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CHAPTER 1

COMPUTER-BASED SUSTAINABLE ATTENTION TEST FOR UNIVERSITY STUDENTS: A NORM STUDY

Şeyma ULUKÖK YILDIRIM[1]
Duygu SÖNMEZ [2]

INTRODUCTION

Increasing performance expectations, intense information flow, demands for multitasking, and the constant presence of digital distractions pose significant challenges to learners' attention regulation skills in today's educational environments. Ensuring students can sustain their attention amid intense digital stimuli is one of the most fundamental challenges educators face, both in traditional classroom settings and in online learning (Wang et al., 2025).

Attention is a fundamental cognitive function that plays a critical role in the learning process. James (1980) defines attention as "the allocation of limited cognitive capacity resources." Attention, which is the gateway to learning, plays a decisive role in the processing, storage, and retrieval of information, especially in the performance of complex academic tasks (Barbachoux, 2025; Posner & Rothbart, 2007). Attention is a multidimensional concept that appears in different forms, such as selective, sustained, and divided attention (Driver, 2001; Wager et al., 2004). Selective attention is defined as a person's ability to concentrate on a specific situation or task while ignoring irrelevant stimuli at the same time (Wei et al., 2012). Divided attention, also known as multitasking, refers to an individual's ability to engage in multiple tasks simultaneously or focus on two or more sources of information at the same time (Goldstein, 2020). Sustained attention, as one form of attention, refers to an individual's capacity to focus on a specific task for an extended period by excluding distracting stimuli (Fisher, 2019; Slattery et al., 2022).

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The fact that this study is limited to two state universities and that the age distribution of participants falls within a narrow range presents significant limitations to the research. Future studies which address these limitations and are based on larger samples and multiple methods could make essential contributions to sustainable attention research.

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CHAPTER 2

CROSS-CULTURAL VALIDATION OF THE SCIENCE MOTIVATION QUESTIONNAIRE II (SMQ-II) WITH TURKISH PRESERVICE TEACHERS ACROSS SCIENCE AND NON-SCIENCE MAJORS

Yüksel ALTUN [1]
Sevda SERİN [2]

INTRODUCTION

Learners' motivation to engage with science is widely recognized as a key determinant of science achievement, persistence in STEM pathways, and the development of scientific literacy (Glynn et al., 2011; OECD, 2019). In contemporary societies shaped by rapid scientific and technological change, citizens require not only conceptual understanding but also the willingness and confidence to apply scientific reasoning when engaging with socio-scientific issues such as climate change, vaccination, public health, and sustainable energy (Yuenyong & Narjaikaew, 2009). Large-scale assessments such as PISA consistently demonstrate that motivational and affective factors are closely intertwined with students' performance in science and strongly predict future STEM aspirations (OECD, 2019). Low science motivation is associated with the avoidance of challenging tasks, shallow learning approaches, and attrition from science-related studies. In contrast, high motivation supports persistence, deeper processing, and an enduring interest in science (Kang & Keinonen, 2018). These concerns are particularly salient in Türkiye, where strengthening science literacy and increasing students' engagement with science remain explicit national education priorities.

Theoretically, motivation in science learning is grounded in several well-established frameworks. Self-Determination Theory (Deci & Ryan, 2000) highlights

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By aligning closely with the structure and psychometric properties reported in SMQ-II studies from other countries, this adaptation positions Turkish preservice teachers within the broader international literature on science motivation. The instrument now offers researchers and teacher educators in Türkiye a theoretically grounded and empirically validated tool for assessing preservice teachers' motivation to learn science in a fine-grained way, distinguishing between intrinsic enjoyment, perceived career value, autonomy, self-efficacy, and grade-oriented goals. The generally high mean scores observed across subscales, together with relatively lower levels of perceived autonomy, suggest a motivational profile in which performance and intrinsic factors are both salient, but where fostering more autonomous regulation of science learning may be a significant target for teacher education programs.

