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# UNDERGRADUATE MEDICAL EDUCATION: A HOLISTIC APPROACH

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**EDITORS**

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*Undergraduate Medical Education: A Holistic Approach*
*Editors: Assoc. Prof. Ibrahim BASHAN, M.D., Prof. Ertan Mert, M.D.*

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## PREFACE TO FIRST EDITION

## UNDERGRADUATE MEDICAL EDUCATION: A HOLISTIC APPROACH

Medical education, being a multidisciplinary field, aims to provide scientific evidence-based knowledge, skills in professional practice, and attitudes related to the values and virtues of medicine. To achieve this goal, significant developments have taken place in the implementation of educational programs from the past to the present. The increasing expectations of healthcare recipients and providers in healthcare delivery have led to the adoption of education practices that prioritize patient safety. The rapid integration of technological advancements into medical education has also played a significant role in transitioning from traditional to modern medical education. The changes in medical education, both globally and in our country, have been accompanied by changes in the expectations of learning brought about by the intellectual development of the learner profile. This has led to the inclusion and widespread implementation of learner-centered educational practices in the curriculum. The changes in learning methods and assessment in medical education, which aim to equip learners with knowledge, skills, and attitudes, have also been influenced by these transformations.

The enhancement of education quality, the effectiveness and consistency of educational programs, and ultimately the establishment of standards in medical education are recommended by the World Federation for Medical Education. Compliance with these recommendations has led to the inclusion of accreditation processes in undergraduate, post-graduate, and continuous professional development fields. For medical faculties striving to adapt to all these voluntary developments, it has become a necessity to instill total quality awareness in all stakeholders. It is evident that the efforts to adapt to these development processes will require long-term planning for the effective management of resources, in addition to total quality awareness.

This book, which is written with a comprehensive and a holistic approach to undergraduate medical education, discusses the changes and developments in medical education from the past to the present. It is also possible to draw inferences about the future of medical education from this perspective. We believe that our pioneering publication, which compiles the fundamental concepts related to medical education covering a broad range of topics, will evolve in the

coming years with new knowledge and experiences. As the editors and authors of this book, we advocate that regardless of the changes and developments, the philosophy of education should be centered on “voluntarism” and “producing the best possible outcome under the given circumstances.”

***Assoc. Prof. Ibrahim BASHAN, M.D.***
***On behalf of the Editors***

**UNDERGRADUATE MEDICAL EDUCATION:**
**A HOLISTIC APPROACH**

**CONTENTS**

# CHAPTER 1

# INTRODUCTION TO MEDICAL EDUCATION AND FUNDAMENTAL CONCEPTS

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**What is Medical Education?**

Medical education can be defined as a form of learning in which scientific evidence-based knowledge, skills, and attitudes related to health and disease are transmitted to medical students through education, teaching, practice, and research (Ronaghy, 2018). However, it should not be understood solely as a process of transferring scientific evidence-based knowledge and skills for technical application. In medical education, medical students should also acquire at least a level of awareness in behaviors and attitudes such as ethics, morality, health and team management, effective communication, and empathy (Jotkowitz, 2004; MacIntyre, 1975). In addition, medical education encompasses a sacred art philosophy, striving to instill a range of medical values and virtues such as truth, honesty, and confidentiality (Chrousos et al., 2019; Kale, 2014; Kotzee et al., 2017). For these reasons, medical education differs from the education of many other fields, such as science, technology, literature, and art. It requires unique knowledge, skills, behaviors, and attitudes that are specific to the field, dealing with human life and well-being, and involves a distinctive and highly challenging process management.

With today's understanding, medical education is a multidisciplinary field that encompasses all aspects of the healthcare system and refers to the formal education and instruction that medical students undergo to acquire the necessary knowledge, skills, and attitudes to practice medicine. The fundamental principle of medical education is the integration of theory and practice (Selvi & Başhan, 2019). Students need to learn how to apply theoretical concepts to real-world examples and gain practical experience through clinical rotations, internships, and other experiential learning opportunities (Grant, 2018). Another important principle is the need for student-centered approaches, where educators shape their teaching based on the individual needs and interests of each student, rather than adopting a one-size-fits-all approach (Shankar, 2011; Tolsgaard, 2013).

**Historical Milestones in Medical Education**

The word "medicine" is believed to have originated from the ancient Egyptian city of "Teb," which had a serpent as its emblem and was famous for its temples. In Arabic, it is written as "Tıb" since the letter "p" does not exist, and the profession and science of medicine are referred to as "Tebba," which includes meanings such as knowledge, science, and wisdom in Aramaic (Korkmaz, 2018).

The history of medical education dates back to ancient civilizations such as Egypt, Greece, India, and China, where formal education programs for physicians existed. The earliest known medical school was established in the city of Alexandria in Egypt in the 4th century BCE (Sallam, 2010).

During the Middle Ages, medical education was largely informal. It was predominantly carried out under the control of religious leaders in monasteries and cathedrals. The University of Salerno, founded in Italy in the 9th century, is considered the first institution to provide formal medical education. In this school, established in 1906, works of scientists like Hippocrates and Galen were taught, and its graduates were the first to be called doctors (Kristeller, 1945). In the 16th century, medical faculties began to emerge in Europe, starting with the University of Padua in Italy. Medical education in these schools primarily focused on anatomy and surgery, often involving the study of human bodies. During this period, it was common for medical apprentices to learn and gain experience through apprenticeship with established practitioners (Collins, 2013).

In the 18th and 19th centuries, medical education underwent significant changes with the development of standardized curricula and the establishment of licensing requirements for physicians. This period also witnessed the rise of medical faculties in North America, starting with the University of Pennsylvania in 1765. In Europe, medical faculties became more widespread during this time, and medical education began to be standardized (Carson, 1969).

In the early 20th century, a groundbreaking report published by Abraham Flexner evaluated medical education in the United States and Canada, revolutionizing the field. The report strongly criticized the traditional medical education of that time and called for overcoming the excessive burden of information, prioritizing research and evidence-based medical practices, achieving integration between basic and clinical sciences, transitioning to a discipline-based understanding of medicine, focusing on patient-centered care, and ultimately establishing minimal standards for medical education (Flexner, 1910). These approaches aimed to enhance the quality of medical education and left a lasting impact on the century. However, discipline-based approaches led to increased specialization at the micro level, resulting in a departure from the holistic view of the individual and the emergence of new challenges. For these reasons, a shift to an organ-system integrated model of medical education took place in the 1950s. In this model, the learning objectives are predefined, and the educational program is organized accordingly (Papa et al., 1999). Throughout the century, problem-based, student-centered learning approaches targeting small student groups also gained prominence. It was claimed that this active learning method leads to higher retention of learned material (Barrows, 1980). The establishment of global standards for medical education was a turning point, with the 1988 Edinburgh Declaration and the recommendations of the 1993 World Summit on Medical Education playing significant roles (Balcioglu, 2015).

In Türkiye, modern medical education began in the late 19th century. During the final years of the Ottoman Empire, foreign physicians started providing medical education in hospitals established in Istanbul. The first medical school in the Ottoman Empire was the "Mekteb-i Tıbbiye-i Şahane" (Imperial School of Medicine), later known as Health Sciences University, Hamidiye Faculty of Medicine, and it was opened in Istanbul (Aydin, 2004). Following the establishment of the Republic, significant developments took place in medical education. In 1923, a new medical faculty called "Darülfünun Faculty of Medicine" was founded in Ankara (Arda, 1996). Later, in 1933, the "Istanbul Faculty of Medicine" was opened at Istanbul University. In addition to these faculties, Hacettepe University Medical Faculty was established in 1961. Today, there are numerous medical faculties in universities throughout Türkiye. Medical education in Türkiye lasts for 6 years at the undergraduate level, and students receive both theoretical and practical medical education. Furthermore, there are also master's and doctoral programs in the field of medicine in Türkiye (Balcioglu, 2015; THEQB, 2019).

The 21st century has brought further advancements to medical education, including the integration of new technologies, the development of specialized medical fields, and the adoption of evidence-based medicine. Online learning platforms, distance education programs, virtual reality simulations, and interactive educational videos have made medical education more accessible (Chu et al., 2009; Cohen et al., 2015; Howley et al., 2008).

**What is the Purpose and Learning Objectives of Medical Education within the Scope of Quality and Accreditation Studies?**

The purpose of medical education is to produce a workforce capable of improving the health and healthcare of patients and communities (Asch et al., 2014). At its core, the philosophy of medical education aims to educate and develop competent, compassionate, and ethical physicians who can provide high-quality care to patients in various settings. In summary, the purpose of medical education is to train socially responsible, good physicians (Dharamsi et al., 2011). To achieve this purpose, medical education should emphasize not only the acquisition of knowledge and technical skills but also the development of critical thinking, clinical reasoning, communication and collaboration skills, professionalism, and lifelong learning habits (Alfaro-LeFevre, 2015; Epstein, 2007). Ultimately, the philosophy of medical education reflects a commitment to excellence in healthcare that includes continuous improvement, innovation, and the ability to adapt to the changing needs of patients and society.

Before determining the learning objectives that align with the purpose of training socially responsible physicians, it is important to briefly discuss the

developments related to quality, accreditation, and standardization in undergraduate medical education worldwide and in our country.

The World Federation for Medical Education (WFME) has been making significant efforts for years to improve the quality of undergraduate medical education worldwide (Ahn, 2020; WFME, 2020). The Medical Education Programs Evaluation and Accreditation Association (MEPEAA), accredited by WFME and accepted by the Turkish Higher Education Quality Board (THEQB), has made significant progress in standardization and accreditation efforts in Türkiye and has approved the accreditation of more than forty undergraduate medical education programs to date. MEPEAA conducts inspections through reporting and face-to-face interviews to improve undergraduate medical education programs, subjects them to interim evaluations every three years, and requests re-application with expanded accreditation criteria at the end of the sixth year. One of the most important criteria in the accreditation process is 100% compliance with the Undergraduate Medical Education National Core Education Program (NCEP).

The rapid increase in the number of medical faculties established in Türkiye since the 1980s has led to different practices in terms of infrastructure, educational programs, and models in these faculties (Başer, 2017). This situation has necessitated the development of a framework educational program for standardizing undergraduate education. For this purpose, the Undergraduate Medical Education National Core Education Program was previously published in 2014 (NCEP, 2014). Subsequently, with the work of the National Working Group, the National Competencies and Proficiencies Working Group, and the Behavioral, Social, and Human Sciences Working Group, three key competency areas were determined through an output-based holistic approach in 2020 (NCEP, 2020).

As seen in Table 1 for the National Competencies and Proficiencies Certificate for Medical School Graduates, a medical school graduate is expected to be competent in Professional Practices, Professional Values and Approaches, and Professional and Personal Development areas. The eight competencies that graduates are expected to acquire are specified in the table (NCEP, 2020).

**Table 1.** National Competencies of Medical School Graduates

| Competency Area | Competencies |
|---|---|
| Professional Practices | Healthcare Provider |
| | Embracing Professional Ethics and Values |
| Professional Values and Approaches | Health Advocate |
| | Leadership and Management |
| | Team Player |
| | Effective Communicator |
| Professional and Personal Development | Demonstrates Scientific and Analytical Approach |
| | Lifelong Learner |

*NCEP-2020*

According to NCEP-2020 should encompass thirty-two competencies associated with eight competencies that need to be acquired by the time of graduation, as indicated in Tables 2, 3, and 4 (Selvi at al., 2020).

**Table 2.** National Competencies Related to the Professional Practices Competency Area of Medical School Graduates

| Professional Practices - Health Service Provider - Competencies |
|---|
| He/she utilizes the knowledge, skills, and attitudes acquired from basic and clinical medical sciences, behavioral sciences, and social sciences in the delivery of healthcare services. |
| He/she considers individual, societal, social, and environmental factors that affect health and conducts necessary work to maintain and improve health conditions. |
| In patient management, he/she demonstrates a biopsychosocial approach that takes into account the individual's sociodemographic and sociocultural background, without discrimination based on language, religion, race, or gender. |
| He/she demonstrates a safe, rational, and effective approach in the processes of prevention, diagnosis, treatment, follow-up, and rehabilitation in healthcare service delivery. |
| He/she prioritizes the protection and improvement of the health of individuals and the community in healthcare service delivery. |
| Taking into consideration the health and safety of patients and healthcare workers, he/she provides healthcare services. |
| By recognizing the characteristics, needs, and expectations of the target audience, he/she provides health education to healthy/ill individuals, their families, and other healthcare professionals. |
| He/she evaluates the effects of the local and global, international and national physical and socio-economic environment, as well as individual characteristics and changes in behavior, on his/her own professional practices. |
| He/she performs interventional and/or non-interventional practices in the diagnosis, treatment, follow-up, and rehabilitation processes in a safe and effective manner for the patient. |

*NCEP-2020*

**Table 3.** National Competencies of Medical Faculty Graduates Regarding Professional Values and Approaches Competence Area

| **Professional Values and Approaches-Professional Ethics and Adopting Professional Principles- Competences** |
|---|
| He/she takes into account the principles of good medical practice while carrying out his/her profession. |
| He/she fulfills his/her duties and responsibilities within the framework of the ethical principles and rights and legal obligations required by his/her profession. |
| Taking into consideration the integrity of the patient, he/she demonstrates determined behaviors in providing high-quality healthcare. |
| He/she evaluates his/her performance, emotions, and cognitive characteristics in his/her professional practices. |
| **Professional Values and Approaches-Health Advocate** |
| He/she advocates for the improvement of healthcare service delivery, taking into account the concepts of social trust and social responsibility, for the preservation and enhancement of public health. |
| He/she can plan and implement service delivery, education, and counseling processes related to individual and community health in collaboration with all stakeholders, for the preservation and enhancement of health. |
| He/she evaluates the impact of health policies and practices on individual and public health indicators and advocates for the improvement of healthcare service quality. |
| The physician prioritizes and takes necessary measures to protect and enhance his/her physical, mental, and social health. |
| **Professional Values and Approaches-Lead Manager** |
| During service delivery, he/she demonstrates exemplary behavior and provides leadership within the healthcare team. |
| As the manager of a healthcare institution, he/she utilizes resources cost-effectively, in accordance with community benefits and regulations, during the planning, implementation, and evaluation processes of healthcare services. |
| **Professional Values and Approaches-Team Member** |
| He/she establishes positive communication within the healthcare team and assumes different team roles when necessary. |
| He/she is aware of the responsibilities and obligations of healthcare professionals within the healthcare team and demonstrates appropriate behavior accordingly. |
| He/she works collaboratively and effectively with colleagues and other professional groups in his/her professional practice. |
| **Professional Values and Approaches-Communicator** |
| He/she establishes effective communication with patients, their families, healthcare workers, and other professional groups, as well as institutions and organizations. |
| He/she effectively communicates with individuals and groups with specific needs and diverse sociocultural characteristics. |
| In the diagnosis, treatment, follow-up, and rehabilitation processes, he/she adopts a patient-centered approach that involves the patient in decision-making mechanisms. |

*NCEP-2020*

**Table 4.** National Competencies of Medical Faculty Graduates in the Professional and Individual Development Competence Area

| **Professional and Individual Development-Scientific and Analytical Approach** |
|---|
| Applies and implements scientific research plans when necessary and utilizes the results obtained and/or the findings of other research for the benefit of the community it serves. |
| Accesses and critically evaluates current literature knowledge related to the profession. |
| Applies evidence-based medicine principles in the clinical decision-making process. |
| Uses information technology to enhance the effectiveness of healthcare service, research, and education activities. |
| **Professional and Individual Development / Lifelong Learner** |
| Effectively manages individual work processes and career development. |
| Demonstrates the skills to acquire new knowledge, evaluate it, integrate it with existing knowledge, apply it to professional situations, and adapt to changing conditions throughout professional life. |
| Selects appropriate learning resources and organizes their own learning process to enhance the quality of the healthcare services provided. |

*NCEP-2020*

In the Undergraduate Medical Education Program, the educational objectives of faculties should be defined separately in a way that includes knowledge, skills, and attitudes in relation to these thirty-two proficiencies. Term course-block-committee-internship objectives and learning objectives should also be defined separately as knowledge-skills and attitudes in accordance with the hierarchical structure. These objectives are expected to produce continuous observable-objective evidence at every stage of the education program. Related to all these, learning methods and assessment-evaluation methods for knowledge-skills and attitudes should also be designed in line with the predetermined objectives (MEPEAA, 2021; Çakmakkaya et al., 2020). As a result, if it is necessary to summarize what has been explained so far from the end to the beginning, it is expected that each question to be asked in an exam planned to be held in undergraduate medical education should be planned to determine which goal each question is related to, which competence, competence and proficiency area it concerns.

**What are the Activity Areas of Medical Education Departments?**

Medical education, in its current meaning, encompasses three main areas: undergraduate medical education, post-graduate medical education, and continuous professional development (Swanwick, 2018). Undergraduate medical education refers to the undergraduate education received from the beginning to the end of medical school, typically lasting four years (Baernstein et al., 2007;

Swick et al., 1999). It includes theoretical, practical, laboratory, and bedside clinical rotations. In Türkiye, where the duration of this education is six years (seven years including the preparatory class in English-medium programs), it is considered equivalent to a master's level education (Balcioglu, 2015; THEQB, 2019).

Post-graduate medical education is a comprehensive training that follows the completion of medical school and continues until the chosen specialization is completed. During this process, six key characteristics are aimed to be developed, including relevant patient care, medical knowledge, practice-based learning and improvement, professionalism, communication, and system-based practice (Batalden et al., 2002; Brotherton et al., 2018).

Continuous professional development refers to the lifelong learning and professional growth that doctors undertake to maintain their medical licenses and stay informed about advancements in medicine. Continuous professional development expects lifelong learning, continuous improvement in performance, and the maintenance and enhancement of professional competence (Chan, 2002). This education is mandatory in some countries (United States, Canada, Australia, New Zealand, etc.) and voluntary in others (Japan), and it has different implementation examples (Peck, 2000; Giri, 2012).

In general, medical education plays a critical role in ensuring that healthcare providers have the knowledge, skills, and attitudes necessary to deliver high-quality care to patients. The scope of Medical Education Departments can be summarized as follows:

- ***Curriculum Development:*** The Medical Education Department takes responsibility for creating and implementing an effective curriculum that is in line with national and international standards and meets the needs of students (Harden, 1984).
- ***Enhancing Teaching Skills:*** It provides support in developing teaching skills and methodologies, delivering effective presentations, and staying current with the latest research and technology (Kiesewetter, 2013).
- ***Assessment and Evaluation:*** Regularly conducting assessments and evaluations to monitor students' and faculty members' progress, identify areas for development, and assist individuals in their professional growth (Epstein, 2007).
- ***Research:*** Conducting research on educational techniques and methodologies, evaluating the effectiveness of existing programs, and proposing new approaches to enhance the quality of medical education (Bunniss, 2010).

- ***Quality Assurance:*** Working to ensure adherence to best practices and high-quality standards in all aspects of medical education, including curriculum, teaching methods, and assessment and evaluation (Vroeijenstijn, 1995).
- ***Continuous Professional Development*****:** Focusing on the lifelong learning, continuous improvement in performance, and maintenance and enhancement of professional competence for medical faculty graduates (Chan, 2002).
- ***Medical Simulation and Technology:*** Taking responsibility for the introduction and implementation of advanced simulation technologies to enhance medical education and teaching (So, 2019).
- ***Student Affairs:*** *Taking responsibility for supporting students throughout their academic journey, providing guidance and counseling, and promoting student well-being (Miller, 1981).*

These areas of focus within the Medical Education Department contribute to the development and improvement of medical education, ensuring that graduates are well-prepared and equipped with the necessary skills and knowledge to meet the demands of the healthcare profession.

**Suggestions for the Development of Medical Education**

- ***Alignment with Global Standards:*** It is crucial to closely follow the recommendations of organizations such as the World Federation for Medical Education and national accreditation-standardization bodies in the areas of undergraduate, post-graduate, and continuous professional development. These global standards provide guidance for improving medical education.
- ***Integration of Technology:*** Technology can be utilized to enhance medical education by providing interactive and engaging learning experiences. Strategic planning should be undertaken to prepare the necessary infrastructure for high-tech simulators, virtual reality simulations, interactive educational videos, and online learning platforms.
- ***Clinical Practice and Experience****:* Medical education should incorporate extensive clinical practices that help students apply their knowledge in real-world situations. This can be achieved through internships, clinical rotations, and other hands-on experiences.
- ***Lifelong Learning:*** Continuous education and professional development opportunities can help medical graduates stay up-to-date with the latest research, treatments, and technologies.

- ***Promotion of Collaboration:*** Collaboration among physicians, educators, and researchers can facilitate the sharing of knowledge, resources, and best practices, leading to the improvement of medical education.
- ***Patient-Centered Care:*** Medical education should emphasize the importance of patient-centered care, which involves treating the whole person and considering their unique needs, preferences, and values.
- ***Social Responsibility, Accountability, and Transparency:*** Recognizing that individuals are integral parts of society, efforts should be made to ensure that a medical education program is socially responsible, meets societal obligations, and is transparent and accountable. The contributions of the program to education, research, and service should be internalized by all stakeholders and subjected to internal and external audits.

In conclusion, continuously improving and evaluating medical education is essential to ensure that it meets the needs of patients, physicians, and society as a whole.

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# CHAPTER 2

# MEDICAL EDUCATION IN THE WORLD AND TÜRKİYE

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Medical education varies from country to country worldwide. However, in many countries, medical education follows a similar structure. Generally, medical faculties offer undergraduate medical education that can last between 4 to 6 years. Students gain experience through basic medical sciences, clinical rotations, and internships.

Medical education is supported by strict academic standards and regulations globally. Many countries require a post-graduate medical exam, such as the postgraduate medical exam, to obtain a medical license. In some countries, completion of a medical internship after graduation is necessary before obtaining a medical license. Subsequently, medical doctors can pursue specialization training by selecting a specific medical field. This section aims to compile the similarities and differences in medical education provided in different countries across continents.

**Medical Education Process in the USA**

The USA is a large country with a robust healthcare system and a population of 300 million. The medical education system is highly prevalent, with more than 150 medical schools and thousands of postgraduate training programs. These schools enroll approximately 90,000 medical students (Deeze et al., 2012).

In the United States, the prevalent form of medical education is allopathic medicine, represented by 125 allopathic schools, which accounted for 84% of medical school graduates in 2007. Allopathic medicine is a widely used medical approach in many countries and forms the foundation of modern medicine. It employs scientific methods to diagnose, treat, and prevent diseases. On the other hand, osteopathic medicine is another type of medical education in the US. Osteopathic medicine represents a holistic medical approach that supports the body's natural healing ability. It is based on an understanding of the relationship between the body's anatomy, physiology, and function. Osteopathic medicine is practiced by osteopaths who have received osteopathic education. Osteopathic doctors use manual techniques to manipulate the musculoskeletal system and aim to improve the body's balance and mobility. While osteopathic medicine emphasizes the body's integrity and natural healing processes, allopathic medicine focuses on symptom-based diagnosis and treatment. As a result, osteopathic medicine and allopathic medicine are different medical approaches that can complement each other. The application requirements and education for osteopathic students are similar to allopathic doctors, with the difference being the teaching of manipulative techniques in osteopathic schools. In recent years, osteopathic medical schools have been expanding faster than allopathic schools, increasing from 10 schools in 1977 to 28 schools at present (Gevitz, 2009).

The steps to become a physician in the USA are slightly different from those in Europe and other world regions. After graduating from high school at the age of 18, students continue their education at a university or college and obtain a 4-year undergraduate degree before starting medical school (Deeze et al., 2012).

Medical school faculty members consider several factors when deciding whom to admit, and one of these is the Medical College Admissions Test (MCAT). This standardized exam assesses knowledge in verbal reasoning, biological sciences, and physical sciences. Additionally, it requires a writing sample (an essay, etc.) (Deeze et al., 2012). MCAT scores are used by almost all medical schools and predict performance in medical school and licensure exams (Julian, 2005). Other admission factors typically include undergraduate grade point average, recommendation letters, leadership, and elements like an interview for those meeting the medical school's minimum criteria (Elam & Johnson, 1997).

In undergraduate medical education, the teaching style during the preclinical years typically involves lecture-based learning and case-based learning, especially with the use of cadavers for laboratory experiences. The clinical years are usually structured with essential rotations such as internal medicine and general surgery, and in the final year of education, there are elective rotations. During rotations, students work alongside physicians and typically with Graduate Medical Education (GME) trainees (interns and residents) (Anderson & Kanter, 2010).

Assessment during clinical rotations is conducted through various methods. One artificial clinical evaluation system called RIME (Reporter, Interpreter, Manager, Educator) is used in 42% of internal medicine rotations (Hemmer et al., 2008). Nearly all schools utilize knowledge examinations and Objective Structured Clinical Exams (OSCEs) as the intended assessment methods. Other evaluation approaches include portfolios, clinical skills laboratories, and standardized patient interviews (Anderson & Kanter, 2010).

In the final year of medical school, students typically apply for Graduate Medical Education (GME) programs through the matching program, with the largest being the National Residency Match Program (NRMP) (www.nrmp.org; Pace et al., 2000). After graduation, these new doctors receive either an MD (Doctor of Medicine) or DO (Doctor of Osteopathic Medicine) degree and then undergo specialized training in their chosen fields through a residency program, which lasts between 3 to 7 years (Pace & Glass, 2000).

After completing GME training, most specialists and fellows strive to obtain board certification. Board certification is a process that confirms doctors have completed appropriate training in their specialized fields and demonstrated the necessary competence to represent their specialties. The American Board of Medical Specialties (ABMS) (www.abms.org) encompasses 24 major boards.

Board certification is recognized as a hallmark of a highly qualified physician in the specialty and typically lasts for 6 to 10 years (Horowitz et al., 2004).

All physicians are required to be licensed to practice medicine in the United States. This practice began in the 1800s when each state established its own licensing board. All states now require at least completion of medical school, passing licensure exams, completing at least 1 year of GME, and meeting ethical standards. Currently, the licensure exam consists of three parts: the United States Medical Licensing Examination (USMLE) for allopathic graduates (www.usmle.org) and the Comprehensive Osteopathic Medical Licensing Examination (COMLEX) for osteopathic graduates (www.nbome.org/docs/comlexBOI.pdf). In both cases, the first two parts of the exam are completed during medical school, and the final part is taken during the first year of GME. Doctors graduating from medical schools outside the United States can obtain a license in the US if they receive certification from the Educational Commission for Foreign Medical Graduates (ECFMG) (www.ecfmg.org/certification/index.html) (DeZee et al., 2012).

Postgraduate medical education in the United States is regulated by different organizations. The Liaison Committee on Medical Education (www.lcme.org) accredits allopathic medical schools, while the Commission on Osteopathic College Accreditation accredits osteopathic medical schools. The Accreditation Council for Graduate Medical Education (www.acgme.org) accredits Graduate Medical Education (GME) programs for both allopathic and osteopathic physicians (DeZee et al., 2012).

**Medical Education Process in England**

In the UK, medical education is a university program at the undergraduate level. The education typically spans from 5 to 6 years and is offered at universities specifically designed for medical training. To gain admission to medical schools, students need to pass qualifying examinations related to their post-secondary education. The undergraduate program includes both theoretical courses and clinical rotations, providing practical experiences.

Medical education is typically structured into a three-year pre-clinical phase, followed by a two-year clinical phase. The first three years are devoted to theoretical courses and laboratory work, covering fundamental medical sciences. At the end of the third year, students begin clinical rotations to enhance their clinical skills, and the final two years are entirely dedicated to clinical practice and rotations. Medical schools provide additional training opportunities such as simulation-based education, study groups, and clinical skills laboratories to help students improve their practical skills (Williams & Lau, 2004).

The application process typically involves the assessment of various factors, such as school graduation grades, standardized tests like the UK Clinical Aptitude Test (UKCAT) or the Biomedical Admissions Test (BMAT), personal statements, teacher references, and work experience.

After completing the undergraduate program, students receive a Bachelor of Medicine, Bachelor of Surgery (MBBS) degree. Subsequently, to practice medicine, they are required to obtain medical registration known as General Medical Council (GMC) registration. This occurs after a two-year foundation training period following graduation from medical school. Specialization training, which varies between 4 to 8 years depending on the chosen medical field, follows a minimum of 2 years of foundational training.

Medical education in the UK, like similar programs in other countries, is highly competitive and demanding. However, it offers internationally respected medical training, and the majority of graduates achieve success in their careers (Hays, 2007).

**Medical Education Process in Germany**

In Germany, the medical education process typically lasts for six years and consists of three stages. The first stage is a theoretical period of about two years, during which basic sciences are learned. The second stage is a three-year period of clinical practice, where students gain experience in different medical disciplines through clinical rotations. The third stage is a one-year rotation period, during which students participate in rotations in specialized areas (Chenot, 2009).

Medical education in Germany is offered by universities and regulated at the federal level. Medical faculties are supported by student organizations such as the German Medical Students' Association (BVMD). Medical students work in hospitals, outpatient clinics, and other healthcare facilities during their clinical rotations.

