3D Digital VET

Erasmus+

Curriculum: 3D medical digital models in health professionals teaching.

1. CURRENT ISSUES OF TRAINING HEALTHCARE PROFESSIONALS

The intensive development of society, as well as the digitalization of scientific and educational spaces, requires from the system of higher and secondary medical education to build the professional competitiveness of future professionals in modern circumstances (Ermalovich, 2017).

It assumes that the assimilation of theoretical knowledge is equally important as the development of abilities to utilize acquired knowledge in practice, the high level of general intellectual development, initiative, creativity, and mobility. Pedagogically correctly organized and methodically planned fundamental training of students in medical schools becomes a premise of ensuring their purposeful orientation to the future professional activity, given the impetuous development of medicine.

Therefore, the system of medical education in modern society poses to itself at least three global tasks (Denisov, 2004):

1. Training of the professionally and socially mobile, highly motivated specialist;
2. Providing graduates with the required amount of theoretical knowledge, practical skills, and abilities that are necessary for the initial stage of the professional activity.
3. The formation of skills to work with sources of information and skills to organize and carry out independent professional activity.

Talking about the main characteristics of contemporary medical education, we should highlight the following:

- ☐ The integrative interdisciplinary organization of the content of medical education;
- ☐ The focus on building the culture of systemic clinical thinking in prospective graduates;
- ☐ The innovative nature of educational institution;
- ☐ The re-orientation of the educational process from the tasks of transmitting the knowledge and experience to the tasks of teaching students the skills of the independent autonomous acquisition and transformation of knowledge.
- ☐ Autonomous educational resources that do not require the teacher's participation (distance learning, a multimedia course for self-training, electronic copies of handbooks, Internet resources, etc.).

2. METHODOLOGY FOR DEVELOPING THE TRAINING CURRICULUM

Based on the European Qualification framework (EQF) and European credit system for vocational education and training (ECVET), the following steps have been defined to provide the necessary knowledge, guidelines and checklists for developing the 3D Digital VET Training Curriculum.

Set the objectives

The aim of the 3D Digital VET is to:

- ☐ to strengthen EU health professionals training and education by developing a powerful Open Educational Resource in the form of an online library (Al3xandria) that collects medical images produced by the hospitals.
- ☐ to support the initial and continuous professional development of teachers, trainers, and mentors through development of a specific training course focused on using Al3xandria and the 3D medical models (3DMM) in health professionals teaching
- ☐ support adults, students, health professionals and other learners to use the digital technologies, like 3D printing and virtual reality, in creative, collaborative, and efficient ways
- ☐ to support students, health professionals and other learners to use the digital technologies, like 3D printing and virtual reality, in creative, collaborative and efficient ways by providing them access to both 3DMM and training resources that allows them to gain the required skills and knowledge.

The curricula will be released as Open Educational Resource (OER).

Identify professional needs

Providing graduates with the required amount of theoretical knowledge, practical skills, and abilities that are necessary for the initial stage of the professional activity is essential. As 70-80% of clinical decisions are based on diagnostic tests it is crucial that they are accurate. Information and communication technologies (ICT) are present in contemporary society and reflected in the field of education. Such technologies have aided in the learning process by providing tools that lead to the effective participation of students.

The 3D Digital VET project addresses the following target groups:

- ☐ VET teachers, trainers and mentors and VET learning providing organizations
- ☐ adult students/learners
- ☐ health professionals, students, and scientists.

A wide variety of technologies and tools are involved in the diagnostic process. Health IT covers a broad range of technologies used in health care, including electronic health records (EHRs), clinical decision support, patient engagement tools, computerized provider order entry, laboratory and medical imaging information systems, health information exchanges, and medical devices.

Studies have found that current health IT tools are not effectively facilitating the diagnostic process and may be contributing to diagnostic errors (Kuhn et al. 2015; Ober 2015). Key competence areas regarding digitalization from a healthcare perspective identified encompass knowledge of digital technology and the digital skills required to provide good patient care, including associated social and communication skills, and ethical considerations of digitalization in patient care.