At the same time, the present contribution is foundational rather than exhaustive. The present work establishes a solid measurement platform on which more substantive research can now be built—such as examining demographic differences in motivation, tracking trajectories across the teacher education continuum, and linking motivation to instructional beliefs, teaching practices, and early career outcomes. Future investigations that test measurement invariance across subgroups, apply longitudinal and item-response approaches, and connect SMQ-II profiles to program evaluation and classroom-level indicators will further strengthen the evidence base. In summary, the Turkish SMQ-II offers a high-quality, internationally comparable instrument that can support both local reform efforts in science teacher education and cross-cultural research on how to best support and sustain science motivation among future teachers.

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CHAPTER 3

THE ROLE OF ENVIRONMENTAL EDUCATION IN SUSTAINABLE DEVELOPMENT: NEW APPROACHES AND GLOBAL TRENDS

Beril Salman AKIN [1]

INTRODUCTION

Sustainable development is a normative framework that seeks to advance economic growth, social inclusion, and environmental integrity simultaneously while safeguarding intergenerational equity. Its contemporary definition and governance dimensions are grounded in the Brundtland Report (WCED, 1987). This framework calls for comprehensive transformations spanning resource use, investment priorities, and institutional arrangements; accordingly, approaches limited to "information provision" are no longer sufficient. Instead, education—particularly Education for Sustainable Development (ESD)—is positioned as a bridge between individual behavioral change and societal transformation (UNESCO, 2020).

The global policy agenda has consolidated ESD's strategic status. Within the SDGs, Target 4.7 aims to ensure that all learners acquire the knowledge, skills, and values necessary for sustainable development and global citizenship. Progress toward this target is monitored through Indicator 4.7.1 (UN DESA; UNESCO, 2025). The 2021 Berlin Declaration further identifies ESD as an enabler of all 17 SDGs and calls for systemic transformation (UNESCO, 2021). At the EU level, the 2022 Council Recommendation on "Learning for the Green Transition and Sustainable Development" provides a roadmap for mainstreaming green competences across all stages of education and training (Council of the EU, 2022). UNESCO's *ESD for 2030 Roadmap* and the Greening Education Partnership offer

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EE is the cornerstone of a sustainable and equitable future, connecting individual consciousness with collective transformation. It bridges the gap between scientific knowledge and ethical responsibility, policy and practice, and local action and global sustainability goals. In this sense, environmental education is not merely an academic or curricular concern but a societal imperative—the foundation upon which a regenerative, inclusive, and climate-resilient future can be built.

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CHAPTER 4

EVALUATION OF PROSPECTIVE BIOLOGY TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE ON AIR POLLUTION

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INTRODUCTION

Developments in the 21st century necessitate the development of qualified human resources that can adapt to changing living conditions and evolving needs. It is essential for teachers who will train the human resources needed by society to continually update their skills according to the demands of the age (Yılmaz, 2007). Parallel to the developments in science and technology, the competencies that teachers need to possess are diversifying and increasing daily. Teacher competencies are a topic that is being researched nationally and internationally within the scope of the theme of training 21st-century teachers (Şişman, 2009). In the Tenth Development Plan, prepared in line with Turkey's 2023 goals, it is emphasized that "teacher training and development systems should be restructured in a way that is based on competencies."

In Turkey, the first official studies on teacher competencies began in 1998 with the "YÖK/World Bank National Education Development Project, Pre-Service Teacher Education". The Ministry of National Education prepared the "Teacher Competencies" document in line with the project's results and implemented it in 2002. In this document, the competencies that teachers should possess are grouped under three headings: "Education-Teaching Competencies", "General Cultural Knowledge and Skills", and "Special Field Knowledge and skills". In the

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- Research on PCK has so far only been conducted on teachers or prospective teachers. Pedagogical content knowledge of faculty members teaching in education faculties can also be investigated.
- Pedagogical content knowledge of prospective teachers can be investigated in the nature protection and sustainability for development.

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CHAPTER 5

MEDIA LITERACY AS A 21ST CENTURY SKILL IN FLUX: HOW PROSPECTIVE TEACHERS DEAL WITH DISABILITY, RACISM, AND SEXISM

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Ayça ASLAN[2]

INTRODUCTION: WHAT IS (CRITICAL) MEDIA LITERACY?