The number of applicants to medical faculties is usually higher than the available seats, making admissions subject to limitations. On average, there are four to five applicants for each available seat, though significant variations exist among different faculties. In Germany, applications to medical faculties are managed by a federal organization called the Central Office for University Admissions (Yüksek Öğretimde Yerleştirme Merkezi). Admission criteria are based on the Abitur grade, which is a written examination covering various subjects to assess students' overall academic achievements and abilities. Successfully completing the Abitur is considered the best predictor of curriculum completion (Strauss & Brähler, 2005). Each student can apply to up to 6 medical faculties simultaneously by ranking their preferences (Chenot, 2009).

During the application process, students generally submit a motivational letter, and after the initial screening, candidates are invited for interviews. However, this process can be time-consuming and challenging due to the high number of applicants. Therefore, some faculties have reintroduced a national medical admission test called the Test für Medizinische Studiengänge (TMS), which had been abandoned in 1997. The TMS is comparable to the American Medical College Admission Test (MCAT). While the TMS is not mandatory, it provides students with an opportunity to improve their chances of being invited for interviews by enhancing their scores (Chenot, 2009).

The curriculum is divided into three parts: Basic Sciences (2 years), Clinical Sciences (3 years), and Clinical Year (1 year).

In the Basic Sciences, key subjects include anatomy, physiology, biochemistry, and social sciences. Courses are generally evaluated based on a pass or fail grade. The distinction between Clinical and Basic Sciences has been criticized, with postgraduate students often perceiving a significant portion of the curriculum as clinically irrelevant. As a result, there are increasing efforts to integrate the Basic Sciences into a clinical context. A three-month nursing internship is a compulsory component of the Basic Sciences section to provide initial patient exposure (Chenot, 2009).

In the Clinical Sciences section, previously, each subject was taught separately. Now, topics are generally taught in interdisciplinary teaching modules, for example, combining Otorhinolaryngology with Ophthalmology in a "head module" (Strate et al., 1998). Usually, the first year is dedicated to the introduction of clinical sciences and basic skill training in physical examination, general pathology, general microbiology, general pharmacology, and basic laboratory skills in medicine. To enhance clinical experience, mandatory rotations have been introduced in internal medicine, general surgery, pediatrics, gynecology-obstetrics, and general practice areas. Additionally, students are required to complete four one-month elective rotations. One of these rotations must be completed in an outpatient clinic. Completing at least one elective rotation in English-speaking countries is popular (Chenot, 2009).

The Clinical Year is divided into three full-time clinical rotations, each lasting approximately 4 months. Internal Medicine and Surgery rotations are mandatory, and students are free to choose a rotation from all other clinical specialties.

In Germany, to become a specialist doctor, one needs to pass several exams. Firstly, after graduating from university, one needs a permit called "Berufserlaubnis" to work as a medical doctor in Germany. For this permit, candidates are required to take an exam called "Kenntnisprüfung," which tests their language skills and medical knowledge.

To pursue specialization training, one must first obtain a specialist certification known as "Facharzt." The duration of specialization training varies depending on the field but generally ranges from 5 to 6 years. Throughout the training period, hospital-based education and clinical rotations are conducted to acquire specialized theoretical and practical skills specific to the chosen medical field.

After completing specialization training, candidates are required to take a medical specialist examination in Germany. This exam assesses their medical knowledge, theoretical expertise related to the chosen specialization, and practical skills. Passing the exam enables candidates to obtain the specialist title and work as a "Facharzt" (Mader et al., 1998).

**Medical Education Process in Egypt**

In Egypt, higher education institutions, including medical faculties, have a centralized application process managed by a national coordination office. Students are distributed to different institutions based on their preferences and high school grades. The criteria and regulations for admission to state medical faculties, Al-Azhar medical faculties, and private schools differ. Foreign students can join medical faculties in Egypt, but they are subject to additional regulations, such as obtaining a student visa, proving proficiency in Arabic language, and fulfilling specific academic requirements. The admission requirements for foreign students may vary depending on the medical faculty they wish to attend (Hayba, 2016). The admission criteria for medical faculties in Egypt rely on a system where high school final exam scores play a crucial role, and this practice dates back to 1887 (Abugideiri, 2010).

Medical faculties in Egypt follow the French model, which consists of a six-year undergraduate medical education program. This system exhibits distinct preclinical and clinical phases. After graduation, students are required to participate in a complete one-year internship program before obtaining a general practitioner license (Abdalla & Suliman, 2013).

Before 2009, most medical faculties in Egypt adopted discipline-based curricula. These curricula relied on large-group lectures and an apprenticeship approach as the main methods for clinical education. Considering these facts, it can be observed that the education programs in Egyptian medical faculties are currently undergoing a gradual shift towards integration, student-centered approaches, and early clinical exposure (Hosny et al., 2016).

For the assessment of clinical education, most medical faculties in Egypt utilize traditional methods such as long and short case examinations and traditional oral exams. However, several schools have made changes to enhance the effectiveness of these traditional assessment methods. Despite its history dating back to the

1970s, the Objective Structured Clinical Examination (OSCE) is still in the process of widespread adoption in Egyptian medical faculties and is currently implemented with different approaches and degrees in most faculties (Abdelaziz et al., 2016).

After graduation, approximately 20% of medical degree graduates in Egypt pursue postgraduate training programs to obtain a master's degree in a specific medical specialty, while the remaining 80% start working directly as general practitioners (Jones, 2016).

In Egypt, there are two main paths to pursue postgraduate medical education (PGME). Firstly, there is an academic path that leads to a scientific degree (MSc or PhD). Secondly, there is the "FEB; Fellowship of the Egyptian Board" program, which leads to membership in the national medical specialization board. The academic path is under the auspices of universities, while the second program is a vocational training program coordinated by the Ministry of Health. The duration of the specialization training program varies between three to seven years, depending on the chosen medical specialty, and it does not require a research thesis.

In the past, unstructured or opportunistic education has been a significant issue. However, with a recent emphasis on quality and accreditation, many initiatives have been implemented to overcome this problem (Talaat & Salem, 2009). Examples of these initiatives include supervised clinical training and the introduction of portfolios. Nevertheless, a large portion of programs still adhere to traditional "learning by doing" or "apprenticeship" models as their main teaching/learning approaches (Tekian & Boulet, 2015).

Egypt has one of the oldest medical education systems in the Middle East and Africa. Apart from four ancient schools, the current range of postgraduate education programs can be perceived as being in the midst of transitioning towards more integrated, student-centered, and community-oriented models. It is evident that individual medical faculties have made and continue to make changes to achieve this transition, but more effort is needed for further development. Major challenges facing medical education include the lack of financial resources and the brain drain of educated personnel (Abdelaziz et al., 2018).

**Medical Education Process in New Zealand**

Due to New Zealand's population being just slightly over 4 million, there are two medical faculties. The first school, Otago, was established in Dunedin in 1875, while the second school opened in Auckland in 1968 (Mckimm et al., 2010).

The duration of medical education in both universities is six years, and both require students to apply and go through a selection process after completing the "health sciences" courses in their first year. For entry into Otago, ranking decisions are based on the Grade Point Average (GPA) obtained from the courses taken in the

first year of the undergraduate degree and the Undergraduate Medical Admissions Test (UMAT), with a weightage of 66:34, respectively. In the case of Auckland, students participate in a structured interview, and their GPA, interview performance, and UMAT scores are weighted 60:25:15, respectively (Poole et al., 2009).

There are advantages to having a common first year. Firstly, it is likely to provide students from less privileged schools with a fairer chance of competing. Secondly, many medical schools overly rely on standardized tests like UMAT (Undergraduate Medical Admissions Test) or interviews, which only offer a snapshot of a student's ability. The performance in the first year of university can offer a more representative measure of a student's capabilities as success is demonstrated over an entire year. Lastly, students make their career choices at a slightly later age and prove that they can handle university studies (Mckimm et al., 2010).

The sixth year is the Trainee Intern (TI) year, aiming to bridge the gap between the undergraduate program and the first year of specialty training. A TI's work is conducted under the supervision of universities. The TI year aims to provide experiential learning in a limited clinical responsibility work environment. Assessment in the sixth year is more workplace-focused, and it is considered a year where students can solely focus on their work (Dare et al., 2009).

As TI's are considered full members of the medical team, teamwork and communication with other healthcare professionals significantly improve between the fifth year and the TI year. Transitioning from a focus on assessment-based learning in the fifth year, students shift their learning style to prepare for postgraduate training during the TI year. Additionally, the TI year provides research opportunities. Student performance during the TI year offers direct feedback to the university regarding the effectiveness of the medical course and serves as a useful reference point to compare predictability with previous measurements (Wilkinson & Frampton, 2004).

In New Zealand, the term "pre-vocational training" refers to the first two years (Post-graduate Years 1 and 2 or PGY 1 and PGY 2) that medical graduates work after completing their medical degree. Their training is directly supervised by the Medical Council of New Zealand. During these 2 years, trainees work on rotational placements for 13 to 14 weeks each, documenting their acquired skills and knowledge in an electronic portfolio (Medical Council of New Zealand, 2021).

Accredited postgraduate specialist training is managed by 16 colleges. While some are unique to New Zealand, most collaborate with Australia or Singapore as dual or tripartite medical colleges. This specialist training, overseen by these colleges, aims to prepare trainees for practicing at a specialist level after completing the training period and a series of evaluative and formative assessments.

Additionally, those undergoing specialist training are required to complete one or more formal research projects, although specific requirements may vary depending on the training college (Alamri, 2022).

**Medical Education Process in China**

In China, before being admitted to medical school, students are required to pass a national examination called the National College Entrance Examination (NCEE). This exam is planned, organized, and implemented by the National Government. However, admission standards may vary to some extent among different regions and institutions in China. Medical education in China typically lasts for five or seven/eight years.

Basic Medical Sciences (7 or 8 years): The purpose of this section is to educate students who have the knowledge and skills to conduct research projects in one of the basic medical science fields for medicine.

Clinical Medicine (7 or 8 years): This section focuses on acquiring the diagnostic skills and clinical competencies required for qualified clinicians at the specialist level. At the end of this training program, students are usually awarded a postgraduate degree in medicine and often work as practitioners in a clinical discipline.

Preventive Medicine (5 years): This section trains students in preventive medicine theories and hygiene testing techniques. Potential students are awarded a medical degree, and they work in areas such as hygiene and disease control, environmental and food hygiene monitoring.

Anesthesiology (5 years): This department requires undergraduate students to learn both basic and clinical courses, as well as relevant anesthesiology courses. Students also acquire the technical skills required of an anesthesia specialist. Graduates receive a medical degree and work in hospitals providing anesthesia services, emergency departments, or intensive care units.

Radiology Medicine (5 years): This program trains a healthcare professional with a medical degree to be competent in medical imaging diagnosis and analysis, as well as in the fields of radiology and/or radiation therapy.

Dentistry (5 years): Students learn the fundamental theories in the field of dentistry and receive clinical training.

Based on this information, it is clearly understood that students need to determine which specialization they plan to pursue before entering medical school (Ren et al., 2008).

Postgraduate medical education in China is conducted at the master's or doctoral level. Admission to postgraduate education is similar to admission to undergraduate programs. Candidates must pass the "National Postgraduate Entrance

Examination," which is created, organized, and planned by the National Government. After fulfilling this admission requirement, a candidate is interviewed by an advisor. The postgraduate student selects the required core courses from a range of curriculum options recommended by the advisor. Completing a master's degree in medicine takes three years, with 1.5 years dedicated to coursework and 1.5 years for clinical practice or research. After a final oral examination for the thesis, the student receives a master's degree in medicine. A qualified graduate can then become a university lecturer or a clinical physician at a hospital (Ren et al., 2008).

The doctoral studies bear similarities to the master's degree in terms of entrance examination, thesis preparation, and final oral examination. A doctoral student devotes approximately 0.5-1 year to coursework and dedicates the other 2-2.5 years to research work and completing the thesis. Each student has an advisory committee consisting of five to seven professors who objectively assess the research work. Typically, the candidate must complete the thesis requirements within 3-5 years, and failure to do so may result in dismissal from the program (Ren et al., 2008).

**Medical Education Process in Japan**

Japan is a country where medicine is highly popular as a career choice, leading to intense competition in the entrance exams for medical faculties. Approximately 90% of the students are high school graduates, while the remaining 10% are university graduates (Yagi, 2006).

Most students are admitted through a common national entrance exam. Some, however, are accepted based on a combination of interviews, written work, recommendations, and previous community activities. Student quotas for working in rural areas are increasing. While the number of female students is on the rise, they still constitute a minority, and foreign graduates are rare due to language barriers (Suzuki et al., 2008).

The medical education process in Japan typically lasts for six years. Generally, the stages of medical education in Japan are as follows:

High School Graduation: High school graduation is required for admission to medical faculty.

Years 1-2: Liberal Arts Education: The first two years are typically dedicated to liberal arts education. Students are provided with courses in general sciences, language education, and basic health sciences.

Years 3-4: Pre-Clinical Studies: The middle two years are devoted to pre-clinical studies, focusing on medical sciences. Students take courses in basic medical sciences such as anatomy, physiology, biochemistry, and other related subjects.

Year 5: Clinical Rotations: The fifth year is a period in which students participate in clinical rotations. Students work with real patient cases in hospitals and clinical settings, gaining valuable clinical experience.

Year 6: Graduation and National Exam Preparation: The sixth year is dedicated to preparing for graduation exams and national medical licensing exams. Students may conduct a thesis study and fulfill graduation requirements during this period.

In Japan, medical faculties are generally offered by both public universities and private universities. Students are admitted through exams and evaluation processes determined by the universities. Throughout the medical education process, students participate in internships and clinical rotations to develop clinical skills, patient care, and practical application of medical knowledge (Teo, 2007).

In Japan, as in North America, medical education reforms have had an impact. In the 1990s, the introduction of Objective Structured Clinical Examination (OSCE), problem-based learning (PBL), and introductory courses in clinical medicine took place. Currently, all medical faculties utilize OSCE, which is combined with a computer-based test known as the Common Achievement Test (CAT) introduced in 2005 (Onishi & Yoshida, 2004).

In the fifth year of medical school, students usually gain their initial hospital experience. Bedside patient interactions and clinical teaching take up less space compared to activities like conducting literature reviews, writing weekly reports, and attending lectures. During clinical rotations, medical students observe rather than actively participate in clinical care. Towards the end of the sixth year, students take the national medical licensing examination, for which they prepare months in advance. Until 2004, passing the national exam did not require graduates to participate in a post-graduation training program to practice medicine, but around 85% of graduates voluntarily did so (Teo, 2007). Since 2004, all medical school graduates are required to work for two years in rotation, in major specialty areas at hospitals. However, this new internship program has caused a serious problem, such as staffing shortages in local university hospitals and rural hospitals, as more interns prefer to work in renowned teaching hospitals at universities. After the two-year internship training, the intern progresses in their own career path, may enter advanced clinical training for specialization, or serve as a general practitioner in the community (Suzuki et al., 2008).

**Medical Education Process in Türkiye**

Medical education in Türkiye has undergone significant developments and reforms over the years. The education system aims to produce competent and ethical doctors capable of meeting the healthcare needs of society. The Association for the Evaluation and Accreditation of Medical Education Programs (EAMED) is

an organization concerned with the accreditation and evaluation of medical faculties in Türkiye. EAMED's goal is to enhance the quality standards of medical faculties, assess educational programs, and contribute to continuous improvement efforts.

EAMED evaluates medical faculties based on specific criteria and standards. This evaluation process encompasses various factors, including the content of the educational program, academic staff, infrastructure, clinical rotations, student assessment, and continuous quality improvement. Based on the assessment conducted by EAMED, medical faculties can receive accreditation or may need to make improvements in certain areas to meet the required standards.

Medical faculties in Türkiye, in addition to EAMED, make efforts to comply with other accreditation bodies and international standards. These endeavors aim to enhance the quality of medical education and strengthen its international recognition.

EAMED 's efforts contribute to continuous improvements in medical education and the provision of high-quality education to students. The assessment results of EAMED serve as a reference point for medical faculties, assisting in raising educational standards. As a result, the quality and standards of medical education in Türkiye are constantly reviewed and aimed to be enhanced (TEPDAD, 2021).

Medical education in Türkiye lasts for six years and comprises both theoretical and practical courses. In the initial years, students learn fundamental medical sciences such as anatomy, physiology, biochemistry, and pharmacology. Subsequently, they transition to clinical sciences, completing their education through clinical rotations and internship programs.

During the clinical years of medical education, students participate in rotations in various clinical departments, such as internal medicine, surgery, pediatrics, obstetrics, and gynecology. These rotations provide students with the opportunity to apply their knowledge in real patient care settings. Under the supervision of faculty members and experienced healthcare professionals, students actively work and gain practical experience in these clinical environments.

In their final year of education, students participate in internship programs organized by medical faculties. The internship period is a crucial stage for students to enhance their clinical skills and actively participate in the direct care of patients. During this period, students undergo internships in various clinical fields, allowing them to apply their theoretical knowledge in practice.

In Türkiye, medical faculties generally offer elective periods to students, during which they can make choices based on their interests and gain in-depth knowledge and experience. Additionally, students are provided with opportunities to participate in research projects, present their findings at conferences, and publish scientific

articles. These experiences contribute to their academic and professional development.

Medical students' performance is evaluated through various methods, including written exams, practical assessments, oral exams, and clinical evaluations. The assessment methods aim to evaluate students' knowledge level, clinical skills, problem-solving abilities, and professional attitudes (Kurdak et al., 2008; Mengi & Selvi, 2021).

In Türkiye, to become a specialist doctor, one must pass the Specialty Medical Examination and, based on the obtained score, choose a specific specialization area. The specialization training allows candidates to develop theoretical knowledge and practical skills in their chosen specialization field. The duration of specialization training varies depending on the selected specialty and generally lasts between three to five years. During the specialization training, candidates participate in various learning and application opportunities, such as clinical rotations, seminars, conferences, and research projects. As part of the specialization training, candidates are required to prepare a specialization thesis. The specialization thesis entails in-depth research on topics related to the candidate's specialty and the presentation of a scientific study. Upon completion of the specialization training, candidates take the specialization examination organized by their respective faculties. The examination assesses both theoretical and practical skills and determines whether the candidate is eligible to be granted the specialist title (Odabaşı et al., 2010).

**Table 1.** *Duration of Medical Education, Entrance Examinations, Graduation Examinations, and Number of Medical Faculties by Countries*

| Country | Medical Education Duration | Entrance Exam | Graduation Exam | Number of Medical Faculties |
|---|---|---|---|---|
| USA | 4 years undergraduate, 4 years medical education. | MCAT (Medical College Admission Test) | USMLE (United States Medical Licensing Examination) | 154 |
| England | 5-6 years | UKCAT (UK Clinical Aptitude Test) | MRCP (Membership of the Royal Colleges of Physicians) | 33 |
| Germany | 6 years | TMS (Test für Medizinische Studiengänge) | Staatsexamen | 38 |
| Egypt | 6 years | High school graduation score | OSCE (objective structured clinical examination) | 36 |
| New Zealand | 6 years | UMAT (Undergraduate Medicine and Health Sciences Admission Test) | NZREX (New Zealand Registration Examination) | 2 |
| China | 5-7 years | NCEE (National College Entrance Examination) | NMLE (National Medical Licensing Examination) | 276 |
| Japan | 6 years | National Center Test for University Admissions | National Medical Practitioner Examination | 79 |
| Türkiye | 6 years | HIE (Higher Education Institutions Exam) | There is no exam requirement for graduation. | 126 |

*References: DeZee vd., 2012, Hays, 2007, Chenot, 2009, Hayba, 2016, Mckimm vd., 2010, Ren vd., 2008, Suzuki vd., 2008.*

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# CHAPTER 3

# THE IMPORTANCE OF BLOOM TAXONOMY IN MEDICAL EDUCATION

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**Learning, Taxonomy and Bloom Taxonomy**

Learning is the process through which individuals engage with an experience or information to understand, process, remember, and utilize that experience or information (Säljö, 1979). Learning is the foundation of human behavior and continues throughout life. The learning process is associated with individuals' experiences and access to knowledge. People perceive objects, people, and events in their environment and acquire knowledge using these perceptions. This knowledge is stored in their memory and made available for use when needed (Kolb, 1976).

Learning is a complex process that involves physical, cognitive, social, and emotional aspects. The learning process possesses characteristics that reflect individuals' previous experiences, levels of knowledge, skills, and interests. Therefore, different individuals have different learning styles and strategies. Learning can be carried out with various purposes, including acquiring new knowledge and skills, enhancing existing knowledge and skills, gaining different perspectives, and self-discovery. Every learning experience is a valuable opportunity for individuals to improve their quality of life and succeed in life (Kolb, 1976; Säljö, 1979).

Taxonomy is widely used in the fields of science and education. Taxonomy is a system that allows us to better understand the characteristics of objects or organisms with different attributes by grouping them (Marzano, 2001). It also categorizes different concepts to make them more understandable and accessible. A taxonomy system is based on a specific principle or organizational principle and creates specific categories. In biology, organisms are often divided into categories such as species, genus, family, class, order, and kingdom. In education, taxonomy is used to hierarchically classify learning objectives (Yurdabakan, 2012). For example, Bloom's Taxonomy (BT) categorizes learning objectives into different categories such as remembering, understanding, applying, analyzing, synthesizing, and evaluating.

BT was developed by Benjamin Bloom, an American educational psychologist, in 1956 with the aim of categorizing educational purposes and objectives into a hierarchical order from lower-order thinking skills to higher-order thinking skills. It has since been widely used as a model for designing and evaluating educational activities. Each level builds upon the previous one, and mastery is required at each level to progress to the next. BT is commonly used by educators to create learning objectives that target specific cognitive learning levels and design assessments that measure student progress towards these objectives (Bloom et al., 1956; Bloom et al., 2020).

Benjamin Bloom (1913-1999) was born in Lansford, Pennsylvania, and graduated from Pennsylvania State University in 1935. He later completed his master's and doctoral education at the University of Chicago. Bloom began his career as a teacher before transitioning to research and academia. In addition to his work on Bloom's Taxonomy, he conducted research on a wide range of educational topics, including talent development, the nature of intelligence, and the effects of educational technology. He received numerous awards for his contributions to education, including the American Psychological Association's Outstanding Contributions to Education Award and the National Association for Gifted Children's Distinguished Service Award (Bloom et al., 2020; Eisner, 2000).

**Table 1.** Cognitive Learning Levels of Bloom's Taxonomy

| **Learning Level** | **Description** |
|---|---|
| Knowledge | Remembering, understanding and restating basic information |
| Comprehension | Understanding, interpreting and summarizing information |
| Application | Applying and analyzing knowledge to real-life situations |
| Analysis | Breaking a whole into parts, examining relationships and analyzing concepts |
| Synthesis | Bringing knowledge and ideas together, creating a new whole and developing alternative solutions |
| Değerlendirme (Evaluation) | Critical evaluation of information and ideas, evaluation of options, and advocacy of conclusions |

***1. Knowledge:***

The initial stage of BT is "knowledge." In this level, learning objectives aim for students to reach a basic level of knowledge and understanding about a subject. They learn the fundamental concepts, terms, and principles of a topic. An example of the knowledge level would be medical students learning basic knowledge areas such as biology, physiology, pharmacology, and anatomy. In this level, students learn the causes, symptoms, diagnostic methods, and treatment options of a specific disease.

***2. Comprehension:***

In BT, the second level of cognitive learning is comprehension. The comprehension level aims for students to learn basic skills such as understanding,

defining, explaining, and classifying information. At this level, students engage with the information at a level of recall and understanding. They read to understand new concepts and terms that they can use in learning objectives, listen to explanations, and ask questions about learning materials (Birgin, 2016). To assess students' comprehension level, it may be necessary to ask open-ended questions, have them define terms, or explain concepts. An example of this level would be the ability to explain the main idea of an article.

***3. Application:***

This level involves using knowledge or skills in new or unfamiliar situations, such as problem-solving or completing tasks. Application is considered a higher-order thinking skill compared to understanding because it involves more complex mental processes, such as identifying patterns, relationships, or connections between different pieces of information. It is important for developing critical thinking and problem-solving skills, as it requires students to think beyond simply recognizing or understanding knowledge, and instead use that knowledge or skills in a new context or situation (Birgin, 2016). Examples of this learning level include venipuncture, inserting a catheter, or administering an injection.

***4. Analysis:***

Analysis is considered a higher-order thinking skill than application because it involves more complex mental processes, such as determining patterns, relationships, or connections between different pieces of information. This learning level requires students to think deeply about complex information and identify its underlying components. It is important for developing critical thinking and problem-solving skills. Examples related to this learning level include comparing and contrasting two different texts or sources, analyzing data to identify trends or outliers, breaking down a complex concept into its components, or examining the structure of an argument to assess its effectiveness.

***5. Synthesis:***

At this level of the taxonomy, students are expected to gather information from different learning materials, combine that information, and generate new ideas and concepts. Synthetic thinking is the process of creating new knowledge or understanding by synthesizing existing individual learning objectives. It requires students to use higher-level skills such as innovation and critical thinking in their learning process (Birgin, 2016). Project-based learning or problem-solving can be given as examples of learning at this level.

***6. Evaluation:***

This highest level of cognitive learning in BT involves making judgments about the quality or value of information or arguments, such as evaluating the credibility of sources or the effectiveness of strategies (Birgin, 2016). Evaluation involves making subjective or interpretive judgments based on criteria and standards regarding the quality or value of different pieces of information or products. Examples related to this learning level include critiquing an article, evaluating the reliability of a source, assessing the validity of an argument, rating the quality of a product or service, or evaluating the impact of a policy or decision. Evaluation is considered a higher-order thinking skill than analysis as it involves making judgments and decisions based on criteria or standards, which can be subjective or open to interpretation. This level requires the development of critical thinking and decision-making skills.

**Revised Bloom Taxonomy**

The group that was involved in the five-year revision of Bloom's Taxonomy to enhance the previous taxonomy came together again in 1995 under the leadership of Krathwohl and revised it through another five-year study. The Revised Bloom's Taxonomy (r-BT) is an updated version of the original taxonomy and was published in 2001 by Lorin Anderson and David Krathwohl. The r-BT maintains the hierarchical structure of the original taxonomy but provides more detailed definitions and examples of cognitive processes at each level. The team involved in this development included measurement and program development experts, as well as learning psychologists (Anderson, 1999, Anderson, 2002, Bloom et al., 2020, Krathwohl, 2002).

**Table 2.** Comparison of Bloom and Revised Bloom Taxonomies

| | **Bloom Taxonomy** | **Revised Bloom Taxonomy** |
|---|---|---|
| **Summary Description** | A hierarchical taxonomy that classifies cognitive processes into six levels. | Updated by addressing the deficiencies and weaknesses of the Bloom Taxonomy. |
| **Levels** | Knowledge, comprehension, application, analysis, synthesis, evaluation | Remembering, understanding, applying, analyzing, evaluating, creating |
| **Hierarchical Ranking** | There is a hierarchy among the levels. | There is no hierarchy among the levels. |
| **Evaluating** | Assesses only cognitive processes. | Assesses cognitive processes as well as emotional and social learning dimensions. |
| **Example Usage** | Used in teaching topics in courses. | Used in determining learning objectives and designing learning activities. |

Table 2 summarizes the main differences and distinctions between Bloom's Taxonomy and the Revised Bloom's Taxonomy. The Revised Bloom's Taxonomy addresses the shortcomings and limitations of the original taxonomy and incorporates not only cognitive processes but also the emotional and social dimensions of learning. Additionally, the hierarchical ordering has been removed, and the evaluation process has been expanded. The Revised Bloom's Taxonomy provides a more comprehensive framework for determining learning objectives and designing learning activities (Anderson, 1999, Anderson, 2002, Bloom et al., 2020, Krathwohl, 2002).

**Table 3.** Two-Dimensional Structure of Cognitive Learning Area According to Revised Bloom's Taxonomy

| **Dimensions of Learning** | **Cognitive Process Dimension** | | | | | |
|---|---|---|---|---|---|---|
| | Remembering | Understanding | Applying | Analyzing | Evaluating | Creating |
| Factual Knowledge | **X** | | | | | |
| Conceptual Knowledge | | **X** | | **X** | | **X** |
| Procedural Knowledge | | | **X** | | | |

As shown in Table 3, the r-BT has a two-dimensional matrix structure that encompasses six different domains of cognitive processes (Bümen, 2010; Köğce et al., 2009). This matrix defines the six distinct domains of cognitive processes as remembering, understanding, applying, analyzing, evaluating, and creating. The cognitive (knowledge) process dimension includes "factual, conceptual, and procedural knowledge" on the vertical axis. It also includes the metacognitive process dimension. Additionally, it replaces the teacher-centered approach of the original taxonomy with a student-centered approach (Krathwohl, 2002).