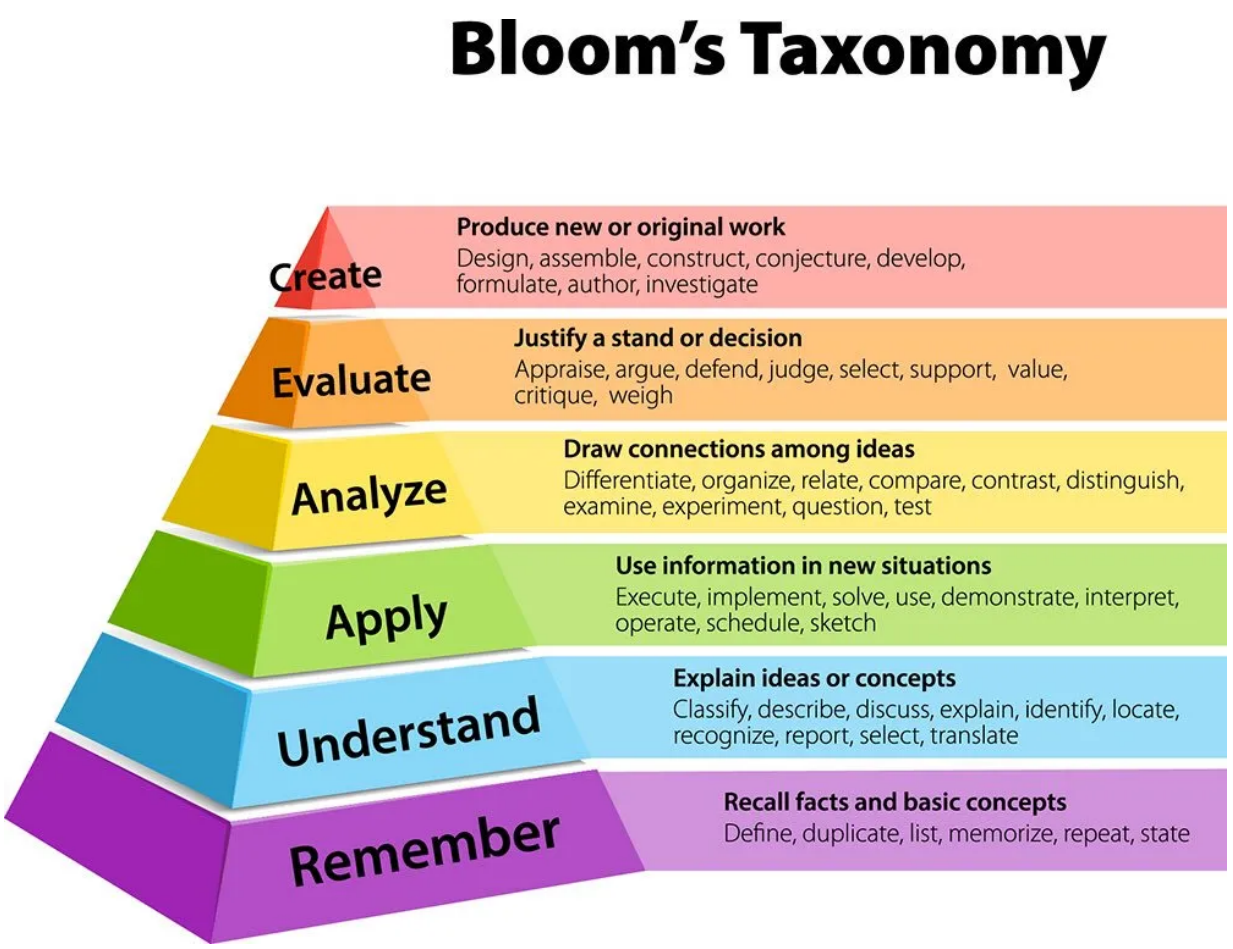
The diagnostic error can be defined as "diagnosis that was unintentionally delayed (sufficient information was available earlier), wrong (wrong diagnosis made before the correct one), or missed (no diagnosis ever made), as judged from the eventual appreciation of more definitive information" (Graber et al. 2005). Clinical audit and communication strategies have been cited in the literature as a means to evaluate healthcare clinical performance, reduce diagnostic errors and improve the quality of patient care (Kuhn et a. 2015).