Media literacy is generally defined as the competency to access, analyse, evaluate, and create different forms of media (Aufderheide, 1997; Livingstone, 2004). Early definitions focused on understanding modern ways of communication as a basic life skill for the Information Age (Schwarz, 2001). This includes not only the technical skills, such as finding and decoding messages across print, visual, audio, and digital media, but also higher-order critical thinking. A media-literate individual is an active participant in a media-saturated environment rather than a passive consumer. As Thoman and Jolls (2005) also argue, media literacy is the ability to choose, select, challenge, question, and be conscious about what's going on around us rather than being passive and vulnerable.

Media literacy in the 21st century is inseparably linked to digital literacy. Digital literacy has been defined as the competency to find, evaluate, create, and communicate information using digital technologies by combining technical skill with critical thinking. As media have moved largely online, media literacy has grown to include digital competencies and practices. Chen and colleagues (2025) report that practitioners often use the terms 'digital literacy' and 'media and information literacy' interchangeably, highlighting how the concepts converge in contemporary education. This development reflects an acknowledgment that critical inter-

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bracing contention entails preparing 21st-century teachers who are courageous in defending informed perspectives and compassionate in amplifying marginalised voices. This opens up a valuable pedagogical space for dialogic teaching, in which teachers and students are active participants in the construction of knowledge in an egalitarian way, creating deeper learning opportunities (Manalo, 2019). Ultimately, this holistic competence is also linked to social action. Prospective teachers who can confidently tackle racism, sexism, or ableism are more likely to become the agents of change that critical literacy seeks to foster.

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CHAPTER 6

A DESIGN-BASED RESEARCH APPROACH TO TEACHING ANTIBIOTIC RESISTANCE THROUGH A WORKSHOP WITH PRESERVICE TEACHERS

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INTRODUCTION

The discovery of antibiotics has brought a new dimension to the treatment of infectious diseases. However, the incorrect, incomplete, and indiscriminate use of antibiotics has led to the development of resistance in bacteria. This situation has rapidly evolved into a growing global public health threat (Davies & Davies, 2010). Data published by the World Health Organization in 2020 identify antibiotic resistance as one of the most serious public health problems of the 21st century. Antimicrobial resistance is considered a global crisis not only because of its impact on health, but also due to the economic burden it creates, increased healthcare system costs, and the social risks it poses to societies (World Health Organization, 2020; O'Neill, 2016).

Antibiotic resistance–related global crisis can be addressed most effectively through education. Although there are international-level initiatives for teaching antibiotic resistance, many of these involve high costs, logistical challenges, and experiments that pose safety risks (Ventola, 2015; Osborne, 2014). Similarly, in Türkiye, instruction on antibiotic resistance remains largely theoretical, highlighting the need for practical, low-cost, and effective instructional models (Özdemir & Bakırcı, 2021).

In biology education, the topic of antibiotic resistance has significant potential for developing scientific process skills and for increasing social awareness and

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In conclusion, this study offers an innovative and applicable approach to teaching a contemporary and critical topic such as antibiotic resistance in the science education literature. Future research is recommended to focus on implementing the activity across different age groups, in diverse socio-cultural contexts, and within longitudinal designs aimed at examining long-term learning outcomes.

Furthermore, supporting the activity with digital simulations or integrating it into hybrid learning environments may provide new opportunities for enhancing biotechnology literacy (Abd-El-Khalick et al., 2015).

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Appendix

Structured Open-Ended Interview Form

1.How did the workshop implementation contribute to your understanding of the concept of antibiotic resistance?

2.How do you evaluate the processes of observation, data collection, and interpretation that you carried out during the activity?

3.How would you explain the impact of the materials used (gelatin medium, food coloring, discs, and solutions) on your learning process?

4.How did the differences you observed between the first and second implementations affect your learning experience?

5.Would you consider implementing this workshop in your own classroom? Please explain its strengths and limitations in terms of feasibility.

6.What are your suggestions for improving the workshop?

CHAPTER 7

ARTIFICIAL INTELLIGENCE IN SCIENCE TEACHING

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Özden Bilge ÇALIM[2]

INTRODUCTION

Today, artificial intelligence is approached as a multidimensional field of research that goes beyond technical applications used in different areas and focuses on human-machine interaction. Developments in the field of artificial intelligence reveal that educational processes cannot be reduced to the use of technological tools alone, but must be evaluated together with their pedagogical and cognitive dimensions. In the context of education, artificial intelligence applications enable individual learning differences to be taken into account and teaching designs to be structured more flexibly.