**Table 4.** The Metacognitive Process Dimension Structure of the Learning Field According to the Revised Bloom's Taxonomy

| **Upper Cognitive Process Dimension** | **Description** |
|---|---|
| Perception | Defines tasks, identifies problems, and selects the appropriate strategies. |
| Response | Takes the necessary steps to solve the task and adjusts or modifies strategies as needed. |
| Valuing | Analyzes solution strategies and evaluates the correctness of their choices. Also evaluates alternative strategies and takes corrective measures to improve the solution process. |
| Organization | Plans, implements, and monitors solution strategies step by step. Also adjusts and modifies strategies as necessary. |
| Characterization | Evaluates the accuracy and effectiveness of the solution. Also evaluates the process and applies what they have learned to solve similar problems in the future. |

As seen in Table 5, the r-BT has a two-dimensional matrix structure that encompasses five different domains of affective processes. This matrix defines the five distinct domains of affective processes as receiving, responding, valuing, organizing, and characterizing (Güllühan & Bekiroğlu, 2018).

**Table 5.** Affective Process Dimension Structure of the Learning Area According to Revised Bloom's Taxonomy

| Affective Process Dimension | Description |
|---|---|
| Receiving | Becomes aware of the task, embraces the task, and has emotional reactions to the task. |
| Responding | Expresses the emotional awareness created by the task when necessary. |
| Valuing | Embraces the task and becomes aware of the responsibilities it entails. The mechanism of internalization regarding the subject is active, and a sense of dedication prevails. |
| Organizing | The task and responsibilities become values. |
| Characterizing | Thoughts that become values tend to become part of one's personality in life. |

**Adapting the Revised Bloom's Taxonomy to Medical Education**

Medical education requires a multidisciplinary process management aimed at providing students with the necessary knowledge, skills, and attitudes (Ronaghy, 2018; Başhan, 2018; Selvi et al., 2022). In the management of this process, the planning of the educational program and the determination of goals/outcomes related to knowledge, skills, and attitudes are among the priorities of educational administrators (Harden, 2002). In determining the level of the intended goal, the r-BT is widely used as a tool for learning and teaching in medical education (Morton et al., 2017; Nkanginieme, 1997; Turna et al., 2021). The r-BT helps students develop their thinking skills and supports deeper learning.

The use of r-BT in medical education enables students not only to memorize theoretical knowledge but also to understand and apply it. Moreover, it helps students develop critical thinking skills, making them more effective in making medical decisions and problem-solving (Morton et al., 2017). For example, medical school students learn foundational subjects such as anatomy, biochemistry, and pharmacology at the knowledge level. At the comprehension level, students acquire more detailed knowledge about the causes, symptoms, and treatment of diseases. In the application level, students develop their clinical skills and intervene in real patient cases. At the analysis level, students examine the causes and treatments of diseases. In the synthesis level, students develop treatment plans for different disease scenarios. Finally, at the evaluation level, students assess the health conditions of patients and re-evaluate their treatment plans. Examples of the use of the cognitive process dimension of r-BT in medical education can be summarized as shown in Table 6.

**Table 6.** Usage Examples of Cognitive Process Dimension of Learning Field in Medical Education According to Revised Bloom's Taxonomy

| Cognitive Learning | Examples |
|---|---|
| **Remembering** | Recalling anatomical terms, remembering drug names and their effects, recalling laboratory tests and their results, remembering medical terminology |
| **Understanding** | Understanding the causes, symptoms, and treatment methods of diseases, understanding complex anatomical structures, understanding drug interactions, understanding medical reports |
| **Applying** | Applying clinical skills, providing patient care and developing treatment plans, recognizing and utilizing anatomical structures, proper dosing and administration of medications |
| **Analyzing** | Making diagnoses, analyzing laboratory test results, conducting data analysis through literature research |
| **Evaluating** | Evaluating patient conditions, assessing the effectiveness of treatment plans, evaluating research data |
| **Creating** | Developing new treatment methods or devices, proposing new theories based on research data, creating customized care plans for patients |

The examples related to the use of the metacognitive process dimension of r-BT in medical education are summarized in Table 7.

**Table 7.** Usage Examples of Metacognitive-Affective Process Dimension of Learning Field in Medical Education According to Revised Bloom's Taxonomy

| Metacognitive Learning | Examples |
|---|---|
| **Perceiving** | Perceiving the patient's complaints, identifying symptoms, understanding the doctor's instructions, observing the patient's condition |
| **Responding** | Developing a treatment plan based on the patient's complaints, following the doctor's guidelines, taking appropriate action in emergency situations |
| **Valuing** | valuating the patient's condition, assessing the effectiveness of the treatment plan, evaluating the patient's emotional and psychological state |
| **Organizing** | Organizing the patient's care plan, scheduling appointments and tests, maintaining records, accurately dosing and administering medications |
| **Characterizing** | Characterizing the patient's condition, making a diagnosis, characterizing the treatment plan, characterizing research data |

Examples of the use of the affective process dimension of r-BT in medical education are summarized in Table 8.

**Table 8.** Usage Examples of Affective Process Dimension of Learning Field in Medical Education According to Revised Bloom's Taxonomy

| Emotional Learning | Examples |
|---|---|
| **Receiving** | Awareness of Symptoms Being aware of the patient's complaints, distinguishing symptoms from each other, paying attention to the doctor's instructions, understanding the importance of changes in the patient's condition |
| **Response** | Generating solutions for the patient's complaints, following the doctor's instructions, taking on tasks, using knowledge, implementing treatment |
| **Valuing** | Caring about the patient's condition, accepting the management of the treatment process, prioritizing the healing process, dedicating oneself to the patient's treatment |
| **Organizing** | Maintaining communication with patients in the same way, showing the same care in tasks performed, showing equal interest in the stages of patient treatment |
| **Internalizing** | Treating every patient in the same way, making the implementation steps a part of one's life, internalizing the work, embracing behaviors as a personality trait |

Table 9 has been created by adapting the learning objectives and outcomes of the Mersin University Faculty of Medicine (MEUTF) Education Program according to r-BT.

**Table 9.** Adaptation of Common Verbs When Writing Learning Goals/Outputs in Medical Faculties to Cognitive and Metacognitive Learning Levels of the Revised Bloom Taxonomy

| Cognitive Learning | Objectives |
|---|---|
| **Remembering** | Defines, describes, repeats, counts, examines, finds, identifies, lists, recites from memory, names, arranges in order, transfers, remembers, recalls, repeats, says, matches, labels, shows the location, finds the location, recognizes, acquires knowledge. |
| **Understanding** | Establishes relationships, modifies, clarifies, transforms, attributes value, explains, expands, generalizes, provides examples, exemplifies, explains with other words, explains in own sentences, predicts, becomes aware, reviews, distinguishes, translates, explains, describes, rephrases, gives examples, illustrates with examples. |
| **Application** | Applies, executes, uses, demonstrates, operates, tests, solves, presents, models, writes a prescription, authors, edits prescriptions, prescribes, takes a history, observes, reports, ensures protection, performs, scans, examines, applies, follows rules, instructs, sutures, stitches, takes an anamnesis, records anamnesis, provides information, keeps records, examines, supports, assists, follows up, fills in. |
| **Analysis** | Analyzes, dissects, divides into subparts, discriminates, calculates, categorizes, classifies, differentiates, criticizes, discusses, simplifies, reduces, deduces, compares, contrasts, discerns, distributes, inspects, investigates, drafts, indicates, questions, tests, schematizes, prepares, identifies, summarizes, selects, delivers, combines, measures. |
| **Evaluation** | Evaluates, selects, concludes, convinces, persuades, critiques, decides, measures, classifies, comments, judges, defends, recommends, associates, scores, validates, makes inferences, diagnoses, organizes treatment, treats, rates, manages, assumes leadership, takes necessary precautions, provides consultancy, manages, establishes relationships, guides, refers, consults, supervises, stabilizes, intervenes, rectifies, suggests. |
| **Creation** | Formulates, structures, constructs, composes, designs, develops, plans, formulates, produces, invents, derives, organizes, creates, reorganizes, discovers, organizes. |

| Metacognitive Learning | Objectives |
|---|---|
| **Perception** | Becomes aware, recognizes, gains awareness, remains receptive. |
| **Response** | Adapts, shows compliance, responds, is willing, assists, acts in harmony, communicates. |
| **Valuing** | Applies, advocates, accepts value, prefers value, demonstrates sensitivity, is sensitive, values, shows care. |
| **Organization** | Organizes, becomes organized, adjusts. |
| **Qualification** | Embraces, evaluates, internalizes, acquires character, acquires habit, dedicates oneself. |

As a result, in medical education, r-BT can be used to create an active and engaging learning environment. It allows educators to anticipate the intended level of the learning goals and plan the appropriate learning and assessment methods. The assessment of the outcomes can guide the quality of education and the necessary measures to enhance it.

When examining the National Core Curriculum for Undergraduate Medical Education (UÇEP 2020), it is observed that specific work has been done regarding the learning objectives in terms of clinical sciences departments. This includes categorizing the relevant course contents under topics such as common diseases, the frequency of their presentation, and the required level of knowledge for the students, covering categories like emergency, diagnosis, pre-diagnosis, treatment, follow-up, monitoring, and prevention. However, there is a lack of sufficient studies related to the curriculum concerning the first three years of medical education.

Considering UÇEP-2020, it is thought that conducting a similar level-determining study for the basic medical sciences curriculum would be beneficial for the development of medical education. The integration of basic and clinical sciences in the curriculum program is considered crucial. In this context, adapting the learning levels specified in r-BT to the learning objectives of medical faculties can provide guidance in determining the learning level in the educational program.

To make the workload in the curriculum, especially in the Basic Medical Sciences, more efficient in terms of functionality and the responsibilities it imposes on students' learning and recall processes, it is necessary to reduce the intensity of the subjects. Medical faculties can collaborate with the educational responsible parties of Basic Medical Sciences and Clinical Sciences to prioritize the "must-have" elements in the curriculum. In other words, in order to lay the foundation for the necessary clinical notions in Years 4, 5, and 6, it can be

suggested that the required topics for Undergraduate Medical Education in the clinical setting, such as Clinical Anatomy, Clinical Pharmacology, and Clinical Microbiology, should have a predetermined percentage of the curriculum and should be repeated and taught if necessary. Increasing the number of skill-oriented laboratory and clinical practices can also contribute to more effective medical education. The inclusion of more detailed topics required for specialization exams can be considered as "nice to have" by reducing their percentage weight in the curriculum. The essential theoretical topics at the specialty level can be structured from the perspective of "nice to have but not essential" to adopt a more rational and practical approach. This perspective can serve as a guiding principle to overcome unnecessary information overload.

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# CHAPTER 4

# EVIDENCE BASED MEDICINE

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Evidence-Based Medicine (EBM) is an approach that emphasizes the use of scientific evidence in making medical decisions. This approach aims to ensure that medical practices should be based on the best evidence and should be applied in line with current and evidence-based scientific data obtained through clinical trials and research in the process of deciding on patient care and diseases.

The origins of evidence-based medicine date back to the mid-19th century (Sackett, 1997). The National Health Service (NHS), established in the United Kingdom in 1948, played an important role in the development of evidence-based medicine, which was first brought to the agenda by Parisian physicians (Department of Health, 2010). With his book published in the 1970s, Archie Cochrane helped lay the foundation stones for evidence-based medicine and is now recognized as the pioneer of the idea of evidence-based medicine (Stavrou et al., 2014). In Cochrane's book "Effectiveness and Efficiency: Random Reflections on Health Services", which summarized medical research, he expressed the lack of reliable evidence behind many health practices that were widely accepted at the time and emphasized that steps should be taken to evaluate the effectiveness of medical practices and compile evidence. His criticisms encouraged rigorous evaluations of health interventions and emphasized the need for evidence in medicine (Shah & Chung, 2009).

Thanks to the developing technology and research opportunities, studies in the field of health have started to increase rapidly, and the clinical decision-making process has become quite difficult due to variations and inconsistencies between practices based on individual clinical opinions. Evidence-based medicine practices have started to be used more frequently instead of individual clinical decision-making processes. These practices encourage healthcare professionals to follow current research, use evidence-based guidelines and directives, and apply the best evidence-based treatments in patient care. This approach focuses on following developments and research in the medical field and integrating this knowledge into clinical practice. In evidence-based medicine, it is especially important to make decisions based on the results of clinical trials that have proven to be reliable. Not all medical research has the same level of evidence (Burns et al., 2011).

The pyramid of evidence is a representation of the different levels and credibility of medical research and evidence. In this pyramid, the lowest level of evidence is in-vitro studies, and the highest level of evidence is systematic reviews and meta-analyses. As you move from bottom to top, the level of evidence and credibility increases. While there is a general shape to the evidence pyramid, it can vary between different experts and institutions. Below is an example of a typical evidence pyramid:

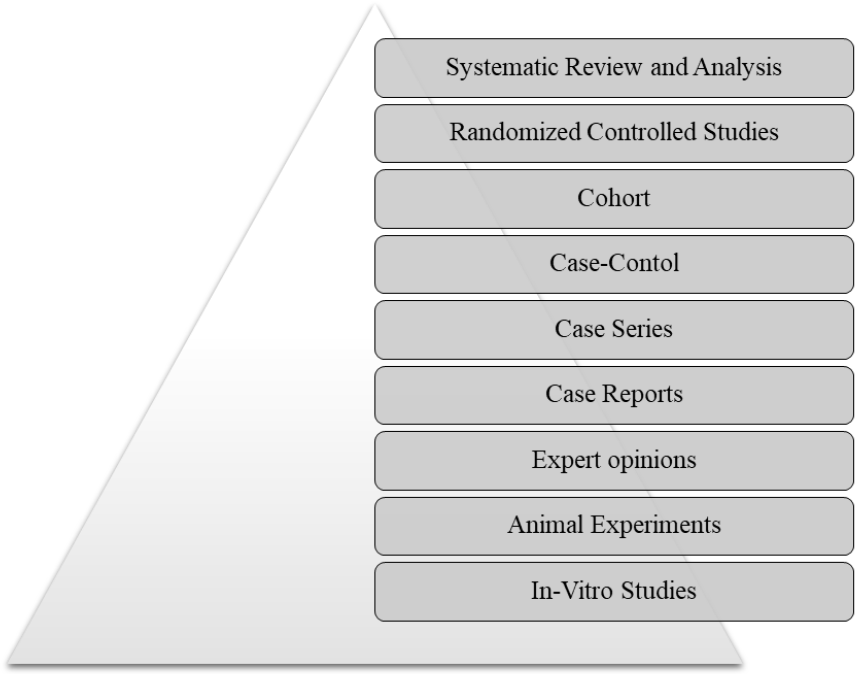


**Figure 1.** *Evidence Pyramid*

**In-Vitro Studies**

The word in vitro means "in glass" in Latin. In-vitro studies are studies in which biological properties are studied in a test tube or a glass container instead of a human or an animal.

In vitro studies allow scientists to isolate specific cells, bacteria and viruses and conduct their studies in isolation from other external factors. However, this can sometimes lead to results from in-vitro studies that are incompatible with real life. Except for research on living organisms, in-vitro research is easier, cheaper, and safer. These studies are fundamental to medical advances. It is often used in drug development or in studies testing the efficacy of a drug (Eskes et al., 2017).

To explain with an example; In a study conducted to evaluate the effect of Ononis spinosa L. on different chemical structures of kidney stones, urinary stones removed during surgery from seven patients over the age of 18 were divided into two parts, the first part was divided into the experimental group and the second part into the control group. The kidney stones in the experimental group were kept in the solution prepared with Ononis spinosa L. Plant and as a result, it was shown that O. spinosa L. plant may have a litholytic effect on kidney stones (Bashan & Bozlu, 2020).

**Animal Experiments**

Firstly, in 400 BC, studies were carried out on animals to understand the anatomical structures of animals. Galenos, a scientist, conducted experiments on live animals to try to understand their physiological functions by removing their organs (Altuğ, 2009). In the 17th century, modern animal experiments were practiced in England and France (Olsson, 2003).

Experimental animals are the most important source of information obtained from research in various disciplines. Most of the studies in the field of medicine require the use of experimental animals. Animal experiments, which are part of the drug development process, help us understand the cause of many diseases and contribute to diagnosis and treatment methods by mimicking diseases in humans (Uludağ, 2019).

To standardize animal experimentation, it is essential that the biological animal model, species, methods, number of subjects, and experimental design are determined at the planning stage, depending on the research objective, so that effective results can be obtained using the minimum number of subjects. Moreover, ethical principles and blinding or randomization principles that must be followed to prevent unintended effects should also be determined at this stage to ensure standardization (Ankaralı & Ankaralı, 2019).

In the "Principles of Humane Experimental Technique" published by Russell and Burc in 1959, the principles of Reduction, Replacement and Refinement, also referred to as the 3R rule, are also recommended for animal experiments (Russell & Burch, 1959). In addition to these, the principle of Responsibility has been proposed as the fourth rule (Tüfek & Özkan, 2018).

**Replacement:** If possible, in vitro models that can replace animal models should be used in experiments or the number of animals to be included in the study should be reduced by choosing animals that can achieve the same goal and are at a lower life level.

**Reduction:** Previous studies in the literature should be carefully examined and research should not be repetitive. Experiments should be carried out with the minimum number of animals by applying pilot studies, examining the literature well and using statistical methods.

**Refinement:** Measures should be taken to improve the quality of life of animals and to protect animal welfare at the highest level by using methods such as improving the housing conditions of animals, providing a suitable and enriched environment, nutrition, water supply, minimizing painful procedures.

**Responsibility:** Every researcher has a responsibility towards the animal used in their studies, the scientific discipline, supporters, and the public. For this reason, scientific research utilizing animal models adopts a principle that focuses

on raising public awareness in areas such as product testing and education (Ergün, 2010).

As an example of animal experiments, thirty-two rats were used in the study conducted to investigate the effect of mobile phones operating with 4.5G mobile network on the optic nerve responsible for visual information transmission. In the study, the animals were divided into two groups as control and experimental. Rats in the experimental group were exposed to radiofrequency radiation with a mobile phone using LTE-Advanced Pro network. At the end of the study, it was concluded that exposure to 4.5G mobile phone radiation for 2 hours a day for 6 weeks caused optic nerve damage (Özdemir et al., 2021).

**Expert opinions**

Expert opinions consist of the comments of people who have worked on the subject and have expertise. The main reason why expert opinions are at the bottom of the evidence pyramid is the lack of empiricism and problems arising from the recall of past experiences. In addition to these problems, selective recall, learning information similar to one's own thoughts more easily, rejection of a new approach in line with the believed treatment, etc. (Sackett, 1989, Kalenderer & Kılıçoğlu, 2014).

However, expert opinion plays an important role in making critical decisions about the disease or treatment. An interdisciplinary board meeting is held to decide whether the patient should undergo surgery or not. In very rare diseases, mutual consultations and board decisions may need to be taken both internally and externally. Sometimes this may require sharing of expert opinions between countries.

**Case Reports and Case Series**

Case reports are based on the examination of a single clinically distinct case. It is the most common type of descriptive research (Çaparlar & Dönmez, 2016). It may include information such as a patient's medical history, symptoms, diagnosis, treatment and outcomes. These presentations can be used to encourage the sharing of experience and knowledge among health professionals, to understand a particular condition or disease, and to develop strategies for future cases (Cohen, 2006).

According to the report by Bashan et al (2017), a 37-year-old woman complained of upper respiratory issues and worsening dyspnea and was admitted to the emergency department five days after giving birth. An echocardiogram was performed in the emergency department, displaying mild left ventricular hypertrophy, global hypokinesia, a reduced left ventricular ejection fraction

(LVEF) measured at 35%, a 5.3 cm left ventricular end-diastolic diameter, and grade 2 mitral regurgitation. While being transported to the coronary care unit, the patient suffered respiratory arrest, which was treated with cardiopulmonary resuscitation and tracheal intubation. The patient was monitored in the coronary care unit for three days, and during the follow-up echocardiography, a left ventricular ejection fraction (LVEF) of 37% with global hypokinesia was observed. Additionally, mild mitral regurgitation and a minimal pericardial effusion were detected. On the seventh day, the patient's symptoms subsided, their vital signs returned to normal, and they were discharged (Bashan et al., 2017).

Case series are among the most common studies in medical publications and are usually studies in which the clinician identifies an unusual, unexpected situation or describes rare conditions. They reveal a new disease, a new agent or the results observed in the case(s). They allow a detailed description of cases without using a control group.

In cases where it is not possible to apply an experimental design within a case series, the results can be evaluated by creating groups within the case series in order to make observational evaluations, to reach the underlying reasons for the differentiation of some characteristics of some patients, to observe the effects of different treatment methods applied to the same patients. In this case, the name of the research design is specialized and defined as a comparative case series (Goodrick, 2020).

This study presents a comparative case series examining the outcomes of patients with end-stage ankle osteoarthritis who were treated openly and arthroscopically at two different institutions. The study followed the patients for two years and evaluated their Osteoarthritis Scale score, SF-36 physical and mental component scores, length of hospital stay, and radiographic alignment values. There were 30 patients in each group, and both groups showed significant improvements in the Foot Osteoarthritis Scale score and SF-36 physical component score during the first and second years of the study. The patients in the arthroscopic arthrodesis group showed significantly greater improvement in the Foot Osteoarthritis Scale score after one and two years and had shorter hospital stays (Townshend et al., 2013).

**Case Control Studies**

In case-control studies, the case usually represents the patient group while the control group represents healthy individuals. In these studies, it is aimed to investigate whether these variables have an effect on the disease by comparing the same variables of healthy individuals who do not have the same disease

against a patient group. Especially genetic studies are frequently encountered as case-control studies. In these studies, it is examined whether gene expressions or genotype structures obtained from patients and controls affect the disease. Compared to other study designs, it can obtain important scientific findings by spending relatively little time, money and effort (Song & Chung, 2010).

Researchers conducting case-control studies need to be careful to eliminate biases. Researchers should clearly define the criteria for diagnosing a case and identify any eligibility criteria used for selection. To avoid selection bias, the control group should come from the same population as the cases (demographics should be the same) and the number of individuals in the groups should be as evenly distributed as possible. Researchers should conceal the case or control status of participants, or if not possible, at least the main hypothesis of the study, to avoid bias in statistical results during data collection or at the analysis stage. Careful attention to these points will increase the validity of the results and strengthen the reader's confidence in the findings (Schulz & Grimes, 2002).

In the study by Bashan and Bakman, the effect of daily walnut consumption in the diet on dyslipidemia was investigated. Patients who were recommended to consume walnuts in their individual diets within one year were retrospectively screened and 72 people who were recommended only a diet program were included in the first group and 73 people who were recommended to consume walnuts in the diet were included in the second group. After three months, the experimental group consuming walnuts with their diet had significantly lower total cholesterol, low-density lipoprotein cholesterol, very low-density lipoprotein cholesterol, and triglyceride levels compared to the control group (diet only). Thus, the study concluded that walnut consumption reduces cardiovascular risk and the inclusion of walnuts in dietary interventions enhances blood lipid levels (Bashan & Bakman, 2018).

**Cohort Studies**

"Cohort" is derived from the Latin word "Cohors" and Epidemiologist W.H. Frost first used the word "cohort" in his study published in 1935. The modern epidemiologic definition of the word is currently used as "individuals followed for the purpose of determining the incidence, mortality or some other outcome of a particular disease".

In cohort studies, individuals in a disease-free sample or population are followed until the occurrence of disease or another expected outcome due to specific exposures over a period. In case-control studies, the disease state is known at the beginning of the study and then exposure is investigated, whereas in these study designs, unlike case-control studies, exposure is determined before

the occurrence or development of the disease/outcome. Since people are followed for a certain period after exposure or until the disease/outcome occurs, it has the potential to provide strong scientific evidence for causality assessment.

**Advantages of these studies:**

- Collect data to record the sequence of events; assess causality.
- There is the possibility to examine more than one outcome for a given exposure.
- Suitable for investigating rare exposures.
- Disease rates such as incidence and relative risk can be calculated for exposed and unexposed individuals over time

**Disadvantages:**

- Large numbers of participants are required to investigate rare exposures.
- It is sensitive to selection bias.

If patients were not exposed to risk before the start of the study, it is called a "Prospective Cohort", while if the risk exposure occurred before the start of the study, it is called a "Retrospective Cohort". Prospective cohort studies may encounter situations such as long follow-up time, increased costs during follow-up, and individuals who want to leave the study or cannot be reached during follow-up, while in retrospective cohort studies, situations such as inability to remember or misremember the time of exposure of the people followed and less control over the variables examined can be observed (Song & Chung, 2010).

An observational, prospective cohort study of Carbapenem-resistant Pseudomonas aeruginosa (CRPA) isolated from blood, respiratory, urine, or wound cultures of patients from 44 hospitals in 10 countries between December 1, 2018, and November 30, 2019 was conducted by Reyes et al. They analyzed the mortality rate at 30 days starting from the day of index culture. The authors compared the outcomes of patients with Carbapenem-resistant Pseudomonas aeruginosa infection by type of infection and geographical region. They also evaluated the association between carbapenemase production and 30-day mortality. The study found differences in clinical characteristics and outcomes of patients with Carbapenem-resistant Pseudomonas aeruginosa infection across different geographical regions. Carbapenemases were rare in CRPA isolates in the United States of America, while in other regions, KPC-2 and VIM-2 carbapenemases were commonly found. The authors concluded that the 30-day mortality rate was higher in patients with carbapenemase-producing CRPA infection (Reyes et al., 2023).

**Randomized Controlled Trials**

Randomized Controlled Trials (RCTs) are widely used in scientific research and have a high evidence value. RCTs allow researchers to randomly allocate participants into groups and evaluate the effect of interventions in a controlled manner, rather than deciding which intervention will be applied to which group in a study.

In these studies, subjects/individuals are divided into different groups using random assignment methods. One of these groups receives a treatment or intervention that the researchers want to test and is called the intervention group, while the control group usually refers to a standard treatment, placebo or no intervention.

Random assignment of subjects allows groups to have similar characteristics, especially by reducing selection bias. Such studies are crucial for obtaining statistically significant results that are free from bias and for assessing the true effect of the treatment or intervention (Straus et al., 2005).

Randomized controlled trials are frequently used, especially to evaluate the efficacy and safety of medicines, but can also be applied in other areas such as other health interventions, psychological treatments or social programs. This type of study is an important tool for obtaining reliable results due to its compliance with the basic principles of the scientific method.

Randomizations in RCTs can be applied in different ways (Kanık et al., 2011).

1. Full Randomization
2. Constrained Randomization
3. Randomization by Baseline Risk Factors
4. Response Oriented Randomization

An example of different ways of conducting RCTs is shown in Figure 2. In the absence of a standard treatment (A), the experimental group may receive the treatment, while the control group may receive a placebo or no treatment. If there is a standard treatment (B), the experimental group receives the treatment while the control group continues with the standard treatment procedure. This is a preferred method, especially to avoid leaving patients without treatment. If there is a standard treatment and discontinuation of this treatment is not suitable for the patients or if it is aimed to develop another treatment in addition to the standard treatment (C), treatment combination application can be used. In the first step of the study, after the groups are randomized, one group receives the standard treatment, and the other group receives the new treatment (D). In the second step, the treatments given to the groups are switched so that the individuals are under their own control. Between the two phases, a “washout period” is applied to

eliminate the effects of the first treatments. In this way, the effects of the treatments do not affect the results of the next treatment.

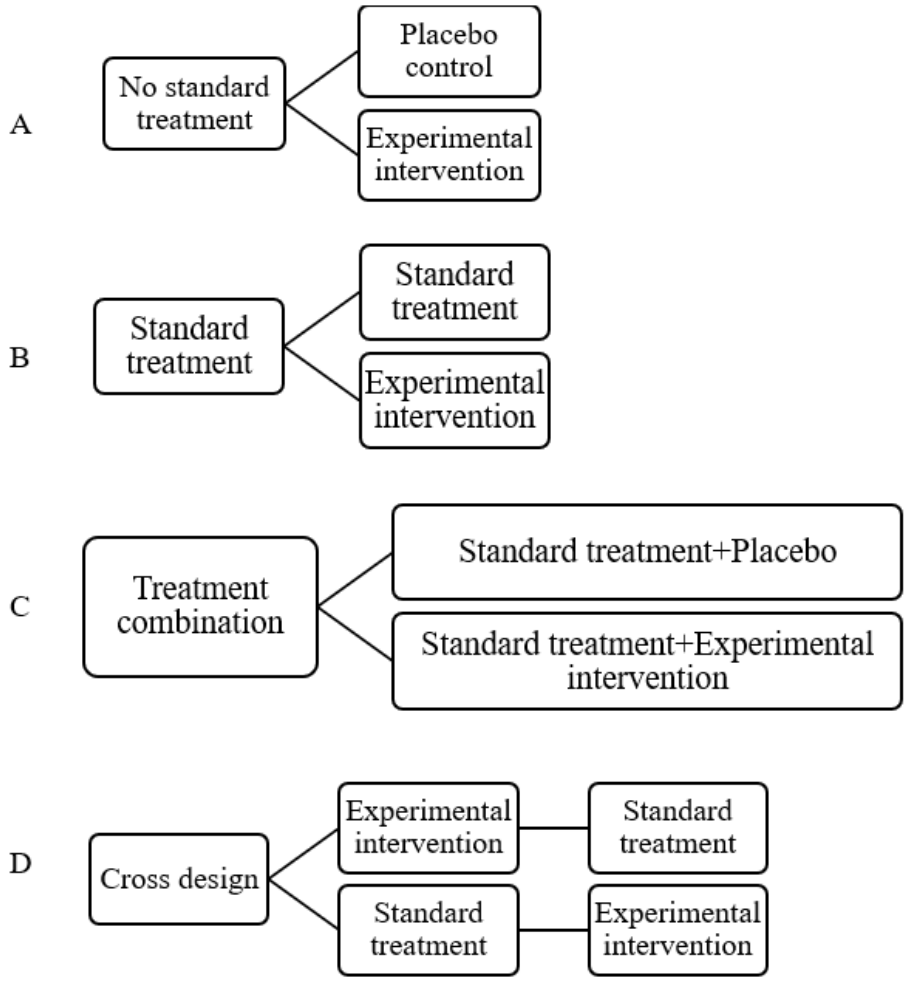


**Figure 2.** *Randomized Controlled Trial Designs*

Randomized controlled trials are most commonly used in Phase III trials. The classification of clinical trials by phase is given in Table 1. Phase I evaluates how best to administer a drug, frequency, maximum tolerated dose and side effects. Phase II evaluates the potential efficacy of the maximum tolerated dose determined in Phase I and investigates whether the treatment benefit has an effect on disease. Phase III trials are full-scale evaluations of the treatment and compare the new treatment to standard treatment to assess its effectiveness. It can also be characterized as the "pre-marketing phase" of scientific clinical research, the most rigorous and comprehensive type of trial for a new treatment. Typically, Phase III

is the most costly and time-consuming of the other trials. After the Phase III phase, a Phase IV trial is conducted to investigate the long-term effects and morbidity of the treatment, which are too rare to be detected in previous studies (Stanley, 2007; Mahan, 2014).