Establish learning outcomes

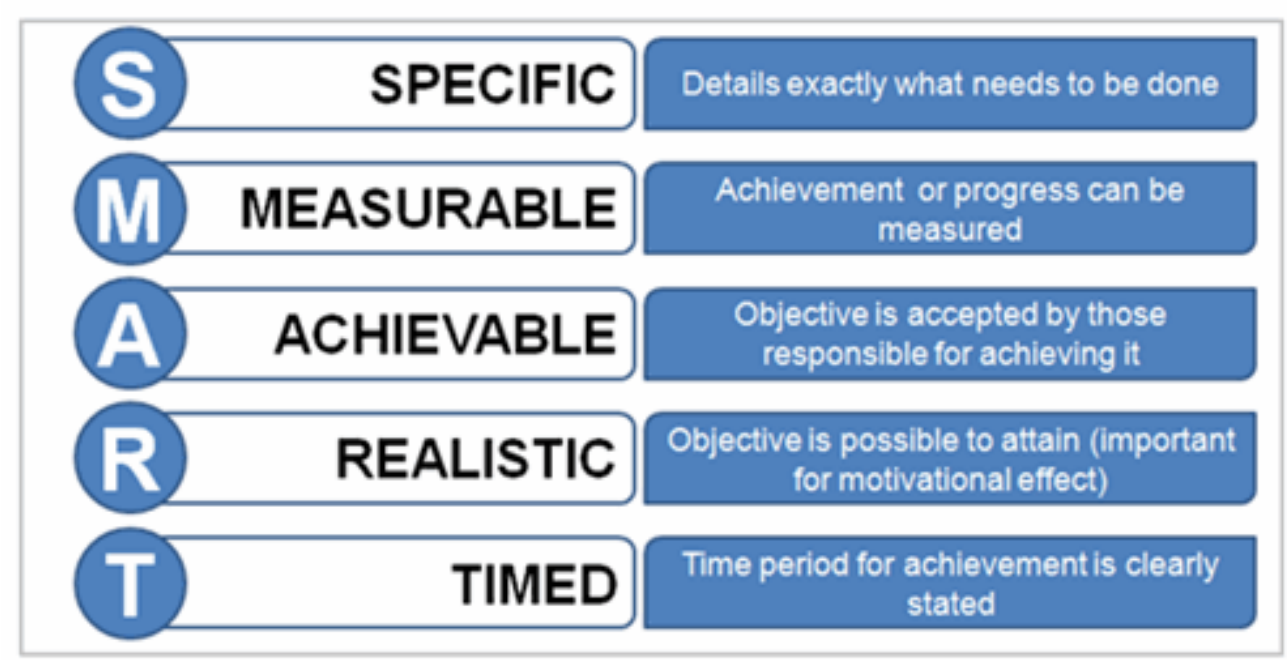
All European courses has now clear learning goals in compliance with the European Qualification system (EQF). Each goal can be broken down into specific learning objectives, which are concise statements about what learners will be able to do when they complete the training. To achieve the objectives, learners will be trained in different areas, thus acquiring a set of competences.

Well-defined and articulated learning objectives are important because they provide students with a clear purpose to focus their learning efforts, direct the choice of instructional activities and guide the evaluation / assessment strategies. Therefore, it is very important to establish clear and adjusted learning objectives for the students and the teaching learning activities.

To create these objectives, we take into consideration two different theories/frameworks: Bloom's taxonomy of educational objectives but evolved and improved with the latest research. This develops in the KSA framework: knowledge (to know), skills (to know how) and attitudes (to be). In the EQF they call the last one "responsibility and autonomy".



The SMART approach to objectives: Specific, Measurable, Attainable, Relevant, and Time-bound.



Formulating learning outcomes requires expertise and experience.

Generic guidelines in 3D Digital VET Training Curriculum include:

- ☐ LOs are concise statements, devised independent of delivery and setting, worded in clear, unambiguous language.
- ☐ LOs are written in the future tense and commence with an active verb which most precisely describes the actual or preferred outcome, and results in overt behaviour that can be measured. In general, only one verb is used to structure each outcome, verbs are appropriate both to the level and the strand.
- ☐ LOs clearly reflect the level of the award.
- ☐ LOs are observable and measurable. Learners must know what is expected of them.
- ☐ LOs enable and encourage a range of assessment methodologies to be applied.

Learning fields:

- ☐ How to access Al3xandria 3D medical library and download 3D models
- ☐ Using Digital Learning Objects (DLO's) for health professionals training
- ☐ Using DLO's for training, planning and optimization of medical procedures
- ☐ Using DLO's for training in the diagnostic process
- ☐ 3D printing of DLO's
- ☐ Using DLO's in conjunction with Virtual Reality

Set learning activities

Benjamin Bloom highlighted three domains of educational activity:

- ☐ Cognitive – mental skills (knowledge);
- ☐ Affective (emotional) – emotional reactions (spiritual and sensual growth);
- ☐ Psychomotor – motor (physical) skills (mastery).