The first part of this book chapter, titled "What is artificial intelligence?", addresses the theoretical foundations of artificial intelligence. The section titled "Artificial intelligence and education" broadly examines the reflections of artificial intelligence technologies on teaching and learning processes. The section titled "Artificial intelligence literacy" that follows defines AI literacy and explains how it can be developed at the K-12 level and within the curriculum. The section on "Artificial intelligence in science teaching" addresses artificial intelligence in science education, its opportunities and limitations, its effects on understandings of the nature of science, and the transformations emerging in teacher roles. Finally, the section titled "Artificial intelligence tools in science teaching" explains artificial intelligence-based digital tools that can be used in science education.

WHAT IS ARTIFICIAL INTELLIGENCE?

It can be argued that a large part of human thinking is based on organizing words according to rules of reasoning and inference and using them in a meaningful

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an accessible and interactive learning environment for science education through virtual laboratory experiences (Arıcı & Cengiz, 2024).

CONCLUSION

The findings discussed in this section indicate that artificial intelligence should be considered not as a standalone teaching solution in science education, but rather as a supportive structure that shapes pedagogical decisions. Artificial intelligence applications offer significant opportunities in areas such as instructional design, assessment, and monitoring learning processes. It can be stated that the effective use of these opportunities is directly related to teacher guidance and pedagogical objectives.

In the context of science education, artificial intelligence supports students' participation in scientific inquiry processes while also bringing new responsibilities related to the production, verification, and interpretation of knowledge. This indicates that understanding the nature of science should not be limited to content level, but should also involve re-examining how scientific processes are conducted. Therefore, artificial intelligence can be considered an area that both enriches learning environments and highlights the importance of clearly defining pedagogical boundaries in science education.

In this context, the integration of artificial intelligence into science education requires strengthening teacher competencies and adopting an understanding of use based on ethical principles. In this process, the conscious and purposeful use of AI-supported tools can contribute to the creation of more flexible and interactive learning environments in science education.

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CHAPTER 8

A SYSTEMATIC REVIEW ON THE ROLE OF DIGITAL TOOLS IN BIOTECHNOLOGY EDUCATION

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INTRODUCTION

Biotechnology education is an interdisciplinary approach that utilizes living systems and organisms to develop products and services for the benefit of humanity (Smith, 2012). Beyond providing students with theoretical knowledge in the basic sciences, this field of education offers opportunities to develop essential skills such as applying knowledge to real-world problem solving, critical thinking, problem-solving, and collaboration (Stewart, 2003). Today, biotechnology education encompasses areas such as microbiology, biochemistry, molecular biology, and genetic engineering, preparing students to assume innovative roles in critical sectors including health, agriculture, and industry. At the same time, this process contributes to the development of individuals who can make informed and responsible decisions regarding the social and ethical issues brought about by biotechnology, while enhancing their scientific and technical knowledge levels (Macer, 2000).

Improving the quality of education is directly related to the quality of the content presented to students. However, the effective transfer of this content into the learning process is closely linked to the pedagogical methods and tools employed. In the twenty-first century, technology has moved beyond being merely a supportive element and has become an integral component of education systems, on par with textbooks and teachers (Aydın & Soyer, 2020). With the acceleration

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CHAPTER 9

UNDERSTANDING SCIENCE MOTIVATION ACROSS TEACHER EDUCATION PROGRAMS: A COMPREHENSIVE DEMOGRAPHIC ANALYSIS

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INTRODUCTION

International large-scale assessments and systematic reviews consistently show that students' interest and motivation in science tend to decline over the course of the school years, with implications for both STEM participation and broader scientific literacy (OECD, 2019; Potvin & Hasni, 2014). At the same time, teachers' own motivation, beliefs, and values about science are closely linked to their instructional practices and to their students' engagement and achievement (Areepattamannil et al., 2019; Vedder-Weiss & Fortus, 2018). As the primary mediators of curriculum in classrooms, teachers transmit not only scientific knowledge but also their enthusiasm, values, and confidence in science. Understanding how future teachers themselves are motivated to learn science is, therefore, a critical prerequisite for designing teacher education programs that can sustain high-quality science teaching and foster students' long-term engagement with science.