**Table 1.** Phases in Clinical Trials Description

| | | **Number of individuals** |
|---|---|---|
| Phase I | Investigation of possible toxic effects and determination of the tolerability of the intervention (and the tolerable dose in the case of a drug study). | 10-30 |
| Phase II | To determine whether the treatment is working or whether it is likely to benefit and outweigh the risks. | 20-50 |
| Phase III | To compare the new treatment with the standard of care or with a control or placebo (if there is no standard of care). | 100-1.000 |
| Phase IV | To obtain long-term information on morbidity and late effects on a large scale (post-marketing study). | >1.000 |

Although the majority of Phase III studies are randomized controlled trials, not all controlled trials are classified as Phase III trials. Randomization is less frequent in Phase I and Phase II trials. In addition to ensuring that the groups are as similar as possible, randomization in Phase I and Phase II trials can sometimes be regarded as an equitable mechanism to ensure equal access for patients to a promising new medication with limited resources.

In RCTs, incomplete observations may occur for certain reasons. Disruptions in the order of the research may occur due to reasons such as participants wanting to leave the research, side effects due to the treatment they receive, the occurrence of an additional condition that will negatively affect their disease, inability to reach the participant, etc. Due to such situations that may arise, the "intention-to-treat analysis" method is used to maintain the effect of randomization and to prevent incomplete observation bias. This method is called "intention-to-treat analysis" (ITT) and involves the inclusion of each participant in the analyses in the group to which they are assigned, regardless of any reason such as dropout, non-compliance, treatment/intervention or not, which occurs after randomization. The basic principle of ITT analysis can be summarized as "analyze how you randomized". The main advantages of this method can be listed as maintaining the balance of randomization, avoiding bias and increasing the power of the research. Among the disadvantages, it can be said that it can reduce the effect of treatment and there are problems of completing missing data (Elkins & Moseley, 2015; Fisher et al., 2017).

Another important element in RCTs is blinding or masking. The purpose of blinding is to ensure that the results of the expected response to treatment are not affected for certain reasons. Blinding can be applied in different ways. Single-blind applications are when the researcher or participant does not know which treatment they are receiving. It is usually applied more on participants/patients. In this way, the effect realized especially in the placebo group is seen more clearly, while the participants in the treatment group are prevented from expecting benefit from the treatment. Double-blind studies are those in which both researchers and participants do not know who is receiving which treatment. In triple-blind studies, researchers, participants and evaluators (usually statisticians) do not know which treatment is received. Triple blinding is the most effective method to prevent bias. When blinding is not used in the study, the study is called an "open-label study". An open-label RCT is also called an open RCT, open study, unblinded study or unblinded trial (Schulz & Grimes, 2002; Renjith, 2017).

**Systematic Review and Meta-Analysis**

Systematic reviews and meta-analyses are considered the studies with the highest level of evidence. They are secondary studies used to objectively examine and synthesize scientific studies. Systematic review and meta-analysis methods are used by researchers in medicine, psychology, education, social sciences and many other disciplines.

Systematic review is the process of screening, selecting and evaluating the existing literature around a specific research question. This process involves selecting appropriate studies according to predetermined criteria, collecting data and compiling them systematically. A systematic review aims to reach reliable conclusions by examining the available evidence in depth using a systematic approach.

Meta-analysis is the process of statistically combining and synthesizing the results of systematic reviews. Meta-analysis provides stronger evidence by bringing together the results of studies that answer similar research questions. With meta-analysis, sampling errors can be reduced and inconsistencies and contradictions in studies can be evaluated through statistical methods (Ahn & Kang, 2018).

When conducting meta-analysis, a comprehensive literature review should be conducted. In line with the research question, it is an important factor to reach all studies related to the relevant subject. The results of the studies in the literature are combined according to the effect sizes of the studies and a general effect value (total effect) is calculated.

The main purpose of meta-analysis studies can be listed as follows:

• Providing strong evidence and increasing statistical power
• Determining effect size
• Heterogeneity analysis
• Examining subgroup analyses and effect modifications

**Providing a Strong Evidence Base and Increasing Statistical Power**

A stand-alone study can often have a limited sample and its results may have some uncertainty in terms of reliability. Meta-analysis combines the results of many studies, allowing you to have a larger sample and make the results more reliable, while increasing statistical power by increasing the likelihood of identifying effects that are weak in smaller samples.

Randomized Controlled Trials, Observational Studies (Cohort, Case Control, Cross-Sectional), Diagnostic Studies, the results of different studies consisting of more than one study type with similar research questions are combined under the same roof and the results are interpreted for a much larger sample size (Littell, 2008).

**Determining Effect Size**

It is important to assess whether there is consistency between the results obtained in different studies. Meta-analysis allows you to determine the effect size by pooling the results of similar studies. This allows a better understanding of the true impact of a treatment or intervention. For example, in one study, drug A was found to be effective for a particular disease, while in another study, drug B was found to be effective. So which study should the physician base his/her treatment on? By applying meta-analysis and combining the results of studies in which drugs A and B are effective, it can be observed that one of the two treatments is more effective or that there is no difference between the treatments.

**Heterogeneity Analysis**

Meta-analysis allows you to assess the level of heterogeneity (differences between studies) in results from different studies. By identifying differences between studies, heterogeneity analysis allows you to understand how the results may be affected.

In meta-analyses, heterogeneity is most commonly expressed by the $I^2$ value. An $I^2$ value of less than 25% indicates very low heterogeneity, between 25% and 50% indicates moderate heterogeneity and greater than 50% indicates high heterogeneity (Higgins et al., 2003). Heterogeneity in meta-analyses can be caused by various factors (Petitti, 2001):

***Sample characteristics***: One source of heterogeneity may be that different studies have different sample characteristics. For example, studies may have been conducted in different age groups, in different geographical regions or at different disease stages. These situations may affect the results of the study in the opposite direction.

***Study design***: Different designs of studies can affect heterogeneity. For example, some studies may be randomized controlled trials, while others may be observational studies.

***Variability*** Natural variability in research subject matter can affect heterogeneity among results. For example, the effect of a treatment may vary across individuals, which may create heterogeneity in the results of a meta-analysis.

***Treatment protocols***: Different treatment protocols may be used in different studies. These differences may cause heterogeneity in results. For example, differences in dose or treatment duration may lead to heterogeneity in results.

***Publication bias***: Although there are many studies that have not been included in the literature due to the tendency of studies with negative results not to be published, studies with positive results are more likely to be published, the publications in the literature are in different languages and the publication years are very old. Heterogeneity may occur in meta-analysis results due to incomplete or biased publications (Crowther, 2010). Various methods are used to determine publication bias in meta-analyses. The most frequently used of these is the Funnel Plot application. Funnel plot is a graphical method and serves to visualize the results of meta-analysis by taking into account the effect sizes and sensitivities of the studies.

As shown in Figure 3, the Funnel plot has dots that form a funnel shape on the graph, with the effect sizes of the primary studies on the horizontal axis and study sensitivities (usually standard errors) on the vertical axis. In a funnel plot, effect sizes and sensitivities of studies are expected to be evenly and symmetrically distributed (Figure 3A). In meta-analyses with publication bias, on the other hand, asymmetry occurs, the funnel shape may be distorted, and a spread or irregularity may be seen in one direction in the graph (Figure 3B).

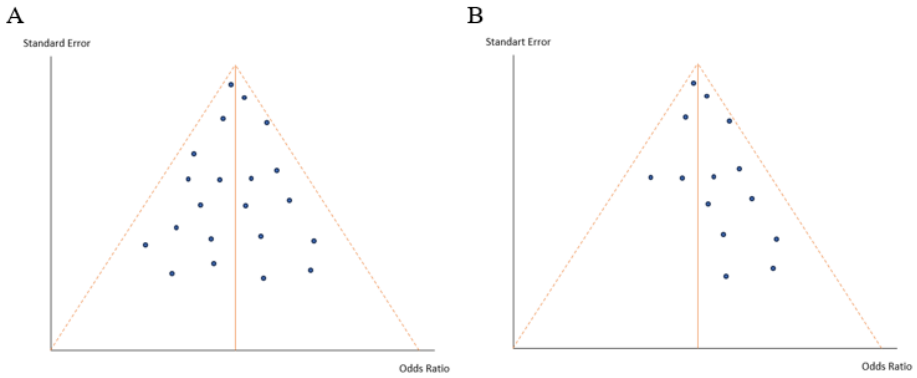


**Figure 3.** *Funnel Plot (A: Without publication bias, B: With publication bias)*

**Subgroup Analyses and Review of Effect Modifications**

Meta-analysis enables the conduction of subgroup analyses to determine how the effects differ in various subgroups or under different study conditions such as different dose administration or use of additional medication. It also enables the performance of effect modification analyses to examine whether some factors such as age, gender, duration of treatment, etc. alter the total calculated effect.

Meta-regression analysis is utilized to examine effect modifications and identify sources of heterogeneity. Meta-regression can be defined as the combination of meta-analysis techniques with principles of linear regression. Meta-regression investigates the presence and direction of a linear relationship between variables and a comparative treatment effect. Meta-regression is a more sophisticated approach for exploring heterogeneity than subgroup analysis, by enabling effective assessment of one or more covariates.

**Interpretation of Meta Analysis Results**

In meta-analysis studies, heterogeneity is first checked. Because the statistical method used will change according to heterogeneity. If the $I^2$ value we mentioned in the heterogeneity section is greater than 25%, the studies should be analyzed with the Random Effect Model. In the absence of heterogeneity, the Fixed Effect Model method is applied. As a result of the model used, we obtain the following results;

**Effect size of studies:** Represents the effect size of the study and the confidence interval for the estimated effect size.

**Weight of studies:** Refers to the weight of each study in its contribution to the outcome of the meta-analysis. The weight is determined based on the sample size of the study and/or other factors.

**Total effect size**: The total effect size (usually the average effect size) is calculated by combining the weight and effect size of each study. The total effect size is a synthesized measure of the results of all studies.

In meta-analysis, a type of graph, the "Forest Plot", is used to visualize the effect sizes and confidence intervals of studies. This graph shows the effect size of each study (usually with its standard error) with a rectangle or dot representing the weight of the study. The studies are ordered from bottom to top, and a vertical line is used to compare the results with each other. Forest plot is an important tool for understanding and evaluating the results of meta-analysis. The graph allows you to compare the effect sizes and confidence intervals of the studies. It also allows you to visualize the contribution of each study and the strength of the meta-analysis result.

Calculations can be made for different types of variables. If we are working on a continuous variable, when the difference between the averages is "0", the main axis will be distributed around "0" as it means that there is no difference (Figure 4).

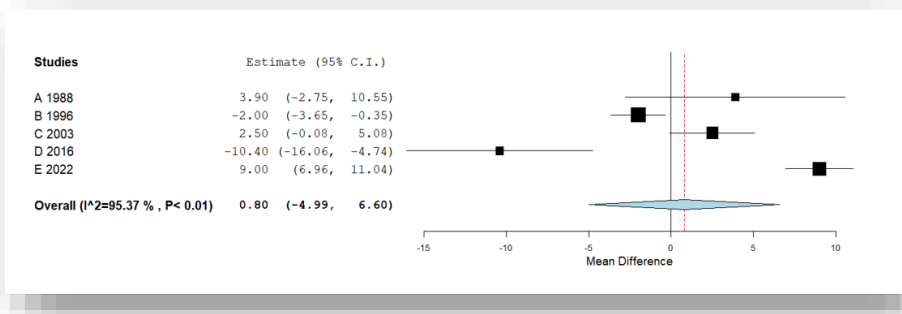


**Figure 4**. Example of Forest Plot for Means

When the value of a ratio such as Odds ratio, Risk ratio, Hazard ratio is calculated as "1", it means that the result is ineffective, there is no difference between the values, so the dividing point for the axis will be "1" in meta-analyses based on the ratio (Figure 5).

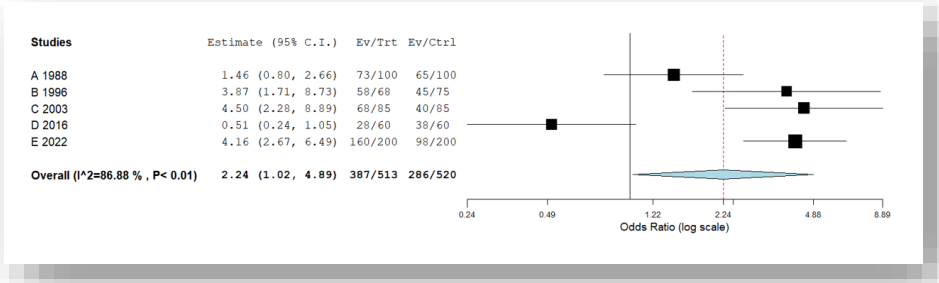


**Figure 5**. Example of Forest Plot for Ratios

For Sensitivity and Selectivity values in diagnostic tests, the split point will be "0.5" (Figure 6). If a total effect value is calculated that cuts across the split points, the research question can be answered as no difference.

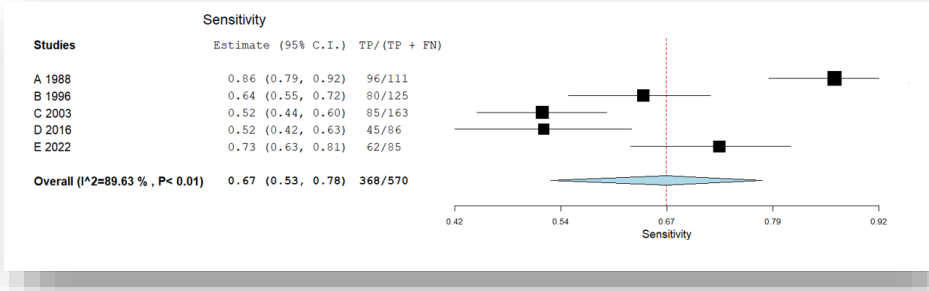


**Figure 6**. Example of Forest Plot for Diagnostic Tests

**Limitations of Meta Analyses**

Despite the highest level of evidence, a meta-analysis embodies all the characteristics of the studies incorporated in the analysis. Hence, performing a meta-analysis does not resolve the inherent issues in the design and implementation of primary studies. Moreover, it does not rectify the biases originating from selective publication. More often, the studies reporting significant outcomes are recognized, summarized, and then merged in a meta-analysis than those reporting a lesser impact.

Pooling studies with contradictory results in a meta-analysis may hinder interpretation of the outcomes. Merging studies of poor quality with high-quality studies may not be helpful and may result in inaccurate estimations of the true

effects or a misleading impression of precision. An incorrect impression of precision can also occur when patients are separated into subgroups based on their characteristics, like age or gender, to analyze the effects of treatments that differ across subgroups. In these situations, providing a total measurement of the treatment effect can be deceptive if there are critical factors that account for the inconsistent effects of treatment among diverse patient groups.

Merely labelling an article as a 'systematic review' or 'meta-analysis' does not necessarily imply that the review was conducted or reported with necessary rigor. One must carefully review the literature and thoroughly examine and report the quality, biases, and limitations of the included publications (Garg et al., 2008).

**Reporting Guidelines by Research Types**

It is possible to plan research in many different ways. However, each study has advantages, disadvantages and limitations. Reporting guidelines have been developed for different types of research. These reporting guidelines also guide researchers on what to consider when planning a study.

These guidelines are added to and subtracted from over time as needed. Table (Equator Network) shows the different reporting guidelines that can be applied according to the type of research and the purpose for which they are used.

**Table 2.** Reporting Guidelines Used According to Research Types

| Research Type | Checklist | Description |
|---|---|---|
| Systematic Review and Meta-Analysis | PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) | It includes detailed reporting requirements in areas such as research planning, data sources, study selection, data extraction, data synthesis, quality assessment and results. |
| Randomized Controlled Trials (RCTs) | CONSORT (Consolidated Standards of Reporting Trials) | It is used to set standards for reporting RCTs. It includes detailed reporting requirements in areas such as participant selection, randomization, blinding, treatment protocol, measurements, data analysis and outcomes. |
| Observational Studies (Cohort, Case Control, Cross-Sectional) | STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) | It specifies detailed reporting requirements for the study in areas such as purpose, design, data source, participant selection, |
| Diagnostic Studies | STARD (Standards for Reporting of Diagnostic Accuracy Studies) | The methodology specifies detailed reporting requirements in areas such as participant selection, reference standard, tests, data analysis and results. |
| Case Report | CARE (Case Report) | It includes the patient's symptoms, diagnostic process, treatment methods, laboratory findings and other relevant details. It helps to identify rare diseases or rare complications. |
| Biomedical Research | ARRIVE (Animal Research: Reporting of In Vivo Experiments) | It is used in the reporting of biomedical research studies on animals. It includes detailed reporting requirements in areas such as experimental design, animal selection, interventions, measurements, data analysis and results. |

**The Importance of Evidence-Based Medicine in Medical Education**

Evidence-based medicine is of great importance in medical education and clinical practice. The use of treatment options based on scientific evidence increases the quality of health services, ensures patient safety, improves treatment outcomes and helps to use resources effectively. During the medical education process, physician candidates gain the following competencies and qualifications through evidence-based practices.

**Scientific basis:** By learning reliable research methods, medical students develop the ability to understand and critically evaluate the scientific literature. This makes them more competent in addressing health problems and determining the most appropriate treatment options.

**Patient safety:** By evaluating treatment options based on current scientific evidence, medical students learn to avoid unnecessary or ineffective interventions that could put patient safety at risk. This is of paramount importance in making sure that patients are safe.

**Critical thinking skills:** Evidence-based medicine helps medical students develop critical thinking skills. They gain the ability to evaluate, analyze and interpret medical information based on scientific evidence. This gives them the ability to make more informed and rational decisions in medical decision-making processes.

**Continuous learning:** Evidence-based medicine encourages continuous learning. The field of medicine is constantly open to innovations and developments. Medical students learn to follow current research and integrate new scientific evidence. This enables them to continuously update their medical knowledge and helps them maintain their professional development.

**Patient-centered approach:** Evidence-based medicine supports a patient-centered approach. Medical students learn to create treatment plans taking into account patients' individual preferences and values. A patient-centered approach promotes effective communication and patient satisfaction.

**Improved treatment outcomes:** Evidence-based medicine contributes to improved treatment outcomes by ensuring the use of effective and safe treatment methods. Medical students learn the most effective treatment options based on scientific evidence and use this knowledge in clinical practice to better manage patients' health conditions. This accelerates patients' recovery processes, reduces the risk of complications and improves quality of life.

**Professional reputation:** Medical graduates with knowledge and skills based on up-to-date scientific evidence are perceived as more reliable and respected by colleagues and patients. Health professionals who work in accordance with the

principles of evidence-based medicine maintain their professional reputation and become trusted in society.

Evidence-based medicine learning is of great importance in medical education. This approach enables medical students to make scientifically based decisions, ensure patient safety, develop critical thinking skills, promote continuous learning, adopt a patient-centered approach and improve treatment outcomes. Medical graduates who are trained in accordance with the principles of evidence-based medicine become professionals who can provide quality and effective health care by transforming what they have learned into an attitude (Selvi & Bashan, 2019).

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# CHAPTER 5

# GROUP DYNAMICS IN MEDICAL EDUCATION

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During training activities, trainers have different roles; they play the role of '**trainer**' when giving theoretical presentations in a classroom setting, but play the role of '**facilitator**' during group activities. On the other hand, they play the role of 'trainer' when teaching students different skills and practicing them, and '**evaluator**' when assessing performance. Group activities are more effective than theoretical lectures in terms of knowledge utilization and skill development. During these activities, the trainer's facilitation competence and skills in group dynamics play a key role in the successful conduct of the learning process. A good understanding of the concepts of group dynamics will contribute to the trainers' ability to manage and direct the group (Forsyth, 1990; Sullivan, 1990; Dolmans et al., 2001).

Group teaching is also an important component of medical education. Group dynamics in medical education encompasses situations where students come together for different activities and work towards a specific goal (Imel, 1990; Birmingham & McCord, 2004; Steinert, 2004; Meo, 2013). Group dynamics can be considered as a concept that describes how group members interact and cooperate in an educational environment. The main points that determine group dynamics are summarized below (Forsyth, 1990; Sullivan, 1990):

1. *Communication:* It refers to the mutual communication among group members or with the trainer. Open and effective communication between group members is crucial for group success. Good communication enables group members to understand each other and focus on common goals.
2. *Cooperation*: Group dynamics involves the ability of group members to work together. It refers to participants cooperating to complete tasks together. Collaboration allows group members to use their strengths, share responsibilities and support each other.
3. *Leadership:* Group dynamics involve leadership roles. Leadership is provided by the person or persons who direct, motivate and organize group members. A good leader encourages group members, manages cooperation within the group and directs participants towards common goals.
4. *Roles*: Group dynamics involves the roles and responsibilities of group members. Each member has a specific task or role. Roles enable group members to make the best use of their skills and expertise. Different roles create diversity within the group and bring together different perspectives.
5. *Conflict and Cohesion*: Group dynamics involve conflict and cohesion. Conflict can arise when there are different ideas, values or perspectives

within the group. In a well-managed group dynamics process, conflicts are handled positively, solutions are found and harmony is achieved. An environment of trust, respect and tolerance is created among group members.

6. *Motivation*: Group dynamics involves the motivation of group members. Appropriate management of group dynamics increases the motivation of members and facilitates focus on goals. Celebrating achievements, providing support and creating a positive educational atmosphere increases motivation in the group.

In medical education, group work is used to encourage students' active participation, increase knowledge sharing, develop critical thinking and facilitate learning. Group activities allow students to develop social and collaborative skills, explore different perspectives and achieve better results by working together. Good management of group dynamics increases student engagement, enriches the learning experience and creates a better educational environment (Newble & Cannon, 1987; Meo, 2013).

**Concepts of Group and Group Dynamics in Education**

An educational group is considered to be a living system consisting of participants (students) and trainers who come together to research and discuss a topic within the scope of learning objectives and to produce a common result, and which has different styles and personalities from the individuals within it. Group dynamics refers to the personality traits, behavioral styles, communication skills and interactions of the individuals that make up the group. Therefore, although the educational content and the trainer are the same, different learning processes may develop depending on the characteristics and dynamics of the group (Forsyth, 1990; Dolmans & Schmidt, 2001, Bashan et al.,2021).

Group members exhibit certain predictable behavioral dynamics and patterns, which positively or negatively affect the efficiency of the learning process (Järvenoja & Järvelä, 2005; Linnenbrink-Garcia et al., 2011). When group dynamics are well managed, the learning process moves in a positive and productive direction, while poorly managed group dynamics can lead to negativity, confusion and even crisis. The behavior of group members individually or collectively can have positive or negative effects on the dynamics of a group. The trainer constantly monitors and observes the learning process in order to support the harmonious functioning of the group. In this way, he/she closely follows the developments throughout the process,

anticipates what might happen in the future and, when necessary, intervenes to support learning and ensure group harmony. The success of the training group in the learning process is closely related to the management of situations that affect group dynamics (Dolmans & Schmidt, 2001; Michaelsen & Richards, 2005).

Knowing the characteristics and causes of the situations that affect group dynamics will make it easier to manage the learning process positively. Situations affecting group learning dynamics can be analyzed under the headings of 'content functions of the group' and 'continuity functions of the group'.

**Content Functions of the Training Group**

A group's content functions are the specific behaviors that facilitate a group's performance and completion of tasks within the learning objectives. Content functions refer to what needs to be done in the learning process. These functions should be fulfilled by all members of the group, including the trainer. The trainer should support the learning process by monitoring and guiding the activities of the group members and intervening when necessary. Performing these functions in appropriate ways will facilitate the achievement of learning objectives and successful completion of tasks. The main points that determine the content functions of the group are summarized below (Cranton, 1996; Imel, 1999; Renko et al., 2002).

***1. To begin***: Refers to when the training group starts working together to accomplish a new task within the scope of the learning objectives. This function is considered as the initial action that energizes and drives the group to work together. The stronger the initial energy, the higher the efficiency of the group in the learning process. In addition, the level of commitment at the beginning will also facilitate the internalization of the process. For this reason, enough time should be allocated to the initiation phase to ensure high determination and motivation in the group members, but unnecessary extensions should be avoided in terms of time management. In this phase, providing information about how long a topic will be emphasized and when to move on to another topic will be useful in terms of the predictability of the process and time management.

***2. Analyzing/researching information***: This phase refers to the research and examination of the subject determined within the scope of the learning objectives together with its sub-headings. In this phase, group members divide their work among themselves and search for the necessary information, examples and scientific interpretations on the subject. The trainer, on the other

hand, monitors the group members' work towards the goal with a facilitative and guiding approach and contributes when necessary. The trainer knows where to access the necessary information and when more information is needed and guides the group members.

***3. Assigning responsibility***: It means that group members take responsibility for presenting, interpreting, sharing, expanding and combining the information they have gathered. The trainer encourages the participants to fulfill these functions.

***4. Clarify***: This refers to the trainer's monitoring and, where necessary, corrective interventions for some gaps, inconsistencies, confusions or disagreements that arise when research results are shared and that cannot be resolved within the group. The trainer clarifies, expands and completes any confusions and gaps that arise in the group members' understanding of the topics they are working on in the context of the learning objectives. The trainer should continuously monitor the group's level of understanding and provide corrective interventions when necessary.

***5. Summarize***: It means briefly repeating what has been said and summarizing what has been said under main headings. Summarizing makes some critical points and conclusions clearer. This prevents distraction from the center of the topic and prevents the topic from being distracted by unnecessary details. In addition, summarizing also contributes to more effective and efficient time management. Summarizing the available information and what has been said in the middle and at the end of discussions simplifies complex points and facilitates solutions. Summarizing at the end of each main topic also reinforces memorability.

***6. Testing group agreement***: This function refers to testing how close the group is to consensus and agreement as a result of discussions. In some cases the group is moving towards agreement, while in other cases disagreements may arise due to different ideas and interpretations. If the group is trying to reach agreement, the trainer supports the natural progression of the process and facilitates agreement by emphasizing points of agreement. If the group is moving away from agreement by looking at the issue from different perspectives, the trainer supports the participants towards agreement by drawing the group's attention from the points of divergence to the points of agreement.

**Continuity functions of the Training Group**

The continuity functions of the group are the specific behaviors that determine how to perform the tasks given within the scope of the learning objectives and are expected to be fulfilled by all individuals in the group,

including the trainer. The basis of continuity functions is the communication, feelings, attitudes and needs of the group members with each other. Continuity functions include processes such as the personal development of group members and the development of the group as a whole. It is important that both the trainer and the other group members take responsibility together for the successful implementation of the continuity functions. The main points that determine the continuity functions of the group are summarized below (Forsyth, 1990; Hadfield, 1992; Dörnyei & Malderez, , 1997).

***1. Building harmony:*** This function implies that tensions can be reduced by bringing up differences, discussing them and reaching agreement. Tension is a natural part of the learning process, but it should not reach a destructive level. The trainer should not pretend that there is no tension, should accept differences as richness, and should try to reach agreement and harmony on common points that everyone can accept. If there is conflict within the group on any issue, efforts should be made to meet on an acceptable common ground. The resolution of issues that create tension and on which there is no minimum agreement should be postponed until later.