The **cognitive domain** includes the sum of knowledge and the development of intellectual abilities (Bloom et al., 1956). For example, remembering and position of certain facts, procedure models or concepts that serve the development of intelligence. According to B. Bloom's and his colleagues', there are six basic categories of the cognitive process (we put them here in accordance with the specifics of medical education):

* **Knowledge (knowing)**. Memorization and reproduction of previously learned information (facts, concepts, etc.).
  - ☐ Examples: to remember and to reproduce (to name) symptoms of the certain disease or indications (prescriptions) for surgical intervention; to cite the protocol of providing first medical aid.
  - ☐ Keywords: to define, to describe, to identify, to know, to list symptoms/signs, to find a conjunction/connection, to make a scheme.
  - ☐ Tools: flash cards, underlining and highlighting in books, reading, repeating.

* **Comprehension (understanding).** Understanding (comprehension) of the meaning of a model or a concept; translation; interpretation of instruction, a protocol or a problem.

- ☐ Examples: to rewrite principles in student's own words, to explain the essence of particular surgery in his/her own words to a patient, to give a prescription.
- ☐ Keywords: to transform, to explain, to communicate, to find an example, to assume, to conclude, to translate, to extend, to comprehend, to narrate.
- ☐ Tools: making analogies and metaphors, participating in group training, making notes, storytelling,Internet browsing.

* **Utilization.** The application of obtained theoretical knowledge on practice. The utilization of the studied concept in a new or unusual situation.
  - ☐ Examples: to get informed consent and to prepare a patient to a surgery; to apply mathematical methods and statistical tables to assess the rating of survival.
  - ☐ Keywords: to apply, to use, to change, to calculate, to construct, to demonstrate, to reveal, to manipulate, to prepare, to produce.
  - ☐ Tools: co-education, creation of the new algorithm, blogging, situational tasks.
* **Analysis**. The separation of material or a concept on components, understanding the difference between them.
  - ☐ Examples: to reveal logical mistakes in the colleague's discourse; to reveal merits and limitations in various techniques of rehabilitation.
  - ☐ Keywords: to analyze, to differentiate, to compare, to select, to correlate, to associate.
  - ☐ Tools: creating a diagram,making a table, group discussion.
* **Synthesis.** Learning to make a conclusion about the significance of an idea or material.
  - ☐ Examples: to select the most effective way of treatment of the certain disease; to hire the most appropriate candidate.
  - ☐ Keywords: to assess, to estimate, to compare, to defend, to describe, to interpret, to sum up.
  - ☐ Tools: interview, creating and applying a check-list.
* **Creation**. To pick up a few unconnected parts and to create something new.
  - ☐ Examples: to write an instruction, an algorithm or a protocol.
  - ☐ Keywords: to connect, to compile, to modify, to rewrite, to reconstruct, to conclude, to organize.
  - ☐ Tools: writing an essay, creating a new model, concluding based on facts.
* **Perception**. Awareness, readiness to listen, selective attention.
  - ☐ Examples: to listen to patients with respect.
  - ☐ Keywords: to admit, to listen to, to understand, attention, politeness.
* **Reacting.** The student's active participation, his/her reaction on the certain phenomenon, readiness to answer (to respond) and to demonstrate motivation.
  - ☐ Examples: to participate in group discussion: to create a presentation and to speak in front of the public.
  - ☐ Keywords: to answer, to help, to perform, to greet, to help, to tell, to speak.
* **Assimilation of values.** The value (significance) that an individual associates with the certain phenomenon, object, person, or event. It may vary from just accepting to the more complicated conditions (states).
  - ☐ Examples: to demonstrate sensitivity to individual and cultural differences in colleagues and in patients.

- ☐ Keywords: to value, to care, to demonstrate, to initiate, to invite, to join, to respect, to share.

* **Organization of values.** A student organizes his/her values into priorities, comparing different values and resolving conflicts between them and creating his/her own system of values. The main accent is made on the comparison, juxtaposition, and synthesis of values.

- ☐ Examples: a student forms his/her own opinion about the balance between freedom and responsibility; he/she accepts norms of professional ethics.
- ☐ Keywords: to link, to compare, to synthesize.

* **Internalization of values**. A student accepts the system of values that controls his/her behaviour. This behaviour is ubiquitous, sequential, and predicted.

