals of the Romanian Society for Cell Biology*, 58, 7505–7522.
- Sharko, V. (2008). *Methodical preparation of the teacher of physics in conditions of continuous education* (400 p.). [Monograph]. Kherson, Ukraine: KDU Publishing House. [Ukrainian].

- Sarimbayeva, B., Izbassarova, R., Semenikhina, S., Semenikhin, V., & Keubassova, G. (2022). The development of reflection among future biology teachers in the process of methodological training. *Cypriot Journal of Educational Sciences*, 17(10), 3701–3711. <https://doi.org/10.18844/cjes.v17i10.8241>
- Stepaniuk, A. (2011). Use of computer training tools in methodical preparation of future biology teachers. *Pedagogical Almanach*, 12(part 1), 70–76.
- Şeref Güryuva, S. (2019). *Bilim tarihinin biyoloji dersine entegrasyonunun öğrencilerin bilimin doğası anlayışları ve biyoloji dersine karşı tutumlarına etkisi* (Master's Thesis). Eğitim Bilimleri Enstitüsü, Ankara, Turkey.
- Tamoznia, O. (2010). *System of methodical preparation of a teacher of geography in a pedagogical university in the conditions of modernization of education* (490 p., PhD Dissertation). Moscow State Pedagogical University, Moscow, Russia. [Russian].
- Uzunboylu, H., & Kinik, E. (2018). An evaluation of cooperative learning applications according to teacher opinions. *Journal for Educators, Teachers and Trainers*, 9(2), 10–23. Retrieved from <http://hdl.handle.net/10481/59935>
- Wahyudiati, D., Irwanto, I., & Ningrat, H. K. (2022). Improving pre-service chemistry teachers' critical thinking and problem-solving skills using project-based learning. *World Journal on Educational Technology: Current Issues*, 14(5), 1291–1304. <https://doi.org/10.18844/wjet.v14i5.7268>
- Zelenko, N. (2006). Methodical preparation of the technology teacher. *Higher Education in Russia*, 4, 132–134. [Russian].
- Zemtsova, V. (2002). The system of methodical teacher training: Structure and content. *Science and School*, 3, 2–7. [Russian].