***2. Observing everyone's rights:*** This function emphasizes that all group members should be given the right to participate as equally as possible. It is important to ensure the participation of all group members in the learning process, to give equal responsibility, and to support communication and interaction within the group. However, due to individual characteristics, some group members are sociable and some are shy. Timidity may be a personality trait, or it may be a result of seeing others as more knowledgeable or fear of embarrassment. In addition, dominant participants can make it even more difficult for the timid to express themselves. The trainer should try to increase the participation of timid group members in the training process by asking them easy questions or asking their opinions at appropriate places. The use of interactive methods throughout the learning process promotes active and equal participation.

***3. Encouragement***: The trainer's open, sincere and reassuring attitude makes it easier for other group members to feel more comfortable and express themselves easily. As the training process progresses, changes in emotions and reactions will emerge. In the beginning, there is a more formal environment with limited in-group communication and interaction, but as the process progresses, it is expected that warmer and more sincere relationships will be established in the group. The trainer should encourage communication, interaction and participation within the group and encourage group members to take responsibility.

***4. Compromise:*** Removing the status and equalizing the level between the trainer and all other group members supports the consensus environment by reinforcing the comfort and trust of the participants. In addition, the trainer's acceptance of his/her own mistakes in front of the group facilitates everyone's acceptance of their own mistakes, the resolution of tensions and the achievement of reconciliation in the process.

***5. Standard practices:*** The essence of this function is to set the norms, rules and boundaries that the group will follow. These rules have the status of an intra-group contract. At the beginning of the training, it is important to set expectations and establish common rules and norms with the group members. When necessary, these rules and norms are reminded again.

**Incompatible Behaviors Disrupting Group Dynamics**

In the educational process, some behaviors of group members may hinder the group's progress and success towards the learning goals. These behaviors can be called 'individual-centered behaviors' or 'maladaptive behaviors'. When the content and continuity functions are not fulfilled sufficiently by trainers and group members, maladaptive behaviors may emerge within the group. Greater crises can be prevented if trainers recognize such maladaptive behaviors that disrupt group dynamics at an early stage and take necessary measures (Dolmans & Schmidt, 2001). Common maladaptive behaviors that disrupt group dynamics are summarized below (Lacoursiere, 1980; Newble & Cannon, 1987; Stolba, 1990).

***1. Obstructing:*** Refers to negative behaviors such as disrupting the consensus, hindering the group's movements, taking the discussions off-topic, arguing excessively over a point, spending too much time on irrelevant details and hindering the group's progress. Sometimes the aim of the group member who engages in such behaviors may be to draw attention to himself/herself and put himself/herself forward. If the trainer makes the group member feel that he/she is listening and paying attention to him/her, he/she can prevent maladaptive behaviors in the direction of obstruction.

***2. Being dominant:*** The group member who shows this maladaptive behavior talks incessantly without respecting the rights of others, gives long speeches, wants to control the whole process, makes definite decisions and thinks that what he/she knows is always right. This kind of behavior can make the educational environment tense, and it also prevents the participation of less talkative and timid group members. Usually the underlying reason for this maladaptive behavior is the need for approval and appreciation. The trainer's

approval of this group member at appropriate times and when he/she makes the right statements can reduce the maladaptive behavior of dominance.

***3. Making fun:*** In some cases, one of the group members may have fun by constantly making jokes in inappropriate places. This can disrupt the seriousness of the positive learning atmosphere, distract from learning new things and reduce the efficiency of the learning process. Often the underlying reason for this maladaptive behavior is the need to have fun. If the trainer makes time for small activities and games that can be enjoyed together in the appropriate gaps of the training program, it can prevent maladaptive behavior in the form of teasing.

***4. Thinking for oneself:*** This is a behavior in which a group member always puts his/her personal needs at the forefront and thus puts pressure on others. A participant who constantly thinks about himself/herself draws attention to himself/herself, puts himself/herself at the center during discussions and ignores the needs of other members of the group. Usually the underlying reason for this maladaptive behavior is the desire to prioritize personal needs. In the group agreement on common rules set at the beginning of the training program, determining how personal needs will be met and reminding the group members of this agreement when necessary can reduce maladaptive behaviors in the direction of self-reflection.

**Stages of Transformation of the Education Process**

The training process consists of different phases in which motivation, enthusiasm and satisfaction change. In the beginning, energy is higher, but creativity and motivation to take responsibility are low. As the process progresses, the initial energy starts to drop and boredom may arise due to multitasking. In the final stages of the process, a return to satisfaction is expected with a gradual increase in originality and creativity. In accordance with the characteristics of these phases, the trainer and group members have duties and responsibilities to facilitate the process. The following summarizes the phases that a training group will go through in the learning process, the tasks covered by these phases and the responsibilities of the trainer in these phases (Lacoursiere, 1980; Premi et al., 1994; JHPIEGO, 1997; Dolmans & Schmidt, 2006; Linnenbrink-Garcia et al, 2011).

***Phase 1:*** This is the beginning phase. There is an eager and anxious atmosphere for both group members and trainers. In the beginning, group members have a high level of enthusiasm and energy due to the expectation of learning new things and meeting new people. Participants have a high level of expectation to gain knowledge and skills that they will use in their daily

practice. However, uncertainty about what they will encounter in the learning process, uncertainties about communication and interaction with other participants, worries about failure and expectations to meet personal needs increase the level of anxiety in the group. Participants have many questions about how the learning process will proceed, about regulations and rules. In the beginning, group members are reluctant to express themselves and take responsibility and feel dependent on the guidance of the trainers. Trainers are also anxious in the initial phase as they do not yet know the group and what is expected of them.

In order to increase initial energy and reduce anxiety, the trainer needs to take more responsibility and guide the participants in accordance with the characteristics of this phase. First of all, it is important that the educational environment is pre-structured to meet individual needs and expectations. In the first phase of the learning process, activities should be planned for the group to meet and mingle with each other, the training program should be introduced, learning objectives and the appropriate work time plan should be determined, and tasks should be shared among group members. Reducing the unknowns will support the success of the learning process by reducing the level of anxiety. The trainer's clear identification and definition of the objectives and tasks facilitates the smooth and quick passage of the initial phase. It is necessary to explain how the objectives will be achieved and to closely monitor the group activities. The trainer should establish two-way communication and show exemplary behavior to the participants. Establishing a warm and positive atmosphere in this phase will positively affect the following phases.

***Phase 2:*** The middle phase evolves from boredom to satisfaction according to the progress of the process. At the beginning of the second phase, innovations in knowledge and skills may create a feeling of inadequacy in the participants. This feeling of inadequacy is tried to be overcome through critical thinking and the desire to gain independence within the group. In this phase, participants may feel that their expectations are unrealistic, they may dislike the trainer and their dependence on him/her, they may experience feelings of inadequacy and uncertainty, they may criticize the goals and methods of the training. The beginning of the second phase is the period of the most boredom, disagreements and friction among the participants, the underlying reason being the participant's desire to gain independence. It is important that the trainer accepts this phase as a natural process, does not take reactions personally, and listens and supports the participants.

In the second phase, as the process progresses, the group starts to cohesion and support each other more and more, implementation skills improve,

expectations are restructured at a more realistic level, and the group's feelings of dissatisfaction and boredom gradually transform into satisfaction and self-confidence. At this stage, the trainer's support for the participants' self-confidence, giving more responsibility to the group members, reducing the dominant role, sharing the control of the process with the group, encouraging the participants to be more independent and enabling the group members to give feedback will facilitate the transition to satisfaction.

***Phase 3:*** The final phase is the creativity and task completion phase. In the creativity stage of this phase, group members apply what they have learned at the level of mastery, harmony and cohesion within the group are at the highest level, participants are more open and sincere in communicating with each other, and they value the contributions of others. The most important feature of this period is that the participants can express themselves more freely and realize more original practices. At this stage, trainers should reduce their control over the group, encourage participants to gain autonomy, support creative activities and provide counseling when needed.

At the final stage when the learning process is completed, the energy level of the group reaches its highest level again, the participants are happy to have successfully completed the process, and the group members are open to constructive feedback.

Trainers assume various roles in group work, such as instructors, trainers, facilitators and evaluators. Content functions, which determine group dynamics, determine what the group will do, while continuity functions determine how these tasks will be performed. For the successful execution of the learning process, it is extremely important for trainers to closely monitor the group, make corrective interventions to incompatible behaviors that emerge in group dynamics, continuously support the learning motivation of the group, encourage participants to gain independence, reduce their dominant roles in the process, provide consultancy and guidance during the practices, appreciate successes, complete deficiencies, and use effective communication and interaction methods (Forsyth, 1990; Sullivan, 1990; Dolmans & Schmidt, 2001; Linnenbrink-Garcia et al., 2011).

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# CHAPTER 6

# KNOWLEDGE-ORIENTED TEACHING METHODS IN MEDICAL EDUCATION

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Medicine is a complex field involving a wide range of knowledge. It includes many disciplines from anatomy to physiology, pathology to pharmacology. Therefore, medical students and medical professionals need to have a comprehensive knowledge base. Knowledge-oriented learning methods allow to learn and remember this wide range of knowledge more effectively.

In medical education, a correct understanding of basic principles is of great importance. Basic knowledge such as anatomical structures, disease mechanisms, diagnostic methods, treatment protocols form the basis of medical practice. Knowledge-oriented educational methods in medical education facilitate the understanding and comprehension of these basic principles.

Scientific discoveries, technological advances and new research in the field of medicine lead to a constant updating of medical knowledge. Therefore, medical students and professionals need to access up-to-date information and learn it effectively. Knowledge-oriented education methods enable us to keep pace with this rapid change.

Knowledge-oriented teaching methods encourage more active student participation. Students who are involved in the learning process increase their motivation and interest in learning. This leads to more in-depth learning and helps to retain the information learned.

Medical education is not limited to acquiring knowledge. It also includes developing effective communication skills, acquiring critical thinking and problem solving abilities and supporting professional development. Knowledge-oriented education methods contribute to the development of skills in these areas. For all these reasons, utilizing knowledge-oriented educational methods in medical education facilitates students to acquire, comprehend, retain, and apply information more effectively. Moreover, it is crucial for keeping up with the constantly evolving medical knowledge and supporting professional development.

The ranking of knowledge-oriented education methods in medical education is as follows;

- Classroom lecture / presentation method
- Interdisciplinary learning activities
- Case/problem-based small group interactive learning activities
- Independent learning method
- E-learning method

**Classroom Lecture / Presentation Method**

It is the oldest and most frequently used method. It is teacher-centered. It is one of the most effective methods when time is short, the subject is large and

the class is crowded. It is suitable for gaining behaviors at the knowledge level. Verbal communication is at the forefront. Clear, clear expressions, simple and short sentences should be presented in a way that everyone in the class can hear. The method should be supported with examples and question-answer technique.

This method is based on the method of straight presentation by a teacher or trainer. In this method, the teacher conveys information by telling and showing. The teacher can interact with students using question and answer style, lecture style or informal teacher talk. This method focuses on knowledge based on a cognitive domain (Terzi et al., 2009). There are different types of lectures and conferences and the most common ones are lectures and conferences.

The planning and execution of lessons should focus on the higher levels of knowledge (application, case analysis, evaluation). In this way, the aim is for students to develop a deep understanding of knowledge in an integrated way and to develop cognitive skills such as problem solving, decision making, planning, monitoring and evaluation. While basic concepts and principles are conveyed through short instructional presentations, interactive presentations enriched with activities such as group discussions, case studies and gamification can be preferred.

A lecture is a style of teaching in which a topic is presented within a given time and structure. It is usually a one-way communication between teacher and student. Lectures can be delivered orally, in writing, through representation, pictures, models or music. The aim is to explain a topic, describe a problem or teach specific skills to the audience. However, according to a Yale University study, 40% of the information was not remembered after a one-hour lecture, 60% after 12 hours and 90% after a week. Therefore, although lectures are a frequently used method, they are not considered to be a very effective method (Terzi et al., 2009).

A conference is a speech prepared by an expert to explain and teach his/her feelings and thoughts on a particular subject. Conferences are speeches made to inform the audience in many fields such as science, art and literature. It is a type of speech that carries a scientific claim. The speaker aims to inform the audience about a certain subject and explains his/her purpose by introducing the subject. Each conference is prepared as a result of a long research and examination process.

A meeting can be organized within a congress or as a stand-alone event. It does not have to be organized periodically. A meeting is organized for the purpose of presenting information, proposals or solutions and usually has fewer participants and a narrower scope of topics than a congress. It does not need to be organized with a routine frequency. It usually lasts for one or a few hours and

may rarely be spread over several sessions and last a working day (Terzi et al., 2009).

The positive aspects of the strategy of teaching with the presentation technique are as follows;

- It provides a large amount of information transfer in a short time,
- It is an economical and cost-effective method,
- It offers training opportunities for large groups,
- Effective in teaching general concepts and principles,
- Improves listening and note-taking skills,
- Easy to implement and low cost,
- It is highly suitable for students who are prone to learning by listening,
- It does not require many tools and equipment.

The negative aspects of the teaching through presentation strategy are as follows;

- Without meaningful learning, it can lead to memorization,
- It can cause learners to be in a passive state,
- It becomes difficult to recognize the audience,
- Individual differences, interests and needs are not responded to,
- After a while, attention and interest wane and motivation drops,
- Since only verbal communication is involved, it is easy to forget (Ekinci, 2008).

**Interdisciplinary Learning Activities**

Given that society is changing rapidly in almost all areas of life, we will need to develop new skills, tools and techniques to solve complex challenges. These complex challenges are often influenced by multiple factors that are studied separately by different disciplines. While a monodisciplinary approach solves some single aspects of complex problems, the integration of knowledge and skills from different disciplines and fields of knowledge is required to reach comprehensive solutions (Spelt et al., 2009). For this, an interdisciplinary environment is needed.

In order to prepare a program based on an interdisciplinary approach, a model consisting of four stages is required;

Stage 1: Choose a topic that is current and appropriate to the student's interests and needs. The topic should not be too general or so narrow as to limit the elements of the work. It can be a concept, theme, event or problem.

Stage 2: Once the topic has been identified, related sub-topics and related disciplines should be identified. The teacher should encourage the students to brainstorm, especially to discover related disciplines.

Stage 3: A systematic structure should be created by establishing relationships between the identified topics and disciplines. Common points and connections should be identified and questions should be raised. These questions can address more than one discipline.

Stage 4: Program preparation should be made based on the questions developed. In this process, students should be made to think about how to teach the subject or theme determined according to the interdisciplinary approach (Jacobs, 1989).

Examples of interdisciplinary learning include seminars, panel conferences, multidisciplinary case presentations, focused activities at congresses, morbidity and mortality meetings. Interdisciplinary learning in medical education is an approach that encourages collaboration and interaction between different disciplines. This approach provides students with the opportunity to integrate knowledge from other disciplines related to medical sciences and to address health problems from different perspectives. Interdisciplinary learning in medical education has many benefits. Gaining a holistic perspective, developing communication and collaboration skills, addressing problems in a multidimensional way, and developing innovation and research skills are some of them. Interdisciplinary learning in medical education provides students with a multidimensional perspective and enables them to address health problems from a broader perspective. This can have positive effects on better patient care and the health system (Oudenampsen et al., 2023).

Interdisciplinary learning is an approach that aims to integrate knowledge and skills from different disciplines and can be applied in a variety of ways. Some types of interdisciplinary learning are;

Simultaneous Interdisciplinary Learning: In this method, students from different disciplines come together at the same time to work on a project or a course activity. For example, a health sciences student, an engineering student and a social sciences student can form a team and work on a health technology project. In this way, a comprehensive solution is developed by combining the perspectives of different disciplines.

Sequential Interdisciplinary Learning: In this method, students attend courses from different disciplines in a sequential manner. For example, a medical student first attends courses in basic medical sciences and then moves on to courses involving clinical practice. This method provides an educational process in which different disciplines are interrelated.

Integrated Interdisciplinary Learning: In this method, interdisciplinary learning is integrated as a core part of a course or program. For example, in a health services management program, students attend courses from different disciplines such as health policy, management principles, communication skills, etc. at the same time. In this way, students are offered a comprehensive education in health services management from an interdisciplinary perspective.

Project-Based Interdisciplinary Learning: In this method, students integrate knowledge and skills from different disciplines when working on a project or problem. Students can be presented with real-world problems and encouraged to use knowledge from different disciplines to solve them. In this way, students both develop interdisciplinary collaboration skills and gain practical experience in real-life scenarios (DMani, 2011).

Interdisciplinary learning, like all other learning methods, has its own advantages and disadvantages.

Advantages;

- It offers a more comprehensive perspective by combining the perspectives of different disciplines. In this way, students gain the ability to evaluate and understand the subject from different perspectives,
- Bringing different disciplines together increases the potential for creative thinking and innovation,
- It develops the ability to develop a multidisciplinary approach to solving complex problems. In this way, students can find more effective and creative solutions to real-world problems,
- Students from different disciplines working together develop collaboration and communication skills. In this way, students develop the ability to work in teams and understand different perspectives (Jacobs, 1989).

Disadvantages;

- It may create complexity as it requires combining knowledge from more than one discipline. It may take time for students to understand the language and concepts of different disciplines,
- It may require additional resources and time. Combining and synthesizing information from different disciplines can take time,
- The fact that different disciplines have different methodologies and theories can sometimes create inconsistency and contradiction. This can lead to student confusion,

- It may prevent in-depth examination of topics that require in-depth expertise. The interdisciplinary approach carries the risk of focusing on the surface of the issue (Jacobs, 1989).

**Case / Problem Based Interactive Learning Activities with Small Groups**

Problem-based learning emphasizes that students step into learning environments based on their prior knowledge and cognitive structures. Therefore, problem-based learning aims to guide students in using their thinking skills and existing knowledge so that the information becomes meaningful and understandable for them. It also encourages students to construct knowledge in a new way (Baden & Major, 2004).

Therefore, the problem-based learning approach uses complex, real-world problems to motivate students to investigate and identify concepts and principles. In problem-based classrooms, students use skills such as knowledge integration, communication, and inquiry by coming together in small learning teams, following processes similar to scientific inquiry (Allen & Duch, 2006).

Problem-based learning was first applied at Case Western Reserve University in the United States in the 1950s. Then, towards the end of the 1960s, studies were conducted at McMaster University in Canada on the Problem-Based Learning Model and its adaptation to education (Kaptan & Korkmaz, 2001).

In the problem-based learning approach, one of the most important factors to ensure that students learn the subject matter is the problems created for them. A constructivist teacher, in order to encourage students to think, asks them questions that they would not think of. In this direction, he/she presents students with a big problem that they need to think about, research and find answers to (Brooks & Brooks, 1999). In the problem-based learning approach, problems should be related to the real world, complex and lead students to investigate. Well-structured problems enable students to think deeply and generate solutions. Unstructured problems, on the other hand, do not challenge students sufficiently and do not encourage them to think. The difference between well-structured and poorly structured problem scenarios is as follows:

Well-structured problem scenarios can be organized and free from complexity. Such problems have a good organization that guides students to a clear solution. Simple, well-structured problems, especially for inexperienced students, provide guidance for solution and help students understand the rules and principles of the problem. Bridges & Hallinger (1995) define well-structured problems as "problems that educators encounter annually and that contain specific steps for problem solving" (Lee, 1999).

Problem scenarios that are not well structured contain ambiguous problems and incomplete information. They reflect real-world situations and there is no single path to a solution (Mason et al., 1981). Such problems encourage students to formulate hypotheses by questioning different perspectives and expose them to situations that require an explanation of the problem. Bridges & Hallinger (1995) describe problems that are not well structured as complex, disorganized and with unclear goals (Lee, 1999).

Problem-based learning involves four basic stages: problem analysis, student-centered learning, brainstorming and evaluation of the solution (Massa, 2008).

Problem-based learning is a process in which students follow the following learning steps: Students are presented with a problem, then they create a plan and determine what they know and what they need to learn, conduct their research within this plan, analyze the data and develop the solution. Finally, they present the solution and share it with others (Koszalka et al., 2002).

Problem-based learning is an approach that focuses on solving multidimensional problems encountered in real life. Therefore, problem-based learning scenarios should not be limited to a single subject or unit. An approach in which problem scenarios are determined around the curriculum and subjects or an application that provides flexibility is necessary. In this way, teachers can be given more flexibility in the teaching process and students can work in an integrated way with different subjects and units while solving complex problems in the real world.

Problem-based learning has many advantages over classical education;

- It enables information to be internalized by making sense of it,
- It provides opportunities to encounter different ideas,
- Their ability to use time effectively, collect and interpret data improves,
- Provides sustained learning,
- Gains scientific thinking ability and attitude,
- Increases students' interest and motivation,
- Develops critical thinking and questioning skills,
- They learn to use different resources (Gürpınar, 2007).

Although problem-based learning has many advantages over classical education, it also has some limitations. These are;

- It is a more challenging process for students than traditional education, requiring self-directed research and access to information,
- For trainers, it is a method that requires them to work on topics they are not experts in,

- Not applicable to all subjects,
- It cannot be applied if basic concepts and knowledge have not been acquired,
- It is difficult to assess all students,
- It takes time,
- Not all students may be able to use all stages of education,
- Training materials may not always be available,
- It may differ in terms of cost as more stationery (paper, whiteboards, etc.) is consumed than in classical education (Gürpınar, 2007).

**Independent Learning Method**

It is an approach that includes the steps of application, analysis and synthesis in the process of learning a subject or a problem on one's own. This approach is based on research and investigation strategies. Individual study method is generally preferred outside of class time. Students can study by practicing and experiencing activities when they need to. Students who prefer the self-study method use it when they want to study the subject according to their own learning speed and priorities. In this method, students take responsibility for learning and organize the learning environment according to their needs (Feletti et al., 1984).

Some skills are needed for independent learning. These are;

Cognitive skills: Cognitive skills include skills such as memory, attention and problem solving. Students need to reach a certain level of cognitive development, such as the ability to analyze basic information, before they can begin independent learning. Teachers can support independent learning by encouraging this cognitive development.

Metacognitive skills: Metacognitive skills are skills associated with an understanding of how learning takes place. Characteristics such as students' ability to articulate their own learning processes and to identify others who have helped them learn are related to metacognitive skills. Metacognitive skills are necessary for students to be able to self-assess their learning.

Emotional skills: Emotional skills are those skills that are related to emotions, such as developing a value system, internalizing those values and acting on those values. Motivation is considered the most important emotional skill and is directly related to increased independent learning. It can also be a consequence of independent learning (Meyer et al., 2008).

This method has advantages and disadvantages.

Advantages;

- The student learns his/her own learning pace and style,

- He takes responsibility for himself,
- The learner has freedom of choice in terms of knowledge and methods,
- High recall as it is active participatory learning,
- Their ability to plan and organize work improves,
- Students develop independent study skills,
- It enables students to be aware of their own limitations and manage them better (Meyer et al., 2008).

Disadvantages;

- It is difficult to realize in a classroom environment,
- Inadequate for teaching complex and complicated subjects,
- It distances itself from the educational influence of the teacher and society,
- It is limited in enabling social interaction,
- Difficult to follow up and correct mistakes,
- There are difficulties in recognizing student characteristics and making student-specific planning (Meyer et al., 2008).

**E-Learning Method**

E-learning refers to improving knowledge and performance through the use of internet technologies. E-learning technologies allow learners to tailor their experience to their personal learning goals by giving them control over content, learning sequence, learning pace, time and often media. E-learning can be realized through digitally delivered learning materials, interactive learning experiences, virtual classroom environments, online discussion forums, interactive tests, simulations and virtual reality, game-based learning. E-learning is becoming increasingly popular for its advantages such as flexibility, accessibility, student interaction and providing feedback. Learners do not see e-learning as a replacement for traditional teacher-directed education, but as a complement to it and accept it as part of a blended learning strategy (Ruiz et al., 2006).

Innovations in e-learning technologies mark a revolution in education. These innovations make it possible to individualize learning (adaptive learning), increase students' interaction with others (collaborative learning) and transform the role of the teacher (Ruiz et al., 2006).

Three different models are applied in e-learning: synchronous, asynchronous and blended. In the synchronous method, learners and instructors come together simultaneously from different regions via computer and internet. During the lesson, the learner continues his/her education by communicating (audio, video

and written) with other learners and the trainer. The disadvantage of synchronous education is that it goes against the philosophy of distance education in terms of time, because distance education involves the continuation of education regardless of time and place. However, there is a time constraint in synchronous education. Because the definition of distance education includes the continuation of education independent of time and space. However, there is a time limitation in synchronous education. In the asynchronous method, the lessons are prepared in advance (by the instructor) and the student can access this information at any time. The communication between the trainer and the learner does not take place at the same time and in the same time frame. Students can complete their education by accessing this information from wherever and whenever they want. During the process, they can communicate the issues they do not understand to the instructors or other students by asking them to the designated addresses via tools such as e-mail, discussion forums, etc. and in this way they can share information. In the mixed model, asynchronous and synchronous methods are used simultaneously. While some parts of the lesson proceed asynchronously, certain parts continue synchronously (Dangwal, 2018; Dhawan, 2020).

E-learning offers many advantages and benefits compared to classical education and computer-assisted learning methods. These advantages are;

*Student perspective;*

- It offers access to information by providing international access,
- Provides education to all by minimizing inequality of opportunity,
- It enables students to complete their education regardless of their geographical location,
- Provides instant access to other relevant resources,
- It offers in-depth research and learning on topics of interest,
- Provides audiovisually rich educational materials,
- It gives the possibility to adjust the learning speed according to the needs of the individual,
- It allows the individual to continue his/her education according to his/her wishes, regardless of time and place,
- Saves time,
- It encourages individual learning,
- Supports independent learning,
- It provides lifelong self-learning habits,
- It reduces the cost of education for both the student and the educational institution (Knebel 2001; Holsapple & Lee-Post, 2006).

*Trainer perspective;*

- Easy updating of the training content,
- Saving time,
- Ensuring standardization in educational programs (Knebel 2001; Holsapple & Lee-Post, 2006).

Although e-learning provides many benefits in education, it also has some limitations.

These are;

- Requires dependence on technology (computer, internet, etc.),
- Experiencing deficiencies in terms of communication compared to face-to-face education,
- Limited opportunity for students to socialize,
- Not benefiting enough from practice-based courses,
- Failure to perform skills and attitudinal behaviors effectively,
- Difficulties in planning for individuals who have not developed the habit of working on their own or who lack this skill,
- It is difficult to reach the desired level of learning in students who have computer phobia or who do not have the skills to use computers (Horton & Horton 2000; Knebel 2001; Holsapple & Lee-Post, 2006).

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# CHAPTER 7

# TEACHING METHODS FOR MEDICAL PRACTICE IN MEDICAL EDUCATION

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**The Importance of Medical Practice in Medical Education**

The goal of medical education is to produce good physicians based on the principle of "first do no harm". Medical practice education ensures that students are successful and safe as they learn to become good physicians through practice. This improves the quality of patient care (Goodwin, 1995; McManus et al., 1993; Remmen et al., 1999; Stillman et al., 1987).

To prevent medical errors, it is crucial to provide professional skills training in medical education, particularly in the early stages. This helps to cater to students' diverse learning models (Grosseman et al., 2011). Medical students can develop their professional skills and acquire the ability to anticipate risks in safe environments by employing these methods, which enable them to make mistakes before dealing with actual patients. Hence, understanding the causes and consequences of mistakes made by students would help prevent similar errors in the future (Keskitalo et al., 2016; Yücesoy et al., 2001).

**The Role of Clinical Skills Laboratories and Simulated Patient Centers in Medical Education**

Clinical skills laboratories were established to enhance the clinical skills of medical students and physicians. The laboratories aid students in acquiring a comprehensive medical education by integrating theoretical knowledge with practical skills (Açıkgöz, 2020). Practicing various clinical skills prepares students for their interventions with real patients. Physician candidates may feel more competent and confident in the process of learning difficult skills while repeating their practices with models, mock-ups and simulators. However, in cases such as abdominal examination practices, simulated patient practices should be preferred for history taking and physical examination practices instead of models (Özkan vd., 2016; Baran vd., 2019; Yaşar vd., 2020).

Clinical skills laboratories are designed to meet the various practice needs of physicians and can be categorized into the following subtypes.

**Basic Clinical Skills Laboratory**: It is used to teach basic clinical skills to medical students. Students learn how to draw blood, administer injections, measure blood pressure, and perform heart and lung examinations here. The laboratory is equipped with blood pressure measuring devices, ECG machine, respirators, and other equipment of this nature (Turan et al., 2017; Güzel et al., 2021).

**Surgical Skills Laboratory:** Students practice surgical procedures using equipment such as surgical instruments, surgical robots, and simulators. The laboratory is used for preoperative and postoperative practice.

**Simulation Laboratory:** Students use realistic hospital beds and patient mannequins to practice on virtual patients before doing so on real patients (Kassab et al., 2011). In a different type of laboratory, students practice with simulated patients in various scenarios (Gürses et al., 2018). These laboratories prepare students with ambulance, fire extinguishing equipment, and other emergency equipment for unforeseen critical situations.

**Anesthesia Laboratory:** The laboratory is designed to develop skills in the field of anesthesia. Here, students practice applying various anesthesia techniques. These laboratories are used to develop skills in administering anesthesia during surgery and post-anesthesia care.