- ☐ Examples: a student uses the objective approach when solving a problem; he/she demonstrates professional compliance with ethical practice in the course of everyday life; he/she revises previously made conclusions and changes his/her behavior in the light of new evidence; he/she is able to value people the way they are.
- ☐ Keywords: to act, to differentiate, to modify, to perform, to ask questions, to revise, to decide, to verify, to check.

The classification of the **most popular interactive educational (training)** methods may be as following (Artjukhina & Chumakov, 2012):

1. Creative tasks.
2. Work in small groups.
3. Educational (training) games: roleplaying, business, educational.
4. Utilization of public (social) resources: invitation of a specialist working in the field; guiding tours to hospitals / clinics.
5. Social projects: competitions in professional mastery; exhibitions, shows, performances.
6. Warm-ups, doing exercises.
7. Study and consolidate new theoretical material (new information): interactive lecture; student in the role of a teacher; work with graphics models (visual aids); everyone teaches everyone; use and analysis of video- and audio recordings; practical tasks, case method; analysis of situations from the practice of the participant (student, mentor).
8. Work with documents: drafting of documents;
9. Discussion of complex and debatable professional issues.
10. Testing, exam following with the analysis of the results.

Education through simulation is a type of training when a student undertake professional actions in the situation that replicates professional reality. Imitation education helps to improve the quality of education because a professional skill might be replicated many times in a safe situation. Special equipment, tools, simulators, surrogates, and techniques are used. The utilization of such high-tech educational (training) tools allow forming professional competencies and developing clinical thinking. It provides all the students with possibilities to master (learn) various aspects of future professional activity.

The *3D Digital VET* curriculum is based on interactive training methods, such as presentations of case studies, best practices, educational films and exercises to practice the skills to be learned.

Training Curriculum consists of a total of 6 learning units or modules. This curriculum allocates 36 hours of total learning distributed over the six main learning outcome units, corresponding to a total of 1 ECVET point (1 credit = 25 hours). These hours comprise contact hours/theoretical hours, face-to-face sessions/practical sessions, individual study and assignments/assessments.The distribution of the hours can be revised according to the national needs, cultural specificities and teachers / trainers / training providers practices.

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Set assessment of learning

Assessment and evaluation are crucial steps in educational process. Before making a choice of assessment method, some important questions must be asked: what should be assessed?, why assess?

A wide range of assessment methods currently available include essay questions, patient management problems, modified essay questions (MEQs) checklists, OSCE, student projects, Constructed Response Questions (CRQs), MCQs, Critical reading papers, rating scales, extended matching items, tutor reports, portfolios, short case assessment and long case assessment, log book, trainer's report, audit, simulated patient surgeries, video assessment, simulators, self assessment, peer assessment and standardized patients.

The purpose of assessment should direct the choice of instruments. Needs assessment is the starting point of good assessment that identifies the current status of the students before the commencement of the actual educational activities. Needs assessment is used to determine the existing knowledge base, future needs, and priority areas that should be addressed.

Good quality assessment not only satisfies the needs of accreditation but also contributes to student's learning. Assessment methods should match the competencies being learnt and the teaching formats being used.

3. 3D DIGITAL VET TRAINING CURRICULUM

Number and name of the module:

Module 1: How to access Al3xandria 3D medical library and download 3D models

Overall objective, methods and resources of this module:

Objective:

- To get familiar with the library
- To understand its main objective
- To know how to access and how to use its content
- To be able to present the library to the medical sector

Methods:

- Presentation
- Videos
- Online course
- Face to face training

Resources/materials:

- Computer and internet access

Content:

SECTION 1:

- How to access to the library

SECTION 2:

- What we can find inside the library

SECTION 3:

- How we can find content and how to find pathologies and characteristics of the parts

SECTION 4:

- How to download the content

Learning outcomes:

By the end of the module, participants will be able to:

- To know the library
- Know how to use it in the medical field.
- Know the resources and how to use them

Hours of total learning for the module:

- Online =3 hours 36 minutes
- Face to face = 2 hours

The unit will be delivered through :

The unit will be assessed through

References

Number and name of the module:

Module 2: Using Digital Learning Objects (DLO's) for health professional

Overall objective, methods and resources of this module:

Objective:
The objective of this module is to offer the information needed for the undestanding and efficient use of digital learning objects in health professionals' education.