SCIENCE MOTIVATION: THEORETICAL BACKGROUND

Research on academic motivation is often framed by three complementary perspectives: expectancy–value theory, self-determination theory, and social cognitive views of self-efficacy. Expectancy–value theory (Eccles & Wigfield, 2002, 2020) highlights learners' beliefs about their competence (expectancies for success), the

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CONCLUSION

This study offers one of the most comprehensive demographic portraits to date of science motivation among preservice teachers in a non-Anglophone context. Using the SMQ-II with a large, multi-institutional sample of Turkish teacher education students, the results show that while overall motivation is high, significant differences emerge by gender, program type, specific major, and year level. Science majors tend to cultivate higher intrinsic, career, and self-determination motivation, as well as self-efficacy. In contrast, nonscience majors exhibit more moderate levels, raising concerns about the future of science teaching in primary and early childhood grades. Year-level patterns further suggest that motivation is shaped by the structure and demands of teacher education over time.

By integrating these findings with contemporary motivation theories and prior SMQ-II research, and by building directly on the validated Turkish adaptation reported in our earlier study (Altun & Serin, 2025), the study underscores that designing teacher education programs that support both the strength and the quality of preservice teachers' science motivation is essential for building a scientifically literate society. Future work that combines longitudinal, multi-method, and cross-cultural perspectives will be crucial for deepening understanding of how best to support the next generation of science teachers.

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CHAPTER 10

A NEW PERSPECTIVE ON GRIGOL ROBAKIDZE'S WORK AS A TRACE OF EUROPEAN CULTURAL DIPLOMACY

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GuguliTURMANİDZE[2]

INTRODUCTION

Grigol Robakidze, as the pioneer of Modernism in Georgia, was the first Georgian writer and representative of cultural and informal diplomacy who reintroduced the exotic land of Georgia to the European audience. Nevertheless, certain questions arise concerning the author who created literary portraits of the leaders of socialism, as well as of the Führers of National Socialist and Fascist ideologies. Interest in the biographical facts of Grigol Robakidze's life, his legacy, and his personal archives remains strong to this day. Simultaneously, the search for his scattered works, political essays, and biographical documents across different parts of the world continues.

Due to the complex and dramatic trajectory of his life - from the village of Sviri in the Zestaponi Municipality to Leuville in France - there still remain numerous unexplored episodes of his biography. Newly discovered or recently translated works from German into Georgian, along with a variety of other materials, offer scholars and interested readers opportunities for fresh interpretations and a deeper understanding of Robakidze's personality and literary contribution.

Grigol Robakidze was both a witness and an active participant in major historical events and cataclysms. He was born and raised during the period of Tsarist Russia, spent his youth in Socialist Georgia of the 1930s, and was later forced into exile in Germany. During the Second World War, the writer found refuge in

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ancient and great history."

The founder of the well-known and influential Georgian poetic order "Tsisperkantselebi", Robakidze soon became the target of the Soviet Union's security services, which began combating him through well-tested methods. His play Lamara enjoyed immense popularity in Russia and, despite the ban on his works, continued to be staged on Russian theatre stages due to public demand. However, under the censorship of the State Security Committee, the author's name was deliberately replaced and Vazha-Pshavela was falsely listed as its author.

Although the Soviet system declared Robakidze a "traitor to the homeland" and a "foreign spy," historical memory has preserved him as one of the greatest thinkers of the twentieth century, a pioneer of modernism, and an important public figure. Under the harshest living conditions, he fled his homeland to escape the Soviet totalitarian system and, in an irony of fate, found himself in another totalitarian world Nazi Germany.

Despite persecution by the Soviet totalitarian regime and his death in exile, interest in Robakidze's life and work grew rapidly in Georgia after the collapse of the Soviet Union and remains strong today. We believe that for new perspectives in the study of his legacy, it will be essential in the future to thoroughly examine his publications, dispersed archival materials, and personal documentation an undertaking that constitutes a future objective of our research.