**Activities for Learning in Clinical Skills Laboratories and Simulated Patient Centers**

**Training in Medical Simulation:** Simulation training allows students to experience clinical situations with devices that simulate real-life scenarios and improve their clinical skills. Training materials such as simulated patient mannequins, virtual reality devices, and diagnostic equipment may be used (Erçetin et al., 2013).

**Training for Developing Clinical Skills:** These trainings provide the opportunity for students to enhance their clinical skills by using materials such as injection needles, blood collection needles, surgical instruments, and suture threads.

**Improving Skills through Training Videos:** The training videos are designed to assist students in improving their clinical skills. These videos provide students the opportunity to observe skills like injections, blood drawing, and suturing, before practicing them.

**Project-Based Learning:** During Project-Based Learning students collaborate on a shared project and develop original ideas.

**Problem-Based Learning:** Students collaborate to solve practical problems and develop solutions.

**Collaborative Learning:** Students learn to collaborate across diverse disciplines.

**Experimental Learning:** Students create novel insights by conducting experiments in a laboratory setting, utilizing multidisciplinary knowledge and skills (Azer et al., 2019; Doppelt et al., 2019; Nortvig et al., 2019; Ward et al., 2012).

**Education Methods for Patient Participation in Medical Practice**

Learning at the Patient's Bedside: Under the supervision of physicians in the service and outpatient clinic, students learn about the patient's medical condition and treatment methods.

**Patient Visits:** Students are involved in processes where physicians visit patients to learn about their medical conditions and treatments.

**Structured Focused Patient Visits:** During these rounds, students enhance their clinical thinking skills by focusing on specific clinical situations under the guidance of physicians.

**Service Experiences:** Clinical practices, such as patient care, medical decision-making, reporting, and collaboration, are learned by students through internships in clinical wards.

**Experience in outpatient clinics:** Students gain experience in patient assessment, diagnosis, treatment, and follow-up processes through internships in outpatient clinics (Allen et al., 2015; Davis et al., 2013; Hauer et al., 2014).

Training sessions that involve patient participation facilitate transformation of the students' theoretical knowledge into practical skills, development of the students' clinical thinking skills, and enable collaboration in patient care. Moreover, these training sessions enable young physicians to utilize their ethical and communication skills, as highlighted by Kim et al. (2016) and Remmen et al. (2006).

**Community Based Learning Activities for Good Medical Practice in Medical Education**

Community-based learning activities are an educational method that enables medical students to learn about the provision of health services for public health. Some community-based learning activities include:

**Home visits:** During these visits, medical students can see the health problems and needs of communities with limited access to health services. This enables students to develop a community health perspective.

**Observation of health risks:** Students can prepare brochures to draw attention to health risks in workplaces or schools. This activity can help students raise health awareness in the community.

**Service delivery in primary health care institutions:** Medical students can work with physicians in primary health care facilities to closely observe how patients are treated and how health services are delivered.

**Evaluation of services provided:** Health surveys administered by students to the community can help prospective physicians understand health systems and

identify community needs for health services (Greenberg et al., 2003; Delgado et al., 2019; Skochelak et al., 2010).

**Learning and Assessment on the Job in Medical Education**

Learning and assessment on the job in medical education allow students to apply theoretical knowledge in practice, enhancing their skills.

The on-the-job learning process involves direct participation in patients' care, aiming for students to gain experience under the guidance of experienced physicians in clinical settings. During the evaluation process, students' clinical skills and knowledge are evaluated to improve their performance (Kıvanç et al., 2019).

The following are some methods used in these processes:

**Internships:** Medical students gain practical skills and experience from internships in clinical settings. According to Tekian et al. (2013), internships are an essential part of medical school curricula.

**Individual and Group Assessments:** Students' clinical skills, knowledge and practical abilities are measured through individual and group assessments by teachers. These assessments provide feedback to students, helping them to identify areas for improvement.

**Simulation Training:** Simulation Training is an effective method for students to improve their clinical skills. Virtual patients are used in Simulation Training to enable students to practice and prevent possible mistakes in real patients (McGaghie et al., 2010).

**Monitoring and Evaluation Files (Portfolios):** These portfolios are created by documenting the work done by students in internships and clinical settings.

**The Purpose and Importance of Portfolios in Medical Education**

Portfolios are used in medical education to monitor and evaluate students' clinical skills and professional development. When creating their portfolios, students record their work during their hospital rotations, documenting patient stories, treatment plans, diagnoses, and treatment results. The portfolio is used to track students' progress, assist in their development within the medical profession (Boud, 2000).

Creating a portfolio also enables students to set their own learning goals, make self-assessments, and access opportunities for self-improvement. It can also provide references for future career goals (Snadden et al., 1998).

**Teaching Methods in the Operating Room for Medical Education**

Teaching methods in the operating room are a crucial part of medical education. These methods combine theoretical knowledge with practical applications, enabling students to gain clinical experience (Seymour et al., 2002; Stefanidis et al., 2008).

Teaching methods in the operating room may include watching live surgical applications, and students practicing surgical procedures through surgical simulations. Thus, it is ensured that students learn the situations they may encounter in the operating room and develop their practical skills (Borman et al., 2002; Reznick et al., 2006).

**Structured Case Discussions in Medical Education**

Structured case discussions that assist students in developing clinical thinking, decision-making, and communication skills are a beneficial learning approach in medical education. Additional functions of these discussions include:

**Facilitate development of communication and collaboration skills:** Through these discussions, students learn to communicate and collaborate with one another and other healthcare professionals in order to effectively manage patient care.

**Promoting patient-centered care:** Students are able to develop therapy plans that adequately address patients' requirements, preferences, and values.

**Encouraging team learning:** Through group discussions, students can learn from one another, fostering a culture of team learning.

**Developing Skills in Ethical Thinking and Practice:** These discussions help students to identify, analyze, and resolve ethical issues and contradictions (Lucey, 2013; Durning et al., 2011).

**The Significance of Teaching Clinical Reasoning in Medical Education**

Clinical reasoning is a frequently used teaching methodology in medical education. During this process, students gather and assess clinical information, evaluate various options, and ultimately determine the most suitable treatment plan with the aim of improving clinical decision-making. For instance, students may conduct organized case discussions with the guidance of an experienced lecturer or physician. Consequently, students analyze diverse diseases and symptoms, deliberating various diagnostic options and treatment plans (Norman et al., 1992).

Furthermore, in specialized facilities like simulated patient centers, students interact with simulated patients, perform physical examinations, and apply

clinical reasoning abilities while diagnosing and devising treatment plans (Khosla et al., 2019).

**Peer Learning and Teaching in Medical Practice in Medical Education**

Peer learning and teaching has gained importance in the field of medical education in recent years. This approach enables students to enhance their learning process by collaborating with peers of similar or higher proficiency levels and exchanging feedback with each other (Ramani et al., 2008).

Learning activities conducted via this method include student presentations, peer evaluations, group discussions, role-playing exercises, and clinical case discussions (Ten Cate et al., 2007; Topping, 1996).

**The Importance of Effective Communication in Medical Education in Medical Practice**

Effective communication in medical practice significantly impacts patient satisfaction, treatment adherence, patient trust, and clinical outcomes. Effective communication allows physicians to interact with patients, understand their needs and concerns, and plan better treatments (Street et al., 2013).

Teaching communication skills in medical education is crucial for students' interactions with both patients and colleagues. In addition, teaching these skills helps physicians to humanize the practice of medicine (Makoul et al., 1999; Bickley et al., 2016).

Communication skills encompass various aspects such as active listening, empathy, clear and candid communication with patients and their family members, patient education, and delivering negative news sensitively. Understanding the health status of patients by asking the right and effective questions is essential to ensure proper treatment. Establishing positive and supportive communication helps patients to increase their motivation during the treatment process (Silverman vd., 2013).

**Communication Between Students and Instructors in Medical Education for Medical Practices**

In medical education for the practice of medicine, communication between students and instructors is important for students to develop their clinical skills and establish their professional identity. A positive student-instructor relationship enables students to feel motivated, increase their self-confidence, and learn more effectively.

The following elements are important for promoting good communication between students and instructors:

**Building empathy:** It is important for educators to try to understand students' perspectives and try to listen to them effectively to comprehend them.

**Using clear and understandable language:** Explaining complex terms in a simple manner helps students to better understand.

**Asking questions:** It is important for educators to actively engage students in education and ask questions to help them think.

**Receiving and giving feedback:** Educators need to provide feedback to help students understand their strengths and weaknesses. Similarly, educators receiving feedback from students about the education they provide enhances good communication with students and the quality of education.

**Motivating:** It is important for educators to motivate students, encouraging them to improve themselves and achieve better results (Haidet et al., 2006; Ramani et al., 2008; Kurtz et al., 2005).

**The Significance of Students' Feedback on Medical Education Practice**

In the realm of medical education, the feedback provided by students to trainers on medical practice approaches, is an indispensable means of enhancing the quality of education and promoting more active participation of students in the learning process. Through feedback, students gain insight into their performance and identify areas for improvement to become better and more competent medical professionals (Ramani et al., 2012; Bing-You et al., 1998; Veloski et al., 2006).

In the field of medical education, receiving feedback from students is essential to enhance their motivation and self-confidence. For instance, Veloski et al. (2006) demonstrated that student groups taught by teachers who received regular feedback from students exhibited higher scores in exams.

A study was conducted to analyze the use of simulation-based Continuing Professional Development (CPD) training method among family physicians in Mersin (MAHDER) and Ann-Arbor (AFMRD). The evaluation questionnaires were sent via email to the respective family physicians' associations. The study showed that although family physicians in Mersin are aware of the importance of using simulations in CPD, they do not widely adopt this training method. The study data indicates that simulation based CPD training programs for family physicians in Mersin, and other developing cities, require further development (Bashan et al.; 2017).

**Issues Encountered in Medical Education for Medical Practice and Suggested Solutions**

Medical education, particularly training for medicine practice, is complex and presents various difficulties. Some of these can be outlined as:

**A lack of clinical experience:** When students do not encounter an adequate number and variety of patients during their internships or practicums, their clinical experience might be inadequate. To address this issue, institutions should provide increased opportunities to engage with simulation practices, virtual patients, and real patients (Bashan et al., 2016).

**Unequal Learning Opportunities:** Differences in learning opportunities across locations can create inequality in student education. To mitigate this issue, institutions should develop and implement standardized teaching materials to ensure equal learning opportunities.

**Teaching Methods:** Conventional teaching methods may hinder active learners' participation and restrict them to theoretical knowledge. Active learning techniques like interactive lectures, group discussions, case studies, and simulations can encourage students to engage more effectively.

**Assessment methods:** The methods used to evaluate academic performance may only gauge theoretical knowledge, omitting practical competencies. This issue can be overcome by diversifying the methods employed, focusing on assessing practical capabilities (Tekian et al., 2019; Khan et al., 2011).

**Advancements and Innovations in Education Methods for Medical Practices in Medical Education Worldwide**

In medical education, training methods for the practice of medicine are constantly being developed and innovations are being added. Many factors such as technological developments, pedagogical approaches, development of teaching materials are involved in this development.

Recently, virtual reality has emerged as an essential element of medical education. Virtual reality technology allows students to practice in simulated environments that replicate surgery conditions (Kim, 2017; Ruesseler et al., 2015).

A 2020 study highlights that during the COVID-19 pandemic, telemedicine is crucial in alleviating the healthcare systems' burden, reducing the risk of infections, and providing easier access to healthcare services. The study underscores the role of telemedicine technologies in enhancing healthcare services' sustainability and their vital role in areas such as managing pandemics, remotely monitoring patients, diagnosing, and treating diseases (Smith, 2020). The fact that telemedicine technologies are on the agenda suggests that it would

be beneficial to include practices related to these applications in the content of physician practice training in current medical education.

Moreover, in medical education, innovations like interactive educational materials, digital learning platforms, online education programs, and simulation training are commonly employed highlighting the need to further develop these areas in our country (Wallace, 2012; McGaghie et al., 2010; Bashan et al., 2016).

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# CHAPTER 8

# TRAINING METHODS FOR PROFESSIONALITY IN MEDICAL EDUCATION

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Methods aimed at professionalism in medical education aim to enhance medical students' professional values, ethical principles, and behaviors (Bashan et al., 2022). These methods foster the development of skills such as shaping students' professional identities, establishing relationships with patients, making ethical decisions, and coping with contemporary issues (Goldstein et al., 2006).

The table below provides a list of professionalism education methods used in medical education along with brief explanations:

**Table 1.** Teaching Methods for Professionalism Used in Medical Education

| Teaching Method | Description |
|---|---|
| Interprofessional Learning Activities | Bringing together students from different disciplines to engage in activities such as discussions, meetings, panels, forums on a common topic. |
| Critical Incident Discussions | Students engage in discussions and propose solutions based on critical incident scenarios. |
| Reflection Sessions | Sessions conducted for students to reflect on themselves, their abilities, values, and professional identities |
| Gamification, Psychodrama | Using methods such as games, drama to make education interactive. |
| Reading and Interpretation of Written and Visual Texts | Developing students' skills in reading, interpreting, and critiquing written and visual works related to the field of medicine. |
| Student Development Portfolio | Students create and regularly update a personal portfolio to track their learning and development. |
| Learning and Assessment in the Workplace (Mini-PET) | Students apply their professional skills on real patients to enhance their practical skills and undergo assessment. |

**Interprofessional Learning Activities**

Interprofessional Learning Activities (ILA) in medical education refers to an approach where multiple disciplines contribute their methods and knowledge to examine a subject or problem (Jacobs, 1989). Another approach defines ILA as the "conceptual integration of a concept across different disciplines" (Erickson, 1995). Jacobs and Erickson stated that the primary goal of educational programs is to prevent knowledge fragmentation in various disciplines. In medical education, the aim of ILA should be to facilitate learners' holistic and high-level thinking skills in addressing the problems they encounter. In short, the goal in medical education is to bring together different disciplinary perspectives on the purpose, topic, and investigation of a problem (Duman & Aybek, 2003).

Considering the educational approach of the Turkish Board of Family Medicine Competence, it can be observed that it emphasizes evidence-based, community-oriented education that takes into account the lifestyle and attitudes of the community, encourages interdisciplinary coordination, and adopts a balanced and qualified service approach, while also advocating for the widespread dissemination of such education. Accordingly, the aim is to train professionals who are equipped with competencies rather than mere qualifications, open to individual and professional development and innovation. Medical education continues to be conducted through learning strategies and assessment models in line with these defined goals (TAYK, 2013).

ILA in medical education involves collaboration among healthcare professionals from different disciplines, including doctors, nurses, pharmacists, social workers, psychologists, and others. (Selvi, & Bashan, 2019; Selvi et al., 2022). These professionals can work together to develop a comprehensive understanding of health issues and to devise more effective solutions by sharing their knowledge and expertise (Hall & Weaver, 2001).

There are numerous examples of interdisciplinary work in medicine. For instance, when treating cancer, oncologists, radiologists, and surgeons collaborate in an interdisciplinary approach. Additionally, different healthcare professionals from various disciplines (such as doctors, nurses, dieticians, psychologists) work together to holistically treat a patient and meet their needs.

**Case Studies/Critical Incident Discussions**

A case study is a scientific approach that allows for the detailed examination of a researched system by systematically collecting multiple data, with the condition of having a well-defined mechanism or arrangement (Chmiliar, 2010).

Case studies are used to describe or investigate everyday events. They also examine the causes of events, serving to understand and explain the development of events (Taghisoylu, 2020).

The key characteristic of a case study is its focus on the delimitation of factors such as time and space related to the studied phenomenon. Studies are conducted on events encountered in real life. A study can be obtained by comparing one or more cases. Due to the aim of thoroughly examining the topic of the study, it requires the use of multiple data sources such as interviews and observations (Creswell & Poth, 2016). Qualitative and quantitative data can be used together. The ability of case studies to utilize both methods strengthen them, according to Yin (2003). The types of case studies in medical education can be summarized as in Table 2.

**Table 2.** The types of Case Studies

| Case Studies | Definition | Purpose |
|---|---|---|
| **Explanatory/Descriptive Case Studies** | Defines a specific situation or event and establishes cause-effect relationships. | Analyzes a specific situation or event. |
| **Exploratory Case Studies** | Conducts in-depth research on a particular topic or problem. | Generates hypotheses or develops new theories. |
| **Critical Incident Case Studies** | Examines rare or extreme cases that deviate from the norm to challenge existing theories or assumptions. | dentifies limitations or flaws in existing theories. |
| **Program Implementation Case Studies** | Focuses on the implementation and execution of a specific program or initiative. | Examines factors contributing to the success or failure of a program and provides insights for future program design and implementation. |
| **Outcome-Based Case Studies** | Evaluates the outcomes and effects of a specific program or initiative. | Examines the effectiveness of the program in achieving intended goals and identifies factors contributing to its success or failure. |
| **Cumulative Case Studies** | Gathers and analyzes data from multiple cases to develop a broader understanding of a specific phenomenon. | Examines how a particular topic or problem manifests in different contexts and identifies common patterns and themes among cases. |

According to the theoretical framework based on Datta (1990), six different types of case studies can be described as follows:

***Explanatory/Descriptive Case Studies:*** These case studies are descriptive in nature. They use specific examples to provide information about an event. This method aims to help researchers or learners gain knowledge about a topic by presenting it in an explanatory manner when they have limited prior knowledge about it.

***Exploratory Case Studies:*** These case studies are intensive and are conducted before a comprehensive research study. They are used when there is significant uncertainty about the research, and they help in selecting and developing questions and scales. They can also lay the groundwork for broader research studies.

***Critical Incident Case Studies:*** These case studies are conducted with a specific purpose in multiple fields. The most common use of this study is to

examine a unique situation without concern for generalizability. These studies are particularly used to answer cause-effect questions regarding a specific situation or event of concern, such as discussions on professionalism, ethical dilemmas, and communication techniques in challenging situations in medical education (TAYK, 2017).

***Program Implementation Case Studies:*** These studies help us understand whether a research study is appropriate for its purpose. They are used when concerns exist about problems in the research. They are longitudinal in nature.

***Outcome-Based Case Studies:*** These studies measure the impact of the research and help draw conclusions about the reasons for success or failure. The research question often requires generalizability.

***Cumulative Case Studies:*** These studies bring together data collected from multiple research studies conducted at different times. The cumulative case study method helps in gathering past studies and provides support for both retrospective and future research studies.

**Reflection Sessions**

Reflection is a metacognitive process that aims to develop a deeper understanding of both the self and the situation, in order to be aware of previous encounters and inform future encounters. It is a cognitive process that selects, monitors, and evaluates itself, according to Flavell's definition of metacognition as a self-regulation process (Flavell, 1979).

There are several important aspects to this definition:

- Metacognition asserts that effective reflection requires "thinking about thinking." In other words, reflection is a cognitive process. This demonstrates that reflection is a controllable behavior and emphasizes the importance of different educational methods to facilitate its development.
- Reflection can occur before, during, and after an encounter. It is often done only after an event or situation.
- Understanding both oneself and the situation goes beyond describing the acquisition of new knowledge and skills, such as the application of a specific clinical method in lifelong learning.
- Informing future encounters suggests that reflection is a process with a specific purpose of thorough thinking (Sandars, 2009).

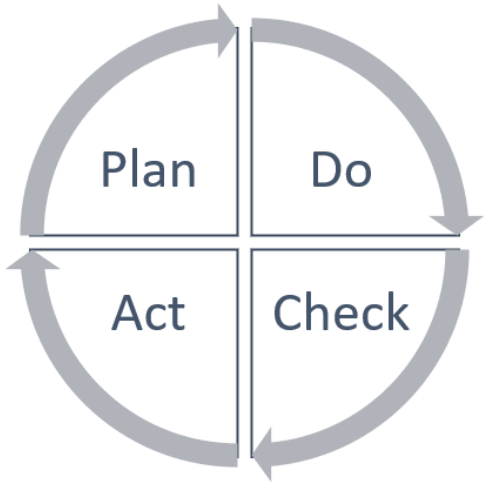


**Figure 1.** *Basic Three-Stage Model of Reflection (Sandars, 2009).*

In medicine, reflection allows for the consideration of the meaning and consequences of experiences and actions, reinforcing and reorganizing existing sets of knowledge, concepts, skills, and values. When used correctly, reflection will support an individual's progress. However, reflection is rarely used (Branch & Paranjape, 2002). While time constraints are often cited as the reason for the infrequent use of reflection in clinical settings, it is known to occur in short periods of time. The inability of clinical educators to effectively facilitate deep thinking and their lack of engagement in reflective thinking contribute to this situation. Additionally, medical doctors may disregard their ability to think abstractly as they are primarily trained to think concretely. The lack of reflective thinking is a deficiency in medical education (Coulehan & Williams, 2001).

The simplest definition of reflection is a recurring, cyclical learning process that involves thinking about previous experiences, drawing lessons from them, developing learning objectives, and applying the acquired knowledge when encountering similar situations. It originates from three theories:

***Pozitivizm:*** Theory emerges from research and may be disconnected from practice. It is only the value of the theory that matters, and theory and practice should interact and guide each other. The knowledge applied can be renewed by the users, and this process occurs through reflection. Therefore, reflection connects theory and practice.

***Interpretive Theory:*** Knowledge is interpreted through the reinforcement of existing and past experiences, guiding us.

***Critical Theory:*** Knowledge is in disciplined interaction with critical thinking and practice. Critical thinking helps break away from fixed ideas and explore different approaches (Alimoğlu & Alpsoy, 2014).

The practice of reflection is the thinking ability employed by the learner to be continually engaged in the process of learning. The aim of reflective practice is not merely the absolute result of learning from the experienced phenomenon but to think consciously about the experience. It serves as a bridge to thorough understanding and learning (Sandars, 2009).

Reflection sessions can be conducted in groups or individually. They involve the participation of a medical student group and at least one educator. The purpose of these sessions is to retrospectively evaluate the students' performance in relation to the incidents or situations that occurred in the department (outpatient clinic, ward, emergency room, procedural rooms, operating theater, etc.). The aim is for students to develop competence in reflective skills (Gülpınar, 2011).

Gülpınar's "reflection in seven steps" learning strategy consists of the following steps:

1. The student briefly describes the cases observed in the ward, intensive care unit, emergency room, etc.
2. The student verbally expresses their thoughts about the case, the plan they made based on these thoughts, and the actions they took, along with their justifications.
3. The student discusses the problems they have analyzed about the case and the questions they encountered during the problem-solving process.
4. Other students in the session reflect on the learner's experience and actions in the case and, if applicable, pose their own questions.
5. The group discusses explanations and solution suggestions related to the presented case and current problems. Using their existing knowledge, the group engages in a preliminary discussion. During this discussion, the educator asks questions to guide, provide insights, point out mistakes if any, and elevate the case presentation to a different level. The educator should avoid simply providing information or explanations.
6. During the group discussion, action plans are developed to enhance competencies such as providing more helpful answers to problems, improving evidence-based medicine utilization, delivering quality services, etc., and to identify the knowledge that needs to be acquired.
7. Based on these action plans, students experience and evaluate their independent learning processes. They seek assistance from their educators if needed (Gülpınar, 2011).

**Gamification, Psychodrama**

***1. Gamification***

Gamification is defined as incorporating game elements into the teaching of desired behaviors to increase motivation, maintain engagement with the subject matter, and enhance the efficiency of the learning process (Deterding et al., 2011). Gamification is "the process of using game thinking and game mechanics to engage users and solve problems" (Zichermann & Cunningham, 2011).

Gamification offers unique learning opportunities for students to navigate through game processes in complex systems. This approach requires active student engagement, can influence behavior, and provide motivation (Singhal et al., 2019).

Gamification is described by a system consisting of three categories: dynamics, mechanics, and components. Dynamics encompass the fundamental elements found in games, such as constraints and storytelling. Mechanics define situations like challenges and chance elements. Components represent the representation of dynamics and mechanics (Güler, 2015).

Gamification enables learner-centered dissemination of knowledge and allows students to acquire the necessary information while being entertained by appealing to their interests. Studies conducted in medical education have demonstrated that gamification enhances learning in medical students, improves compliance with desired competencies, increases learner satisfaction, and enhances concentration levels, making the learning process enjoyable and increasing participation rates (Shrivastava, 2023).

In medical education, gamification involves incorporating game elements into the learning process to increase engagement, motivation, and retention of knowledge. In recent years, especially among medical students from a generation accustomed to digital media, gamification has gained popularity as a way to make learning more interactive and enjoyable. There are various ways to integrate gamification into medical education. For example, educators can create online games, exams, or simulations that challenge students to apply medical concepts to realistic scenarios. Gamification can also be used to track progress, reward achievements, and encourage healthy competition among peers (Shrivastava & Shrivastava, 2023).

In general, gamification in medical education has the potential to make learning more engaging, memorable, and effective.

***2. Psychodrama***

Psychodrama, a therapeutic method for psychological treatment, was developed by Dr. J. L. Moreno. It originated from a religious psychodrama of existential nature found in Austria's traditional culture (Geçtan, 1976).

Psychodrama addresses current problems by identifying their similarities in recent past experiences, resolving relationships from much earlier times, and helping individuals understand their life cycle. It works on exploring issues such as problems, choices, the individual's dysfunctional state, and recognizing alternatives within their life (Orkibi et al., 2017). It is a therapeutic approach that utilizes role-playing and group dynamics to bring out emotional and psychological issues (Şarlak & Öztürk, 2021). While predominantly used in psychotherapy, it has also been integrated into medical education.

In medical education, psychodrama can be used to help students develop communication, empathy, and teamwork skills. It can also assist in understanding and managing emotions (Canel & Pelicioni, 2007).

The use of standardized patients can serve as an example of using psychodrama in medical education. Standardized patients simulate individuals with illnesses, providing a safe and realistic environment for medical students to enhance their clinical skills (Anderson et al., 1994). During a psychodrama session, students have the opportunity to interact with a standardized patient as if they were in a real clinical setting, assuming the role of a physician. It not only helps them improve their communication and empathy skills but also teaches them to work as part of a team with other healthcare professionals.

**Reading and Interpretation of Written and Visual Texts**

Written visual texts can be used to simplify complex medical concepts and explain them in a simplified manner. For example, diagrams and charts can be used to illustrate the functioning of different parts of the human body, which can help students understand medical terminology and concepts. They can also be used to encourage understanding and empathy towards patients' experiences. Written visual texts can be utilized to explore ethical issues that arise in medical practice. For instance, case studies can be presented as written narratives or visual drawings, providing students with a deeper understanding of ethical dilemmas and how to navigate them in real-life scenarios (Spicer & Coleman, 2022).

Examples of written and visual text/study readings in medical education include:

- ***Medical textbooks:*** Medical textbooks are a fundamental element in medical education, providing students with comprehensive and detailed

information on anatomy, physiology, pharmacology, and other medical topics. They often include diagrams, illustrations, and pictures to assist students in comprehending complex concepts.

- ***Medical case studies:*** Medical case studies present students with real-world examples of medical conditions and treatments. They can help students develop critical thinking and problem-solving skills while working on the diagnosis and treatment of complex medical cases (Davey, 2009).
- ***Medical journals and articles:*** Medical journals and articles grant students access to the latest research and discoveries in the field of medicine. They can help students stay up to date with the latest trends and best practices in medicine (Çakmakkaya, 2021).
- ***Medical videos and images:*** Medical videos and images can provide students with visual presentations of medical procedures, treatments, and conditions. They can assist students in understanding complex medical concepts and procedures in a more accessible and engaging manner (Leng et al., 2007).
- ***Medical simulation exercises:*** Medical simulation exercises can incorporate both hands-on experience and written and visual materials. They can provide students with a safe and controlled environment to practice medical procedures, apply treatments, and enhance their clinical skills (Mıdık & Kartal, 2010).

In general, written visual texts in medical education can offer a range of insights and perspectives that deepen students' understanding of medical concepts, patient experiences, ethical issues, and cultural diversity.

**Student Development Portfolio**

A portfolio is a tangible record of what someone has done. It is a collection of works that represents a student's learning, progress, and achievements over time (Redman, 1994). However, a portfolio is much more than just evidence of past accomplishments: it is a dynamic record of growth and professional development (Price, 1994).

The use of professional portfolios is gaining popularity to determine the dimension and measure of a healthcare provider's practice competence. A portfolio is one of the best methods that can be used to assess competencies that may otherwise be difficult to evaluate, such as practice-based improvements, utilization of scientific evidence, professional behavior, and creative efforts. The content within a portfolio can encompass concrete or abstract reflections of

personal development. Portfolios are dynamic and potentially more comprehensive than traditional assessments (Byrne et al., 2007).

There are generally accepted four assumptions related to the portfolio approach with adult learners (Knowles, 1975).

- The student self-directs themselves.
- The student's past experiences are a rich source for learning.
- Readiness for learning develops from real-life tasks and problems.
- The student demonstrates curiosity and self-motivation to grow and achieve.

In medical education, assessment should be approached with an integrated perspective that includes not only knowledge but also professional competencies, problem-solving, ethics, and professionalism. From this perspective, a portfolio is a perfect method for evaluating personal and professional development in medical education as it directly demonstrates what and how much students have learned (Demirören et al., 2009).