Methods:
Lectures, presentations, self-study, discussions based on case studies, group discussion, educational film, self-assessment

Resources/materials:
Multimedia, paper, flipchart, markers
Computer (Wi-Fi network)
Access to scientific data bases (PubMed, EBSCO, etc.), online platforms/ applications

Content:

SECTION 1 INTRODUCTION

SECTION 2 DIGITAL LEARNING OBJECTS.

- definition,
- types,
- utilization

SECTION 3 WEB-BASED LEARNING AND DLO'S IN MEDICAL EDUCATION

- the past,
- the present
- the future

SECTION 4 THE IMPACT OF USING DLO'S IN MEDICAL EDUCATION.

- barriers
- solutions

SECTION 5 APPLICATIONS

- examples of using DLO's for health professionals training

Learning outcomes:

By the end of the module, participants will be able to:

- Get to know the basic principles and main characteristics of Digital Learning Objects - definition, types, utilization;

- Understand the advantages of Web-based learning and DLO's in medical education (the past, the present and the future)
- Understand the impact of using DLO's in medical education- barriers and solutions;
- Identify different applications-exemples of using DLO's for health professionals training;

Hours of total learning for the module:

Online = 3 hours 36 minutes
Face to face = 2 hours

The unit will be delivered through :

☒ presentation
☒ online course
☒ additional materials

The unit will be assessed through

☒ ongoing assessment
☒ quizzes.

References

1. Carnwell, R. and Daly, W.M. (2003), Advanced nursing practitioners in primary care settings: an exploration of the developing roles. Journal of Clinical Nursing, 12: 630-642.
2. Fagerström L. Developing the scope of practice and education for advanced practice nurses in Finland. Int Nurs Rev. 2009 Jun;56(2):269-72.
3. Carrillo de Gea, Juan Manuel & Fernández-Alemán, José & Sánchez García, Ana. (2012). Computer-based nursing education: An integrative review of empirical studies. Journal of Nursing Education and Practice. 2.
4. Bloice MD, Simonic KM, Holzinger A. On the usage of health records for the design of Virtual Patients: a systematic review. *BMC Med Inform Decis Mak*. 2013;13:103. Published 2013 Sep 8.
5. Wiley, David A. *The instructional use of learning objects*. Vol. 1. Bloomington: Agency for instructional technology, 2002.
6. Verbert, Katrien & duval, erik. (2022). Towards a global component architecture for learning objects: A comparative analysis of learning object content models. Follow up of L'Allier, 1997 – Introduction into learning objects
7. Gibbons, Andrew. (2003). What and How Do Designers Design: A Theory of Design Structure. TechTrends. 47.
8. McGreal, Rory & Elliott, Michael. (2004). *Technologies of online learning (e-learning).*

Number and name of the module:

Module 3: Using Digital Learning Objects (DLO's) for training, planning and optimization of medical procedures.

Overall objective, methods and resources of this module:

Objective: This module is designed to teach participants how to use 3D models for training, planning, and optimizing medical procedures using Digital Learning Objects (DLOs).

Methods:
Lecture, presentations, flipchart, self-study, case studies, video.

Resources/materials:
Computer, Software: Powerpoint and VLC-Player
Projector, Smartphone/Tablet, Internet

Content:

SECTION 1 INTRODUCTION

- Explanation of DLO's
- Explanation of the aim of the module and learning objectives

SECTION 2 INTRODUCTION TO DLO's FOR MEDICAL TRAINING, PLANNING, AND OPTIMIZATION

SECTION 3 THE AO CLASSIFICATION OF LONG BONE FRACTURES

- First position of the AO classification code: Description of the body region where the fracture is located.
- Second position of the AO classification code: Specific fracture location within the body region
- Third position of the AO classification code: Evaluation of the fracture
- Fourth and fifth position of the AO classification code

Learning outcomes:

KEY TECHNICAL OUTCOME	KNOWLEDGE	SKILLS	COMPETENCE
Retrieve information and data regarding the use of DLO´s in medicine	The Learner knows and understands: ● Types of DLO`s in medicine ● Principles of DLO use ● The role of DLO in training, planning and optimization of medical procedures	The Learner is able to: ● Gather information on DLO´s in medicine	The Learner: ● Is aware of the power of DLO`s in medicine ● When needed, is able to find and visualize information on DLO ● Uses this learning for more informed reading of articles regarding DLO`s in medicine