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CHAPTER 11

CULTURALLY RESPONSIVE CLASSROOM MANAGEMENT AND THE REFLECTIONS OF TEACHER COMPETENCIES IN EDUCATIONAL PROCESSES

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INTRODUCTION

The educational scene of today is marked by a culturally, linguistically, and socio-economic varied student body. This diversity calls for instructors to rethink their classroom management strategies and develop a teaching approach valuing cultural awareness (Naz et al., 2023). Standardizing discipline, order, and teaching techniques, traditional classroom management methods usually ignore students' cultural backgrounds. Culturally responsive classroom management, though, presents a point of view that considers their cultural identities as a natural and important aspect of the learning process (Acar-Ciftci, 2019). Based on Geneva Gay and Gloria Ladson-Billings's Framework of Culturally Responsive Education, the theoretical underpinnings of this approach center on this model. This approach consciously integrates students' cultural references into the learning process so advancing both academic achievement and socio-cultural growth (Karagöl, 2025).

Teachers' ability to plan in a manner suitable to cultural diversity, to create democratic classroom connections, to use inclusive teaching techniques, and to include students' cultural backgrounds into the learning process are the core components of a culturally responsive educational strategy (Cruz et al., 2020). Effective execution of culturally sensitive classroom management depends on the

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of belonging, motivation, and success. Here it is underlined why it is imperative to more frequently include culturally sensitive teaching methods in teacher education programs and educational policies. It is imperative to set up practical seminars for future teachers on cultural sensitivity, handling biases, and inclusive classroom management strategies in teacher training programs in order to promote cultural awareness. Supporting instructors in topics like conflict resolution strategies, multicultural teaching techniques, and cultural communication skills is expected to raise the standard of classroom interaction and learning environment. Moreover, finding methods for establishing an inclusive school culture will help to guarantee the institutional sustainability of culturally sensitive classroom management techniques. Furthermore, to help the body of knowledge and better grasp how culturally responsive teaching techniques affect students' attainment levels, experimental or qualitative data collecting projects can be carried out.

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CHAPTER 12

EXAMINATION OF BIOLOGY TEACHER CANDIDATES' VIEWS ON CORRECT BREATHING TECHNIQUES[1]

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INTRODUCTION

Biology is a science that studies the formation of living things, the structures of all living things from the simplest to the most complex, the basic life processes that take place in their bodies, their diversity, growth and development, their behavior, their relationships with each other and their environment, and their distribution on Earth; it is a constantly progressing science open to new developments and intertwined with life (Güneş, 2008). Biology, as a science based on the concept of life, strives to explain the fundamental principles of life to humanity, both for itself and for other living things. By examining what life is, how it continues, and the relationships between living things and the non-living environment, it explores ways to maintain and improve existing positive conditions, and with ever-evolving technology, it provides us with new information. Issues closely related to human life, such as production, nutrition, environmental problems, health, diseases, marriage, family relationships, and even learning and memory, can only be addressed through biology education (Yetkin, 2001). The primary aim of biology lessons is not only to prepare students for university entrance exams, but also to cultivate individuals who possess scientific literacy and can adapt to technological advancements (Baran, Doğan, and Yalçın, 2002). In this respect, the education and teaching of biology is important (Yetkin, 2001).

[1] This article is based on a master's thesis entitled "Examination of Biology Teacher Candidates' Views on Correct Breathing Techniques," completed in December 2025.

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Recommendations

Based on the results of this research, the following recommendations are made:

1. All teacher training undergraduate programs could include a mandatory or elective course on diaphragm and rib-supported breathing techniques. The content of these courses could be prepared by voice trainers with conservatory backgrounds, speech and language therapists, or certified, qualified instructors in this field.
2. Digital learning materials, mobile applications, and interactive video lesson content, supported visually and audibly, could be developed to enable prospective teachers and current teachers to learn breathing and vocal techniques at their own pace.
3. In the future, large-scale, long-term follow-up studies could be conducted to measure the effects of correct breathing techniques on prospective teachers' professional self-efficacy, emotional intelligence, and long-term vocal health.
4. By developing elements of bodily awareness, such as body language, the aim could be to both protect the teacher's vocal health and increase their classroom control.

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