**Learning and Assessment in the Workplace (Mini-PET)**

Workplace learning, defined as teaching and learning that focuses on patients and their problems and is often directly relevant to them (Spencer, 2003), occurs in the clinical setting, which consists of inpatient or outpatient care involving patients and their families, each with its unique challenges. It is in this environment that students begin to understand the true meaning of being a physician. Skills such as history-taking, physical examination, patient communication, and professionalism are best learned in the clinical setting, where medical knowledge is directly applied to patient care, learners become motivated by interest, and self-directed learning takes on new meaning (Ramani & Leinster, 2008).

Experiential learning, also known as learning by doing, is the cornerstone of medical education. Medical students working with patients under the supervision of tutors enhance their experiences through hands-on practice. Workplace learning is crucial in medical education for several reasons. Firstly, it allows medical students to translate theoretical knowledge into practice, reinforcing their understanding of medical concepts (Hamdy, 2009). Secondly, it provides opportunities for students to learn how to manage real-life medical situations, such as emergencies, complex diagnoses, and treatment plans (Swanwick & Chana, 2005). Thirdly, it helps develop critical thinking skills as students are required to think for themselves and make decisions based on available evidence (Hamdy, 2009).

According to Spencer, there are also challenges associated with clinical learning. Some examples of these challenges can be listed as follows (Spencer, 2003):

- Lack of clear learning objectives and expectations.
- Teaching material not being appropriate for the learners' level.
- Insufficient delivery of information that should be provided while focusing on problem-solving.
- Lack of active involvement of learners during workplace learning.
- Inadequate observation of learners and feedback during the learning process.
- Insufficient time for reflection and discussion.
- Lack of alignment with the rest of the curriculum.

These challenges highlight the importance of addressing issues such as clarity in learning objectives, appropriate teaching materials, active learner engagement, effective observation and feedback, dedicated time for reflection, and ensuring coherence with the overall curriculum in order to optimize clinical learning experiences.

**Peer Assessment**

Peer assessment is a method in which individuals' performances or works are evaluated by their peers, typically colleagues or classmates. It is commonly used in educational settings such as universities or schools but can also be utilized in professional environments (Boud et al., 2001).

Peer assessment involves an arrangement where learners can clearly see and determine the level, quality, or achievement of a product compared to their equally positioned peers. The products to be assessed can include written assignments, presentations, portfolios, among others. Peer assessment can be summative or formative. The goal is to assist learners in planning their learning, recognizing their strengths and weaknesses, setting targets for improvement, and enhancing their personal and professional skills. Peer feedback tends to be richer and promptly observed compared to feedback from instructors. Despite having less expertise, peer assessment has the same level of reliability and validity as teacher assessment (Topping, 2009).

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# CHAPTER 9

# AN ACADEMIC OVERVIEW OF NATIONAL CORE EDUCATION PROGRAM FOR UNDERGRADUATE MEDICAL EDUCATION-2020

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## Undergraduate Medical Education in Türkiye

Medical education in Türkiye involves a 6-year undergraduate program that provides training to medical doctors. The program comprises theoretical and clinical education, as well as an internship period (Odabaşı et al., 2011). Moreover, students are taught subjects such as ethics, communication skills and patient rights throughout their education.

### *Theoretical Education (Basic Sciences)*

Students accepted into medical schools generally begin their education by studying basic sciences. During this period, they will take courses in medical biochemistry, medical microbiology, medical histology and embryology, medical biology, medical pharmacology, medical genetics, physiology, pathology, and biostatistics.

### *Clinical Education and Internship*

After completion of theoretical education, the students commence clinical courses and hospital internships. At this point, students are introduced to various medical branches such as general surgery, internal medicine, pediatrics, obstetrics, neurology, among others to learn how to recognize, treat and manage a range of diseases. During clinical education, students acquire new skills by completing internship rotations in various clinical disciplines.

In the final year of medical school, students undertake a full-time internship. Throughout this period, they work in health centers and hospitals, providing direct patient care and following treatment plans. This internship is crucial for developing students' clinical skills and gaining experience in real-world medical practice. More detailed information on this section is provided in Chapter 2.

## National Core Education Program

Medical faculties in Türkiye operate under the supervision of the Council of Higher Education and in collaboration with the Ministry of Health to establish medical education standards and curricula. Nonetheless, diverse educational models and programs are in place across faculties with distinct infrastructures and facilities in Türkiye. Although various systems or programs may be utilized, it is necessary to establish a framework program, the Core Education Program, to impart fundamental knowledge and skills to medical practitioners.

The National Core Education Program (NCEP), which was first prepared in 2002 to ensure the standardization of undergraduate medical education, has created a curriculum program that is aimed to be implemented in the 2003-2004 academic year (Bulut, 2003).

At the Medical Deans Council (MDC) meeting held in Kayseri in December 2012, a commission was formed for the National Curriculum. This commission prepared the National Core Education Program-2014 (NCEP-2014) (Gürpınar et al., 2015). However, it is important to note that this program is not the final version for medical education and must be continuously improved in accordance with the current needs. Therefore, it was decided to review it every 6 years (NCEP, 2014). The NCEP-2014 aims to achieve the following outcomes:

1. When preparing the NCEP, we ensured that the language used was similar to that of the Curriculum Creation System of the Board of Specialization in Medicine (CCSBSM), allowing for easy comparison and integration of CCSBSM curricula with the NCEP,
2. Faculties ought to structure their curricula around the NCEP, to ensure students are not overwhelmed with redundant or excessive information, and physicians acquire the same fundamental knowledge and competencies.
3. The role of the curricula in shaping the Medical Specialization Examination should be based on the curriculum, rather than the exam content.
4. Students can audit their faculties' education programs for compliance with the NCEP.

After the release of NCEP-2014, medical faculties began adopting the use of the NCEP. At Bezmialem Vakıf University Faculty of Medicine, NCEP-2020 was launched in December 2018 and updated over the course of a year (NCEP, 2020). The introduction section of NCEP-2020 comprises the following headings upon examination.

- The Process of Restructuring the National Core Curriculum
- What changes have been made in the National Core Curriculum-2020 and what objectives have been established for the future?
- Changes made in NCEP-2020
  - Table I. NCEP 2014 - NCEP 2020 comparison table
  - Table II. Diseases Added and Removed in NCEP-2020
  - Table III. Core Diseases with Name Changes in NCEP-2020
  - Table IV. Core Diseases with Changed Level of Learning in NCEP-2020
  - Table V. Additions and Removals in the Clinical Symptoms/ Findings/ Conditions List in NCEP-2020
  - Table VI. Additions in Basic Medical Practices
  - Table VII. Removals in Basic Medical Practices

    - Table VIII. Changes in the Level of Learning in Basic Medical Practices in NCEP-2020
- New goals for the continuation of the NCEP-2020 project

Chapter 1 includes examples of the use, creation and listing of the National Competencies and Proficiencies Document for Medical School Graduates, matching competency areas and related competencies, associating them with the training program and determining sub-competencies. Chapter 2 includes updates and content work lists. The table headings in this section are listed as follows:

- Table 2.1. Clinical Symptoms/Findings/Condition
- Table 2.2. Core Diseases/Clinical Problems
- Table 2.3. Matching List for Symptoms/Conditions and Core Diseases/Clinical Problems
- Table 2.4. Lists of Basic Medical Practices
- Table 2.5. Basic Medical Sciences NCEP Alignment Table

Chapter 3 presents the Behavioral, Social and Human Sciences list. Below are the corresponding tables.

- Table 3.1. List of Main/Sub Conditions
- Table 3.2. NCEP 2014- NCEP 2020 Comparison

To summarize the alterations implemented in NCEP-2020 in comparison to 2014.

1. National competencies and proficiencies required for medical school graduates have been identified.
2. “Behavioral, Social and Human Sciences” has been added as a separate heading.
3. It was decided to identify diseases, symptoms and conditions that are particularly common in the community and to include them more in the curriculum.
4. Since the main goal is to train “good physicians at the primary care level”, the phrase “at the primary care level” is emphasized at each level when determining the performance levels of each core disease, symptom, condition, and basic medical practice.
5. The title “Symptoms and Conditions” in the NQAP-2014 has been changed to “Clinical Symptoms/Findings/Conditions “.
6. Some core diseases have been removed, new core diseases have been added and some core diseases have been renamed.

7. The education level of some core diseases has been changed.
8. Removals and new additions have been made to Clinical Symptoms/Findings/ Conditions.
9. While there were 345 items under the heading of "Core Diseases/Clinical Problems" in NCEP-2014, this number was reduced to 342 in 2020.
10. While the number of "Clinical Symptoms/Findings/Conditions" was 124 in NCEP-2014, it was increased to 141 in 2020.
11. While the number of "Core Medical Practices" was 136 in NQAP-2014, it was increased to 157 in 2020.
12. Additions were made to "Basic Medical Practices" and the level of some basic medical practices was changed.

It is evident that the NCEP-2020 has been prepared diligently and with attention to detail. With its invaluable contributions to medical education, it serves as a valuable guide for both instructors and students. For this reason, we wished to thoroughly investigate the NCEP-2020. As a result of our review, we found spelling errors at some points and when we evaluated the tables on Excel, we identified some errors. To summarize them;

Conditions that were included in the clinical symptoms and Clinical Symptoms/Findings/Conditions tables added in NCEP 2020 but not in the matching table were observed (Table 1). For example, while "Stuttering" is included as a Clinical Symptoms/Findings/Conditions in Table V and Table 2.1, it is included in "Speech disorders" in the Clinical Symptoms/Findings/Conditions in Table 2.3. Similarly, "Asphyxia", which is included in the clinical symptoms added in Table V and in Table 2.1, is not included in the Clinical Symptoms/Findings/Conditions in Table 2.3.

**Table 1.** Not Included in the Clinical Symptoms/Findings/Conditions Table (1)

| Clinical Symptoms/Findings/Conditions | Location | Page Number |
|---|---|---|
| Stuttering | Table V | 15 |
| | Table 2.1 | 46 |
| Asphyxia | Table V | 15 |
| | Table 2.1 | 44 |
| Dizziness | Table 2.1 | 44 |

Situations that are in the Core Diseases with Name Changes in NCEP-2020 and Core Diseases/Clinical Problems but not in the matching table were observed (Table 2). For example, while "Ascites" is included in the Core Diseases/Clinical Problems in Table 2.2, it is not included in the Clinical

Symptoms/Findings/Conditions in Table 2.3. Similarly, the core disease formerly named "Vascular malformation" was changed to "Vascular Malformation/Hemangioma" and included in Table 2.2, where Core Diseases/Clinical Problems are defined, but not in Clinical Symptoms/Findings/Conditions in Table 2.3.

**Table 2.** Not Included in the Clinical Symptoms/Findings/Conditions Table (2)

| Core Diseases/Clinical Problems | Located in | Page Number |
|---|---|---|
| Acid | Table 2.2 | 51 |
| Pressure Ulcers | Table 2.2 | 51 |
| Skin Injuries | Table 2.2 | 52 |
| RH Incompatibility in Pregnancy | Table 2.2 | 54 |
| Hyperparathyroidism | Table 2.2 | 55 |
| Colorectal Tumors | Table 2.2 | 57 |
| Troubled childbirth | Table 2.2 | 61 |
| Vascular Malformation / Hemangioma | Table III<br>Table 2.2 | 11<br>62 |
| Gastrointestinal System Malformations in the Newborn | Table III<br>Table 2.2 | 9<br>63 |

In contrast to the situation encountered above, "Developmental Language Delay" was included in Table 2.3 pairings but not in Table 2.2 core diseases/clinical problems (Table 3).

**Table 3.** Not Included in the Core Diseases/Clinical Problems Table

| Core Diseases/Clinical Problems | Clinical Symptoms/Findings/Conditions | Page Number |
|---|---|---|
| Developmental Language Delay | Learning Disabilities | 107 |

It is seen that some of the core diseases and clinical problems that are among the diseases removed from the NCCP 2020 are included in the matching table (Table 4). For example, while it is stated on page 69 of Table II that "Motion sickness" was removed, it is included in the clinical symptom "Headache" in Table 2.3. Similarly, on page 108 of Table II, "Acute Arterial Occlusion" is included in the excluded core diseases, whereas in Table 2.3 it is included in both Paresthesia and Paresthesia/Paralysis clinical symptoms.

**Table 4.** Core Diseases/Clinical Problems forgotten to be removed

| Core Diseases/Clinical Problems | Clinical Symptoms/Findings/Conditions | Page Number |
|---|---|---|
| Motion sickness | Headache | 69 |
| Learning Disorders | Learning Disabilities | 107 |
| Accidents | Paresis/Paralysis | 108 |
| Acute Arterial Occlusion | Paresthesia & Paresis/Paralysis | 108 |

In NCEP-2020, the levels of knowledge acquired by graduates of the Faculty of Medicine pertaining to core diseases and clinical symptoms for primary health care provision are as follows: "E (Emergency): Define the emergency and provide initial treatment. Refer to a specialist when necessary. PD (Preliminary Diagnoses): In non-emergency situations, make a preliminary diagnosis, perform necessary preliminary procedures, and refer to a specialist. D (Diagnoses): Make a diagnosis, possess knowledge of treatment, perform necessary preliminary procedures and refer to a specialist. DT (Diagnosis&Treatment): Make a diagnosis and provide treatment. F (Follow): Should be capable of conducting long-term follow-up and control. P (Protection): Implement measures for protection (primary, secondary, and tertiary protection)." When NCEP 2020 was examined, it was observed that some core diseases/clinical problems had different learning levels in the Core Diseases/Clinical Problems table and the Symptoms/Conditions and Core Diseases/Clinical Problems Matching List (Table 5). For example, while the core disease "Emergencies Related to Alcohol and Substance Use" is shown as "E" level learning for the Clinical Symptoms/Findings/Conditions "Anger and Aggression" and "Pupillary Changes" in Table 2.3, it is expressed as "E-P" learning level in Table 2.2. Similarly, in Table IV, the learning level for the core condition "Transient Ischemic Attack" was changed from "PD" to "E", but in Table 2.3, the learning level for the clinical symptom/findings/condition "Syncope" was left at "PD".

**Table 5**. Core Diseases/Clinical Problems with Different Learning Levels

| Clinical Symptoms/Signs/ Conditions | Core Diseases/Clinical Problems | Recommended Learning Level | Level of Learning Used | Different Definition Page Number |
|---|---|---|---|---|
| Anger and Aggression | Emergencies Related to Alcohol and Substance Use | E-P | E | 106 |
| Pupil Changes | Emergencies Related to Alcohol and Substance Use | E-P | E | 111 |
| Sleep related problems | Cognitive (Cognitive) Disorders (Dementia) | PD-P-F | PD-E-P-F | 117 |
| Syncope | Transient Ischemic Attack | E | PD | 113 |
| Petechiae, Purpura, Ecchymosis | Bleeding Disorders (Hemophilia, Thrombocytopenia, etc.) | PD-P-F | PD | 109 |
| Jaundice | Chronic Hepatitis | PD-P | PD | 112 |
| Impairment of judgment | Schizophrenia and Other Psychotic Disorders | PD-E-P | PD-E-P-F | 105 |
| Anger and aggression | Schizophrenia and Other Psychotic Disorders | PD-E-P | PD-E-P-F | 107 |
| Menstrual Disorder (Amenorrhea) | Eating Disorders | PD | PD-P-F | 64 |
| Headache | Stroke | E-P-F | D-E-P-F | 69 |
| Pupil Changes | Stroke | E-P-F | D-E-P-F | 111 |
| Edema | Urticaria and Angioedema | DT-E-P | DT-E | 106 |
| Stings (Insect etc.) Bites | Urticaria and Angioedema | DT-E-P | DT-E | 114 |
| Stridor | Urticaria and Angioedema | DT-E-P | DT-E | 115 |

Differences were noted in the organ system classification for NCEP 2020 Core Diseases/Clinical Problems (Table 6). For instance, while the preferred organ system for the core disease “Pulmonary Tuberculosis” is “Respiration”, it is listed as “Multisystem” in the clinical symptom “Cough / Expectoration”.

**Table 6**. Core Diseases/Clinical Problems Observed in Different Organ System Classifications

| Clinical Symptoms / Findings/ Conditions | Core Diseases/Clinical Problems | Recommended Organ System | Used Organ System | Different Definition Page No |
|---|---|---|---|---|
| Weakness / fatigue | Pulmonary Tuberculosis | Respiration | Respiratory system | 87 |
| Cough / Expectoration | Pulmonary Tuberculosis | Respiration | Multisystem | 107 |
| Tobacco Use | Pulmonary Tuberculosis | Respiration | Respiration-Circulation | 117 |
| Tobacco Use | Acute Coronary Syndromes | Circulation | Respiration-Circulation | 117 |
| Anemia | Aplastic Anemia | Hematopoietic | Multisystem | 65 |
| Movement Disorders | Ataxic Disorders | Nerve - Action | Multisystem | 87 |
| Tobacco Use | Sexual Function Disorders | Multisystem | Urogenital | 117 |
| Micro-Macrocephaly | Vitamin D Deficiency | Multisystem | Endocrine | 104 |
| Polydipsia | Diabetes Mellitus and complications | Multisystem | Endocrine | 110 |
| Polyuria | Diabetes Mellitus and complications | Multisystem | Endocrine | 110 |
| Pollacuria/ nocturia | Diabetes Mellitus and complications | Multisystem | Endocrine | 110 |
| Urinary incontinence | Diabetes Mellitus and complications | Multisystem | Endocrine | 118 |
| Dry Mouth | Diabetes Mellitus | Endocrine | Multisystem | 64 |
| Change of Consciousness | Diabetes Mellitus | Endocrine | Multisystem | 70 |
| Enuresis | Diabetes Mellitus | Endocrine | Multisystem | 84 |
| Low Back and Back Pain | Herniated disk | Musculoskeletal | Multisystem | 70 |
| Neck Pain | Herniated disk | Musculoskeletal | Multisystem | 72 |
| Muscle Weakness | Herniated disk | Musculoskeletal | Multisystem | 98 |
| Chronic Pain | Herniated disk | Musculoskeletal | Multisystem | 102 |
| Neuropathic Pain | Herniated disk | Musculoskeletal | Nerve-Behavior | 105 |
| Seizures | Baby of a Diabetic Mother | Multisystem | Endocrine | 105 |
| Jaundice | Baby of a Diabetic Mother | Multisystem | Endocrine | 112 |
| Cyanosis | Baby of a Diabetic Mother | Multisystem | Endocrine | 113 |
| Paresis/ paralysis | Birth Trauma | Multisystem | Urogenital | 108 |

| | | | | |
|---|---|---|---|---|
| Tobacco Use | Interstitial Lung Diseases* | Respiration | Respiration-Circulation | 117 |
| Change of Consciousness | Cardio-Pulmonary Arrest | Respiration - Circulation | Circulation | 71 |
| Micro-Macrocephaly | Chromosome Diseases (Common) | Multisystem | Nerve-Behavior | 104 |
| Pollacuria / Nocturia | Chronic Kidney Disease | Excretion | Urogenital | 111 |
| Tobacco Use | Chronic Obstructive Pulmonary Disease | Respiration | Respiration-Circulation | 117 |
| Foreign Object (Swallowing / Aspiration) | Laryngeal Obstruction | Respiration | Respiration-Circulation | 119 |
| Cough / Expectoration | Occupational Lung Diseases | Multisystem | Respiration | 108 |
| Micro-Macrocephaly | Neurocutaneous Diseases | Nerve - Behavior | Multisystem | 104 |
| Seizures | Neurocutaneous Diseases | Nerve - Behavior | Multisystem | 105 |
| Side Pain | Spinal Injuries | Musculoskeletal | Multisystem | 119 |
| Tobacco Use | Peripheral Arterial Disease | Circulation | Respiration-Circulation | 117 |
| Syncope | Pulmonary Embolism | Respiration - Circulation | Circulation | 113 |
| Foreign Object (Swallowing / Aspiration) | Respiratory Insufficiency | Respiration | Respiration-Circulation | 119 |
| Side Pain | Urinary System Infections | Urogenital - Excretion | Urogenital | 119 |
| Colic Pain (Renal, Biliary, Intestinal) | Urinary System Stone Disease | Urogenital - Excretion | Urogenital | 102 |
| Foreign Object (Swallowing / Aspiration) | Upper Respiratory Infections | Respiration | Respiration-Circulation | 119 |
| Foreign Object (Swallowing / Aspiration) | Foreign Object Related Problems | Multisystem | Respiration-Circulation | 119 |

In addition, NCEP-2020 changed “Sexual Dysfunctions” to “Sexual Function Problems” and “Diabetes Mellitus” to “Diabetes Mellitus and Its Complications.” Nonetheless, it was noted that the old terms still appeared in the tables.

At the NCEP-2020 meetings, the question “Should there be a separate NCEP for basic medical sciences?” was discussed, and a sample table (NCEP Table 2.5) was given as an example of how basic medical sciences can use the NCEP instead

of creating a separate list, considering that it may harm integration in education. However, when the table was examined, it was noted that it would be quite difficult to adapt it to basic medical sciences. It was also stated that the compliance of the courses taught in medical faculties with the NCEP -2020 is expected to be around 70-75%, and the remaining 25-30% content is left to the faculties. However, considering that the basic science education, which constitutes the first three years of medical faculties, is more than 30% and considering the current course load, it is considered very difficult to achieve the expected compliance.

In the NCEP -2020, competencies, proficiencies, and sub-proficiencies are defined with a hierarchical relationship between them in order to achieve competencies. Sub- proficiencies are composed of lesson, block, committee, and internship aims and objectives. While the goals and objectives are clearly mentioned, there is a lack of guidance on how to accomplish them objectively. To overcome this challenge, it is recommended to integrate Bloom's Taxonomy into educational programs.

Bloom's Taxonomy (BT), referenced in Chapter 3, is a model developed by Benjamin Bloom, an American educational psychologist, in 1956. Its purpose is to categorize educational goals and objectives into lower-level and higher-level thinking skills. BT is widely utilized for designing and assessing educational activities (Bloom et al., 1956; Bloom et al., 2020). Progression through each level is dependent on mastery of the previous level as each level builds upon the ones before it. BT assists educators in creating learning objectives aimed at specific cognitive learning levels and crafting assessments that evaluate student progress.

When assessing compliance with the NQAP 2020, one can formulate knowledge, skill, and attitude goals for each core disease using verbs from Bloom's taxonomy. This approach works on both the course level and during internship periods when the courses are conducted.

In medical education, the course's knowledge, skill, and attitude objectives ought to harmonize with the learning level of the core diseases and clinical problems being addressed. Bloom's taxonomy may also be employed to gauge the learning level of each course and its corresponding core diseases.

A sample matching of learning levels for core diseases/clinical problems and learning levels according to Bloom's Taxonomy is given in Table 7. When the table is examined, if it is aimed to learn a core disease at learning level “A”, the student should master the steps of remembering, understanding, applying, analyzing and evaluating related to the core disease according to the cognitive learning level, and the steps of perceiving, responding, valuing, organizing and

characterizing from the metacognitive learning levels. Let us explain this situation with an example.

To be able to define and administer the initial treatment for an emergency situation, it is essential to first remember, understand, and perceive information related to the illness. In the intervention phase of an emergency, learning occurs at the levels of application, response, and valorization. In emergency treatment, learning at the level of analysis, evaluation, organization, and characterization requires the ability to differentiate between different diseases and select appropriate treatment. For example, the symptoms of a heart attack and a pulmonary embolism may be similar, but these two conditions have different treatments available. In emergency treatment, learning at the level of analysis is important in distinguishing the disease, while learning at the level of evaluation, organization and characterization forms the basis for being able to accurately assess and describe the patient's current condition and to apply the appropriate treatment at the appropriate dose.

**Table 7.** Learning Levels for Core Diseases/Clinical Problems According to Bloom's Taxonomy

| | | **Bloom's Taxonomy Learning Levels** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Cognitive Learning** | | | | | **Metacognitive Learning** | | | | | |
| | | **Remembering** | **Understanding** | **Applying** | **Analyzing** | **Evaluating** | **Creating** | **Perceiving** | **Responding** | **Valuing** | **Organizing** | **Characterizing** |
| **Learning Level for Core Diseases/Clinical Problems** | **E** | X | X | X | X | X | | X | X | X | X | X |
| | **PD** | X | X | X | | | | X | X | X | X | |
| | **D** | X | X | X | X | X | | X | X | X | X | X |
| | **DT** | X | X | X | X | X | X | X | X | X | X | X |
| | **F** | X | X | X | | | | X | | X | X | |
| | **P** | X | X | X | X | X | X | | | X | | |

Medical education is a comprehensive process that focuses on developing the knowledge, skills, and attitudes required for a doctor (Bashan & Selvi, 2019). If we delve into these three elements in more detail...

**Knowledge:** Medical students learn basic and clinical sciences such as human anatomy, physiology, pathology, and pharmacology.

**Skills:** They acquire practical skills like physical examination, surgical procedures, interpretation of laboratory tests, and medical procedures.

**Attitude:** They develop attitudes such as a patient-centered approach, respect for ethical values, empathy, and professional responsibilities.

In NCEP-2020, the learning level for the core disease "Head Trauma" is indicated as "E". According to Bloom's Taxonomy, examples of knowledge, skills, and attitudes objectives appropriate to the NCEP learning level can be as follows. At the end of each objective, the learning level of the objective according to Bloom's Taxonomy is indicated.

***Knowledge goals***

Describes the emergency approach in patients with head trauma (Level of understanding)

Evaluates patients with head trauma in emergency or non-emergency category (Level of Evaluating)

***Skill goals***

Takes anamnesis from head trauma patients or their relatives (Level of Applying)

Examination of the patient with head trauma (Level of Applying)

***Attitude goals***

Gains awareness by considering the findings that will require emergency intervention in patients with head trauma (Level of Perceiving)

We have previously indicated that Bloom's Taxonomy can also be applied to internship programs, such as those in core disease. Firstly, one can ascertain the internship's objective, and then formulate learning objectives using knowledge, skill, and attitude verbs, as outlined in Chapter 3. For example, the aim of a neurology internship, along with its knowledge, skills, and attitude objectives, are presented in the figure below.

***Example of "Objective" for Neurology internship***

At the end of the Neurology Internship, students; Considering the learning objectives specified in the National Core Education Program, it is to gain the

knowledge, skills and attitudes necessary to know the basic problems related to neurological diseases required in primary health care and emergency conditions, to perform the diagnosis and treatment of these problems during health care, to refer to the relevant centers in cases requiring further examination, to be committed to ethical values.

***Example of "Knowledge" for Neurology internship***

Have an understanding of the physiological mechanisms of the brain and recognize neurological disorders.

Provide an explanation of the disease's etiology.

Refer patients to appropriate resources when necessary.

Evaluate a patient's level of consciousness using the Glasgow or AVPU coma scale.

Takes necessary precautions for proper transportation of the neurological patient.

***Example of "Skill" for Neurology internship***

Takes anamnesis from the patient and/or relatives.

Distinguishes between emergency and non-emergency neurologic patients.

Evaluates direct radiographs.

Writes a prescription for the treatment of the disease.

Applies bandage and tourniquet appropriately.

Assists the lumbar puncture practitioner.

Follows the results of laboratory and imaging requests.

Applies airway.

***Example of "Attitude" for Neurology internship***

Recognizes the importance of effective communication with patients and their relatives.

Pay attention to patient confidentiality.

Gives importance to patient rights.

Recognizes the contribution of rational drug use to health economy.

Recognizes the importance of preventive medicine in neurological diseases.

Adopts effective communication with care centers and non-governmental organizations (associations, etc.) related to some neurological diseases that require care (Alzheimer's, dementia, etc.).

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# CHAPTER 10

# INNOVATIVE TECHNOLOGIES USED IN MEDICAL EDUCATION

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Traditionally, medical education in the pre-20th century focused on diagnosis, treatment, and patient management (Varkey et al., 2009). In a report published in the United States in 1999, it was acknowledged that preventable medical errors were responsible for 44,000 to 98,000 patient deaths annually in US hospitals. Medical schools, teaching hospitals, and healthcare systems recognized the need for greater patient safety and acknowledged that achieving this goal required more than just a single course within the already busy medical school curriculum. This realization necessitated a fundamental cultural change in medical education at all stages (Kirch et al., 2010). The changing role of physicians in healthcare delivery, environmental factors (such as transportation and distance), and the increasing emphasis on patient safety have played a significant role in the rapid integration of technology into medical education (Guze, 2015). Additionally, patients' reluctance to be a subjective part of medical education is believed to have contributed to these developments (Mıdık et al., 2010). Furthermore, there is substantial evidence that students of the millennium era in the 2000s learn more quickly through active learning methods, such as using technology for learning and receiving instant feedback (Eckleberry-Hunt et al., 2011; Twengw et al., 2009). It is important for medical educators to pay attention to learning differences and integrate interactive learning methods that align with their dynamic learning preferences into their curricula (Bashan et al., 2016). This section will introduce innovative technologies that have been increasingly used in medical education in recent years.