Understanding the AO classification of fractures of tubular/long bones	The Learner knows and understands: ● The AO ● Localize bones and segments ● Elements of fracture morphology (types, groups, qualifications) ● The Alphanumeric structure of the AO/OTA classification	The Learner is able to: ● Identify fractures in x-ray images ● Perform fracture classifications	The Learner: ● Pays attention to AO fracture classification in reports
Detecting peculiarities in 2D and 3D (AO) classification of fractures of long tubular bones.	The Learner knows and understands: ● Advantages and disadvantages of fracture evaluation in 2D and 3D images	The Learner is able to: ● Match 3D fractures with 2D image fracture classifications	The Learner: ● Considers carefully that pecularities of fractures may be missed in 2D images
Using 3D models (printed) from CT data in surgery planning and training	The Learner knows and understands: ● OR planning its benefits ● How to print a 3D model from medical image data ● The use of 3D models in surgery training ● The easier imagination and planning power of 3D models ● The use of 3D models for medical education, esp. in application of osteosynthesis	The Learner is able to: ● Realize the pros and cons of an OR planning ● To create a 3D model from medical image data ● Visualize fracture and fragments ● Assign fragments of a 3D model to a 2D image (x-ray)	The Learner: ● Uses 3D models for teaching and planning ● Benefits from visualization
Intraoperative imaging as a tool for optimisation and quality assurance	The Learner knows and understands: ● The use of (3D) images for quality assurance ● The step-by-step approach to the management of proximal tibia fractures ● that 3D images are not necessary for the diagnosis of all fracture types. ● methods for intraoperative quality assurance in orthopaedics	The Learner is able to: ● improve quality in healthcare ● avoid unnecessary post-operative checks ● carry out intraoperative checks	The Learner: ● Identifies and addresses the differences in imaging modalities and use of DLO`s ● Considers carefully the DLO and imaging related options for OR quality assurance

Hours of total learning for the module:

Online = 3 hours 36 minutes
Face to face = 2 hours

The unit will be delivered through :

☒ lectures
☒ presentations
☒ flipcharts
☒ independent study
☒ case studies
☒ videos

The unit will be assessed through

☒ ongoing assessment
☒ quizzes.

References

Meinberg EG, Agel J, Roberts CS, Karam MD, Kellam JF. Fracture and Dislocation Classification Compendium-2018. J Orthop Trauma. 2018 Jan;32 Suppl 1:S1-S170. doi: 10.1097/BOT.0000000000001063. PMID: 29256945.
(download here: https://aotrauma.aofoundation.org/about/news/news-2018/news_classification_compendium_12072018)

Prat-Fabregat S, Camacho-Carrasco P. Treatment strategy for tibial plateau fractures: an update. EFORT Open Rev. 2017 Mar 13;1(5):225-232. doi: 10.1302/2058-5241.1.000031. PMID: 28461952; PMCID: PMC5367528.

Mair O, Pflüger P, Hoffeld K, Braun KF, Kirchhoff C, Biberthaler P, Crönlein M. Management of Pilon Fractures-Current Concepts. Front Surg. 2021 Dec 23;8:764232. doi: 10.3389/fsurg.2021.764232. PMID: 35004835; PMCID: PMC8732374.

Kerschbaum M, Tyczka M, Klute L, Heller MT, Koch M, Popp D, Lang S, Alt V, Worlicek M. The Tibial Plateau Map: Fracture Line Morphology of Intra-Articular Proximal Tibial Fractures. Biomed Res Int. 2021 Aug 24;2021:9920189. doi: 10.1155/2021/9920189. PMID: 34476260; PMCID: PMC8408007.

Gülabi D, Bekler Hİ, Sağlam F, Taşdemir Z, Çeçen GS, Elmalı N. Surgical treatment of distal tibia fractures: open versus MIPO. Ulus Travma Acil Cerrahi Derg. 2016 Jan;22(1):52-7. doi: 10.5505/tjtes.2015.82026. PMID: 27135079.
3D-Model platforms
Medical platforms: embodi3d.com, 3dprint.nih.gov
General platforms: thingiverse.com, grabcad.com/library, sketchfab.com
Meta-search engines: thangs.com, yeggi.com

Number and name of the module:

Module 4: Using Digital Learning Objects (DLO's) for training in the diagnostic process.

Overall objective, methods and resources of this module:

Objective:
The general goal of the module is to provide basic material for understanding of digital learning objects and how it can be used in medical diagnostic process, especially to study and visualize Digital Learning Objects (DLOs) from Al3xandria online library.

Methods:

- Self-reading, self-study, idea presentations, educational film, videos, self-assessment, discussion and group discussion.