**Simulation-Based Medical Education**

Simulation, derived from the Latin word "similis" meaning imitation or resemblance, is defined by Shannon as "the process of designing a model of a real system and conducting experiments with this model in order to understand the behavior of the system or evaluate various strategies for the operation of the system" (Shannon et al., 1976). According to the Turkish Language Institution, simulation refers to "the state of representing or symbolizing an event or situation in an equivalent manner to reality." Simulations are expected to be realistic and applicable to the real environment (Maran et al., 2003).

After the use of simulators in the military field centuries ago, advancements in aviation technology in the 1950s and 1960s led to the development of simulators for pilot training. The first use of simulators in medicine dates back to the 17th century when simple model simulators (mannequins) were used in the field of obstetrics to reduce maternal and infant mortality (Bradley, 2006). One of the earliest examples of simulation-based modern medical education is the development of the technological cardiac patient simulator called "Harvey" in

1976, which enabled medical students and residents to practice cardiac auscultation and diagnosis in a controlled environment (Gordon et al., 1980). Since the 1980s, the use of simulators in medical education has continued to expand with the development of high-fidelity mannequins and computer-based simulations. These technologies have provided students with a more effective learning experience, allowing for more realistic and interactive simulations. In the second half of the 20th century, the use of simulation in the educational environment became more widespread among medical educators (Bradley, 2006). Today, simulation-based medical education is widely used in various medical fields, ranging from emergency medicine to surgery, cardiology, and obstetrics (Ward, 2001).

Simulation-based medical education is an instructional approach that utilizes simulation technology to provide learners with a safe and controlled learning environment that prioritizes patient safety while developing their clinical skills (McGaghie et al., 2010). Simulation plays a crucial role in imparting competence, particularly in the realm of professional practice, by offering learners the opportunity to acquire skills before direct patient contact, thus ensuring standardization in education (Bashan et al., 2016). Well-developed simulation-based training addresses the need for reform in medical education, supports active learning among students, and enhances patient safety (Rodriguez-Paz et al., 2009).

Simulators used in medical education can vary from low-fidelity to high-fidelity devices, catering to a wide range of clinical skills, from basic procedures (such as blood sampling and catheter insertion) on simple models to complex surgeries performed with the aid of high-tech simulators (Mıdık et al., 2010).

Examples of simulators used in medical education include:

- ***Anatomical models:*** Anatomical models are physical models that replicate human anatomy and physiology. These models can be used to teach students about the structure and function of organs, tissues, and systems. They can range from simple plastic models to three-dimensional models (Talairach-Vielmas, 2014).
- ***Task trainers:*** Task trainers are simple models that allow students to practice specific skills such as suturing, injections, or intubation. They can be made from synthetic materials or real tissues and can be used for repeated practice (So et al., 2019).
- ***Procedural simulators:*** Procedural simulators can be used to teach students how to perform invasive procedures such as lumbar puncture, thoracentesis, or laparoscopic surgery. These simulators can provide a

realistic simulation of the procedure and allow students to practice under the guidance of experienced instructors (Okuda et al., 2009).

- ***High-fidelity patient simulators:*** High-fidelity patient simulators are advanced models that simulate human physiology, vital signs, and responses to interventions. These simulators can be used to teach clinical decision-making, communication, and teamwork in a realistic clinical environment (Gordon et al., 2001).

In conclusion, simulator models are a safe and effective method for medical students to apply their clinical skills and gain experience in professional practice. They can enhance students' confidence, competence, and patient safety.

**Virtual Reality and Augmented Reality**

Virtual reality and augmented reality are increasingly being used in medical education to enhance the learning experience and provide students with immersive and realistic simulations. Virtual reality and augmented reality create fully simulated environments that can be interacted with using specialized goggles and headsets. On the other hand, augmented reality can also be used as a measurement and evaluation tool by overlaying digital data onto the real environment through a camera or another device (Caudell et al., 2003; Hsieh et al., 2018).

Virtual reality and augmented reality have various applications in medical education, some examples of which are provided below:

***Anatomy and Physiology:*** They can provide students with a three-dimensional view of anatomical structures and systems. This allows students to learn about these structures in a more engaging and memorable way compared to traditional methods, enabling them to interact with the structures.

***Surgical Training:*** By simulating surgical procedures, virtual reality and augmented reality enable students to practice in a safe, controlled, and realistic environment before performing the procedure on a real patient. This not only contributes to enhancing patient safety but also reduces the risk of complications when transitioning to real patients.

***Emergency Medicine:*** Simulating emergency scenarios allows students to develop critical thinking, decision-making, and teamwork skills in a realistic environment.

***Medical Device Training:*** In postgraduate education (residents) or continuous professional development for graduates and medical specialists, virtual reality and augmented reality can be used to provide training on the use of complex medical devices such as ultrasound machines or magnetic resonance imaging.

***Patient Interactions:*** By providing simulations of patient interactions, virtual reality and augmented reality enable students to develop communication and empathy skills in a safe environment.

In summary, virtual reality and augmented reality offer safe and effective methods for medical students to practice and gain experience in clinical skills, enhancing their confidence, competence, and patient safety.

**Gamification**

In medical education, gamification can be employed by incorporating game-like elements into learning activities such as exams, simulations, and interactive case studies (Donkin et al., 2021; Krishnamurthy et al., 2022; Kopel et al., 2021). Some examples of gamification are provided below:

***Quiz Games:*** They can be used to reinforce learning and test knowledge. They can be designed as simple games or more complex ones that require critical thinking and problem-solving skills.

The "Kahoot" application is a game-based learning platform that allows educators to create quizzes, surveys, and discussions. Learners can use their own devices to play together in real-time, competing with each other to see who can answer questions the fastest and most accurately.

The "Quizlet" application is an online study tool that enables users to create flashcards, quizzes, and games. Educators can create study sets for their students.

The "Jeopardy!" application is a classic trivia game that can be adapted for use in medical education. Educators can create categories and questions covering various topics such as anatomy, pharmacology, and medical history.

Another classic trivia game, "Trivial Pursuit," can be adapted for medical education. With this application, educators can create questions for categories covering a wide range of topics, including diseases, treatments, terminology, medical history, and ethics.

The "Pictionary" application allows players to draw pictures to represent words or sentences. Medical educators can utilize this application to reinforce medical terminology and anatomy.

These examples demonstrate how gamification can be employed in medical education to enhance engagement, motivation, and learning outcomes by incorporating game elements into the learning process.

***Role-Playing Games:*** They can help students enhance their communication and empathy skills by simulating patient interactions. Students can take on the role of a patient or doctor through pre-written scenarios or improvisation, engaging in realistic conversations. This method is considered one of the most effective approaches to developing attitudes in students.

***Simulation Games:*** They can provide learners with realistic scenarios in which they can apply their clinical skills and decision-making abilities. These games can simulate patient encounters, surgeries, or emergency situations.

***Leaderboards and Rewards:*** They can be used to motivate students and encourage healthy competition. Students can earn points or other rewards for completing tasks or achieving learning objectives.

***Story-Based Games:*** They can be employed to make learning more engaging and memorable. These games can be designed around a narrative or storyline that guides the student's learning journey.

Overall, gamification in medical education can offer students a more engaging and effective learning experience. Educators can incorporate game design principles into medical education to enhance motivation, retention, and learning outcomes. However, it is important to use gamification appropriately and ensure that it supports the learning objectives of the curriculum.

**Mobile Learning**

Mobile devices such as smartphones and tablets have facilitated continuous learning by enabling medical students to access learning materials on the go. Mobile learning has become increasingly prevalent in medical education due to the convenience and flexibility it offers students (Walsh, 2015; Klímová, Blanka, 2018; Briz-Ponce, 2016).

Here are some examples of mobile learning used in medical education:

- ***E-books and Digital Resources:*** Medical textbooks and resources can be presented in digital formats that students can access from their mobile devices. This allows students to study and access learning materials anytime, anywhere.
- ***Mobile Applications:*** There are numerous mobile applications available for medical education, including apps for anatomy, pharmacology, and clinical skills. These apps can provide students with interactive and engaging learning experiences.
- ***Podcasts and Videos:*** By downloading podcasts and videos to their mobile devices, students can learn while on the move. Medical podcasts and videos can provide students with access to expert opinions and real-world case studies.
- ***Collaborative Learning:*** Mobile devices can be used to facilitate collaborative learning among students. For instance, messaging apps or social media platforms can be utilized for sharing notes, discussing cases, and collaborating on projects.

- ***Virtual Patient Simulations:*** Mobile devices can be used to provide students with virtual patient simulations that allow them to practice clinical skills and decision-making in a realistic environment.

In general, mobile learning in medical education offers students more flexible and convenient learning options. Mobile devices can be used to access learning materials anytime, anywhere, and provide students with interactive and engaging learning experiences. However, it is important to ensure that mobile learning is used in a way that supports the learning objectives of the curriculum and does not replace other essential aspects of medical education, such as hands-on training and clinical experiences.

**Telemedicine Applications**

Telemedicine allows medical students to participate in virtual consultations and remotely observe professional medical practices. This provides them with the opportunity to observe and understand a wide range of medical procedures and expert opinions (Aron et al., 2020; Budakoğlu et al., 2021; Waseh et al., 2019).

Some examples of telemedicine applications used in medical education are provided below:

- ***Virtual Consultations:*** Students can participate in virtual consultations with healthcare professionals, allowing them to observe real patient cases and learn from them. This provides students with access to a broader range of cases and experiences than they could have in a traditional classroom setting.
- ***Remote Clinical Rotations:*** Students can remotely participate in clinical rotations by using telemedicine technology to observe healthcare professionals and communicate with them. These applications can offer students opportunities to gain clinical experience in a wider range of locations and specialties.
- ***Distance Education:*** Telemedicine technology can be used to provide distance education opportunities to students in remote areas or those unable to attend in-person classes. These applications may include live-streamed lectures, online discussions, and interactive learning modules.
- ***Tele-simulation:*** Telemedicine technology can be used to simulate clinical scenarios and provide students with the opportunity to practice clinical skills remotely. These applications may involve virtual patient simulations, tele-mentoring, and tele-supervision.
- ***Remote Research:*** Telemedicine technology can be utilized to support remote research projects, enabling students to collect and analyze data

remotely. These applications may include tele-observations, tele-interviews, and tele-surveys.

Overall, telemedicine applications in medical education can provide students with new opportunities to gain clinical experience, access a broader range of cases and expertise, and support remote learning and research. However, it is important to ensure that telemedicine is used in a way that supports the learning objectives of the curriculum and does not replace essential aspects of medical education such as hands-on training and clinical experience.

**3D Printing**

3D printing is a technology that allows the creation of three-dimensional (3D) objects from digital models by layering materials such as plastic, metal, or ceramic. It has become increasingly popular in medical education due to its ability to create highly detailed and accurate models of anatomical structures, surgical tools, and medical devices (AbouHashem et al., 2015; Garcia et al., 2018; O'Brien et al., 2016).

Here are some examples of how 3D printing is used in medical education:

- ***Anatomical Models:*** It can be used to create highly precise anatomical models that can provide medical students with insights into the human body. These models can be customized to demonstrate specific features such as pathologies or injuries, offering students a hands-on learning experience.
- ***Surgical Planning and Practice:*** 3D printing can be utilized to create surgical models and tools, allowing surgeons to plan and practice procedures before operating on a patient. This can improve surgical outcomes and reduce complications.
- ***Medical Devices and Implants:*** It can be used to create custom medical devices and implants, such as prosthetics or orthotics, tailored to the specific needs of individual patients. This can improve patient outcomes and potentially reduce costs.
- ***Simulation and Training:*** 3D printing can be used to create highly realistic simulation models, enabling students to practice surgical procedures and medical interventions in a safe and controlled environment. This can enhance student skills and confidence and reduce the risk of errors during real procedures.
- ***Research and Development:*** It can be utilized to support research and development in the medical field, allowing scientists and engineers to create and test new medical devices and materials.

In general, 3D printing in medical education enhances learning and training experiences by providing students with highly detailed and accurate models of anatomical structures, surgical tools, and medical devices. It also has the potential to improve patient outcomes and reduce costs by providing customized medical devices and implants.

**Artificial Intelligence**

Artificial intelligence (AI) can assist medical students in analyzing large amounts of medical data, including electronic health records and medical imaging, and support clinical decision-making. It has the potential to transform medical education by providing new opportunities for personalized learning and assessment (Chan et al., 2019; Garg, 2020; Masters, 2019).

Below are some examples of how artificial intelligence is being used in medical education:

- ***Personalized Learning:*** AI algorithms can be used to analyze students' learning patterns and provide personalized recommendations for study materials and learning activities. This can help students focus on areas where they need the most assistance and optimize their learning experiences.
- ***Adaptive Testing:*** AI algorithms can be used to create adaptive tests that adjust the difficulty of questions based on the student's previous responses. This can enable a more accurate assessment of a student's knowledge and skills and help identify areas that require further learning.
- ***Virtual Patient Simulations:*** AI-supported virtual patient simulations can provide students with a realistic and interactive learning experience. These simulations can simulate a wide range of patient cases and scenarios, allowing students to gain practical experience in a safe and controlled environment.
- ***Diagnostic Decision Support Systems:*** AI algorithms can be used to provide diagnostic decision support for healthcare professionals, enabling them to make more accurate and efficient diagnoses. This can improve patient outcomes and reduce healthcare costs.
- ***Data Analysis and Research:*** AI algorithms can be used to analyze large volumes of medical data, such as electronic health records and medical imaging, to identify patterns and trends. This can support medical research and provide new insights into disease diagnosis and treatment, ultimately improving patient outcomes.

Overall, artificial intelligence has the potential to revolutionize medical education by offering personalized learning and assessment opportunities, as well as facilitating the analysis of medical data for improved clinical decision-making.

**Metaverse**

The metaverse is a term that refers to a collective virtual shared space created by the convergence of physical and virtual reality. Virtual reality, augmented reality, and mixed reality are immersive digital environments that provide a range of interactive experiences. In medical education, the metaverse has the potential to transform the way students learn and interact with medical content (Ahuja et al., 2022; Almarzouqi et al., 2022; Chen, 2022; Sandrone, 2022).

Below are some examples of how the metaverse can be used in medical education:

- ***Virtual Patient Simulations:*** Immersive virtual reality, augmented reality, and mixed reality simulations can be used to create simulations of diverse medical cases and scenarios. These simulations can provide students with a realistic and interactive learning experience, allowing them to gain practical experience in a safe and controlled environment.
- ***Collaborative Learning:*** The metaverse can be used to create collaborative learning environments where students and healthcare professionals can interact with each other in a shared virtual space. This can facilitate collaboration and knowledge sharing among healthcare professionals and students from different parts of the world.
- ***Remote Learning:*** It can provide students with access to medical content and educational materials from anywhere in the world. This can enable remote learning and provide students with a more flexible and personalized learning experience.
- ***Medical Research:*** It can be used to support medical research by providing researchers with new tools for data visualization and analysis. Researchers can use virtual reality, augmented reality, and mixed reality environments to explore medical data and gain new insights into disease diagnosis and treatment.
- ***Medical Device Design and Testing:*** It can be used to design and test new medical devices in virtual environments before they are produced and used in the real world. This can reduce costs and enhance the safety and effectiveness of medical devices.

Overall, the metaverse has the potential to revolutionize medical education by providing immersive and interactive learning experiences, facilitating collaboration and knowledge sharing, and supporting medical research and innovation.

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# CHAPTER 11

# USE OF MANAGEMENT SOFTWARE IN MEDICAL EDUCATION

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In recent years, with the rapid advancement of digital and electronic technologies, a wide range of hardware and software solutions with various functions have emerged in the field of healthcare, as in many other fields. The size of health data, the diversity of variables related to health, and the complex processes and infinite possibilities arising from individual characteristics from diagnosis to treatment have made software tools that facilitate tasks during both education and service delivery an integral part of our lives as basic standards (Lupton, 2014). Particularly, the widespread availability, affordability, and acceleration of internet-based technologies have led to significant advancements in the recording, storage, processing, and presentation of information, revolutionizing not only healthcare but also all sectors, including health (Madon, 2000). These developments in digital communication and information technologies have enabled more efficient, fast, measurable, and scalable healthcare education and service delivery. Today, in healthcare education, as well as in the applications of basic sciences and clinical field practices, numerous hardware and software tools have become indispensable aids in daily life. However, these rapid advancements have also brought about concerns related to data security, protection of personal information, and legal regulations.

There are various software applications used in the healthcare field, each serving different purposes and functions. While many of these software applications are primarily used in post-graduation settings, they often contain educational modules and limited artificial intelligence algorithms. They provide meaningful support to healthcare professionals, particularly in continuous professional development. Some prominent and widely used types of software in the healthcare field can be summarized as follows:

Software applications used in the healthcare field serve various purposes and functions. Although many of these software applications are primarily used in post-graduate settings, they all incorporate education modules to some extent and contain limited levels of artificial intelligence algorithms. They provide meaningful support, particularly in the continuous professional development of healthcare professionals. Here are some prominent and widely used types of software applications in the healthcare field: electronic health records software, telemedicine software, remote patient monitoring software, primary healthcare management software, hospital management software, e-prescription software, medical diagnosis software, appointment booking software, health tracking software, clinical trial management software, mobile health software, medical imaging software, and learning management software.

In this section, we will discuss the features of learning management systems, the terminology associated with these systems, and specifically the widely used learning management systems in the world and in our country. Terminologically, these software applications can be referred to in different ways: training management system, learning management system, training management software, learning management software.

First and foremost, it is necessary to clarify the confusion between enterprise content management software (ECM) and learning management software/systems (LMS). Technically, LMS is a type of content management system, and both types of software have similar functionalities or operational logic. In fact, in recent years, due to flexible web technologies, the functionalities of these platforms have been converging. However, critical functions and details distinguish learning management systems from others (Watson & Watson, 2007). ECM comprises functions such as web content management, document management, email management, digital asset management, workflow management, business process management, backup management, classification, document lifecycle, document and user reporting, and analysis. This wide range of functionalities within ECM components and modules sometimes leads users to confuse ECM and LMS platforms. Another reason for this confusion is that many web-based technologies have become fundamental standards in information technology, independent of specific industries, particularly due to the transformation of 'Industry 4.0' (Koştı, 2020).

**What is Learning Management System (LMS)? Why Do We Need These Systems?**

LMS is the general term for software applications where educational programs, courses, lessons, and other teaching activities are created, monitored, and evaluated. All current LMS platforms are configured to operate over the network, either online (via the internet) or on local networks. Nowadays, the use of LMS platforms seems to be a necessity in all medical faculties, universities, and many other large-scale educational institutions (Turnbull et al., 2020). Due to the large number of students, the diversity of modern teaching and assessment methods, and the variety of stakeholders involved in educational activities, it appears impractical to carry out teaching and learning activities through non-electronic methods or individual efforts on separate local computers. Particularly in recent years, there is a need for LMS platforms to facilitate the standardization and accreditation of educational activities in all fields and levels, ensuring their effective monitoring and evaluation (Coates et al., 2005). Moreover, LMS platforms should be expanded and developed with

additional features and functionalities tailored to the specific needs of faculties, universities, or institutions, considering different standardization and accreditation requirements.

Another misconception about LMS is the notion that they are exclusively used for either face-to-face or distance education. Technically, LMS platforms can have functionalities for content creation, delivery, data storage, monitoring, and assessment for both face-to-face and distance education activities. This depends on the modules and functionalities configured within the specific LMS software. With the flexible and adaptable web technologies available today, standard LMS platforms can integrate modules for distance education (Gravier et al., 2006). Sometimes, the term "distance" is used to indicate that a software or system can operate or be used "online," meaning over the internet.

The term 'mobile' defines a different functionality. In terms such as 'Mobile LMS', 'mobile distance learning system', 'mobile interface support', the term 'mobile' indicates whether the software has been adapted for mobile devices (such as tablets or smartphones) (Laouris & Eteokleous, 2005). Through web technologies or coding techniques that can be adapted or adjusted to different operating systems (desktop computers, tablet or smartphone operating systems), all web-based applications that operate on standard computer screens can be organized to function optimally on mobile devices as well. Therefore, having 'mobile' support for a software or system should no longer be considered as an extraordinary feature.

**General Features of Learning Management Systems (LMS)**

The recent COVID-19 pandemic has emphasized the importance of Learning Management Systems (LMS) and their functions such as remote access, video and audio sessions, online submission and presentation of assignments and projects, and online examination and testing (Alturki & Aldraiweesh, 2021; Setiawan & Fitriyah, 2021). In this regard, the pandemic has had an impact on rapidly implementing technological advancements that could have taken a decade in the fields of education and healthcare within just a few years. The suspension of in-person education for students and the shift towards online classes and exams during the pandemic has demonstrated that such applications not only provide a solution during a crisis but also offer advantages in reducing workload in universities, mitigating the negative effects of physical limitations, and enabling more cost-effective activities. Therefore, even after the pandemic ends and in-person education resumes, efforts have been focused on maximizing the efficient use of LMS in presentations, assignments, projects, and other portfolio works that may not have been fully realized due to the large

number of students or insufficient number of educators. Under this topic, the features and functions that should ideally be present in an advanced next-generation LMS will be emphasized.

In LMS, two main user types are defined: the administrator/admin (instructor, academician, teacher) interface and the user (student, participant) interface/screen. In some LMS platforms, interfaces/screens may vary for sub-users or additional authorizations (Chung et al., 2013).

LMSs have different delivery/access models;

***1. Cloud-based:*** All LMS software code and data are stored and executed in the cloud. There is no need for software installation or downloading to use the LMS. The security of the system is ensured by the cloud computing company. In this infrastructure, the mobile interface adaptation of the LMS can be configured more flexibly. Users do not need to perform additional actions for updates; all changes made in the cloud are instantly reflected on user screens.

***2. Self-Hosted:*** The LMS software is hosted on a private server controlled by the institution. It can be accessed through a local network or by downloading software for data access. In this type of infrastructure, customization, and personalization of the LMS are easier to perform.

***3. Desktop application:*** Access to the LMS is provided through a desktop client software. In some cases, it provides a faster and more efficient working environment.

***Intuitive User Interface:*** It is important for interfaces/screens to be easily understandable as trainers and students will access all content through LMS interfaces. User-friendly interfaces are essential for efficiency and motivation (Ssekakubo et al., 2013). The levels of computer literacy among trainers and students can vary greatly. For the use of an LMS with complex interfaces and menus, it may sometimes be necessary to provide both trainers and students with 'LMS usage training' prior to usage. This implies workforce, time, and cost loss. Additionally, it is important for interfaces to work with optimal efficiency on computer screens, tablet screens, and mobile phone screens of different sizes and resolutions.

***4. Personalization:*** Personalization has gained prominence not only in recent LMSs but also in many software applications. In LMSs, the importance of personalization lies not only in changing visual elements on screens but in adapting functional features to individual users. Generally, LMSs are designed to be applicable to educational institutions, faculties, or departments. Therefore, it is important to highlight and customize different features, menus, and settings based on user types and the needs of educational units (Aplugi & Santos, 2022). Sometimes, a function that will be frequently used by a user or institution may

be placed in a background menu or tab as a default. On the other hand, transferring unused functions, menus, and tabs to the background will create simpler and more user-friendly screens. The ability to make such changes will enhance the efficiency of the LMS and increase user motivation. Furthermore, the ability to customize logos and icons on the LMS according to the institution will provide a more professional appearance.

***5. Reporting and Analysis:*** The electronic LMS's strongest feature is its robust reporting and analysis capabilities. It is crucial to systematically collect data from different users in databases and then analyze and present it according to the intended purpose. Especially in medical faculties in our country, the number of students is increasing every year. Compiling and analyzing data for such many students, performing statistical calculations quickly, are essential functions of LMSs. Given the variety of modern and innovative teaching methods and assessment techniques, analyzing, and reporting the input data and output results derived from these data according to objectives will be valuable for educational institutions in terms of future planning and enhancing educational quality.

***6. Social Learning and Interaction:*** Particularly during the functions of remote education in LMSs, it is important to have communication modules that enable users to interact with instructors and each other, express themselves, and share their ideas and knowledge. For the younger generation, such modules will enhance socialization and communication while learning, thereby motivating students. Of course, all these activities should take place under the supervision and monitoring of supervising instructors. Forum or blog modules can be integrated into LMSs to facilitate these types of interactions.

***7. Online Exams and Tests:*** These functions are essential components that must be present in LMSs. Exam and test modules are actively used during both face-to-face and remote education activities. Configuring the exam and test modules to support not only multiple-choice questions but also other assessment formats will enable instructors to administer exams more easily and frequently. However, two critical points should be considered regarding these modules. First, although the modules may be well-configured, it is crucial to generate and add content to the exam and test modules. In other words, instructors should add as many curriculum-aligned and rule-compliant question items as possible to the database. This responsibility primarily falls on the instructors. The second point is the issue of security. The server hosting the exams and questions should have physical and network security measures in place to prevent unauthorized access (Chatterjee et al., 2023). Reliable and established cloud service providers will take on a significant portion of the security burden for hosted LMSs.

Organizations should pay special attention to data security protocols in LMSs developed in-house or obtained as a service, conducting detailed research and implementing appropriate measures. This involves not only the security of exams and questions but also the security of users' personal data and valuable educational materials generated by the institution.

***8. Support for Different Formats of Educational Materials and Documents:*** LMSs should support widely accepted document formats. In addition to PDF, Word, and Excel, it is particularly important to support various video formats, PowerPoint, and SCORM (Sharable Content Object Reference Model) formats to facilitate ease of use and flexibility in learning.

***9. Integration with Different Tools:*** One of the reasons LMSs are referred to as "systems" is their ability to integrate with other widely used software developed by different developers. For instance, integration with third-party email clients, calendar applications, video conferencing software, and services is necessary (Leal & Queirós, 2012). This way, there is no need for an institution to use separate software, such as Zoom or Google Meet, for video conferencing services outside of their LMS.

***10. Feedback:*** LMSs should have modules that allow for collecting feedback from both instructors and students, as well as enabling the creation of data collection forms and configuring surveys. This way, feedback can be obtained from students regarding the usability of the system, the physical conditions of the educational unit, instructors, and other components, for example.

**LMS Examples**

***1. ATutor:*** ATutor is an open-source LMS. At the time this text was prepared, its latest version was released as v2.2.4. Being open source, it has a rich documentation available. It offers various modules such as social networking, surveys, forums, blogs, and flexible messaging. It features adaptive navigation, providing user-friendly interfaces. In addition to supporting various formats, it also provides SCORM support. It particularly offers many conveniences for software developers.

***2. Opigno:*** Opigno is an open-source LMS distributed by Drupal. It offers a comprehensive and dynamic reporting interface. As Opigno LMS is built on Drupal's API-first infrastructure, it provides a strong foundation for integration and flexible modularity. It is robust in terms of scalability.

***3. Moodle:*** Moodle is an open-source LMS that is widely used worldwide and constantly supported and developed by a large community of developers. It utilizes MySQL and PostgreSQL database systems and can run on any platform with PHP support. It encompasses almost all the modules that are considered

ideal for an LMS. Due to its widespread use in many countries, it has extensive language support.

***4. Claroline:*** Claroline is an LMS released under an open-source license. It is a platform developed based on pedagogical principles. It is supported by universities in different countries.

***5. Sakai:*** Sakai is an open-source LMS supported by the Apereo Foundation and numerous organizations. It is particularly preferred by academic and non-profit institutions. It has a strong technical infrastructure and a large developer community. Sakai offers a highly flexible modular system in terms of personalization and customization.

***6. DotLRN:*** DotLRN has a development history that extends to MIT (Massachusetts Institute of Technology). It uses PostgreSQL and Oracle as its database systems. It is believed to perform fast and efficiently, especially on Linux-based operating systems.

***7. Open edX:*** Open edX is an open-source platform supported by universities such as Harvard and MIT, as well as Google. It features XBlock technology, which allows for easy content creation and management. It has a user-friendly interface and menu system. With its scalable and customizable structure, it is preferred by both large and medium-sized institutions.

***8. ILIAS:*** ILIAS is an application that was initially developed as part of the VIRTUS project in Germany and later continued as an open-source project. It is SCORM compliant, allowing for interoperability with other systems. Additionally, ILIAS is supported by SUN Microsystems.

***9. Blackboard:*** Blackboard is an LMS platform that originated from an American educational technology company. It is now being developed and marketed under the Anthology company. It features a highly flexible, modular, and autonomous infrastructure. Blackboard also provides top-level professional technical support as part of its post-sales services.

Apart from the well-known and widely used LMS platforms, there are also LMSs developed or adapted by the in-house software teams of large institutions or based on open-source platforms to meet the specific needs of the institution. Particularly in medical faculties, the curriculum system, internship system, committee system, and clinical skills modules follow a different educational and instructional process compared to other faculties. Additionally, medical faculties undergo rigorous standardization and accreditation processes. Therefore, it is commonly recommended for medical faculties to use LMSs that are specifically developed for them or adapted from open-source platforms, created by software teams within the Medical Education Department, distinct from other faculties and departments within the university (Thepwongsa et al.,

2021). This allows the software team within the institution to revise, enhance, and develop their own LMS over time based on the needs of the faculty, recommendations from instructors, and feedback from students. They can strengthen it with additional modules and integrations.

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