Resources/materials:

- Computer or laptop, Internet connection (LAN or Wi-Fi network)
- Monitor, video-projector, Multimedia, paper, flipchart, markers
- Access to scientific databases (PubMed, EBSCO, etc.),
- online platforms / applications necessary links
- Access to 3DdigitalVet e-Learning Platform
- Access to Al3xandria library

Content:

SECTION 1 INTRODUCTION

- module content,
- learning outcomes
- structure

SECTION 2 DIAGNOSTIC PROCESS, DECISION MAKING

SECTION 3 CLASSIFICATION

SECTION 4 SIMULATION-BASED TRAINING

SECTION 5 FUTURE: DEEP LEARNING MODELS COUPLED WITH IMAGE PROCESSING

SECTION 6 CHALLENGES

SECTION 7 HOME READING FOR STUDENTS

SECTION 8 2D (X-RAY) AND 3D USING AL3XANDRIA 3D MEDICAL LIBRARY

SECTION 9 TERMINOLOGY

SECTION 10 RECOMMENDED ADDITIONAL MATERIAL

Learning outcomes:

By the end of the module, participants will be able to:

- give an overview about activities and materials available
- explain the independent course-work tasks and evaluation criteria.
- describe the situation in the field of DLO-s in the field of digital health services
- give an overview of global initiatives and directions
- analyze the diagnostic processes and decision making challenges in the era of digital medicine
- present their positive and negative experiences E of using DLO-s during the studies
- presenti ideas and solutions how to increase digital skills and competences in medical decision making in high-school curriculums
- list the challenges of simulation-based training and learning
- list the strengths of simulation-based training and learning
- know the key areas where AI can deliver impact

Hours of total learning for the module:

Online = 3 hours 36 minutes
Face to face = 2 hours

The unit will be delivered through :

☒ presentation
☒ online course
☒ additional materials
☒ self-reading
☒ idea presentations
☒ educational films and videos
☒ group-discussions

The unit will be assessed through

☒ ongoing assessment
☒ quizzes.
☒ self-assessment

References

Ahlberg, G., Enochsson, L., Gallagher, A. G., Hedman, L., Hogman, C., McClusky, D. A., Ramel, S., Smith, D., Arvidsson, D. (2007). Proficiency-based virtual reality training significantly reduces the error rate for residents during their first 10 laparoscopic cholecystectomies. American Journal of Surgery, 193(6), 797–804. https://doi.org/10.1016/j.amjsurg.2006.06.050

AHSN Network AI Report (2018): https://wessexahsn.org.uk/img/news/AHSN%20Network%20AI%20Report-1536078823.pdf

Biese, K., Moro-Sutherland, D., Furberg, R., Downing, B., Glickman, L., Murphy, A., Jackson, C., Snyder, G., Hobgood, C. (2009). Using screen-based simulation to improve performance during pediatric resuscitation. Academic Emergency Medicine, 16(2), 71–75. https://doi.org/10.1111/j.1553-2712.2009.00590.x

Cook, D. A. (2014). How much evidence does it take? A cumulative meta-analysis of outcomes of simulation-based education. Medical Education, 48(8), 750–760. https://doi.org/10.1111/medu.12473

Cook, D. A., Brydges, R., Zendejas, B., Hamstra, S. J., Hatala, R. (2013). Technology-enhanced simulation to assess health professionals: A systematic review of validity evidence, research methods, and reporting quality. Academic Medicine, 88(6), 872–883. https://doi.org/10.1097/ACM.0b013e31828ffdcf

Council of European Union. Regulation (EU) 2017/745 of the European Parliament and of the Council of 5 April 2017 on medical devices. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32017R0745

Cruz, I. Moodle and nursing teaching: a brief experience report. Online Braz J Nurs. 2009;8(1) Davidsson, P., Verhagen, H. (2017). Types of simulation. In Edmonds, B., Meyer, R. (Eds.), Simulating social complexity. Understanding complex systems (pp. 23–37). Springer. https://doi.org/10.1007/978-3-319-66948-9_3

Dinggang, S., Guorong, W., Heung-Il S. (2017) Learning in Medical Image Analysis (free article for home-reading). Annu Rev Biomed Eng 19:221-248. doi: 10.1146/annurev-bioeng-071516-044442
https://pubmed.ncbi.nlm.nih.gov/28301734/
Google Scholar: link

Graber ML, Franklin N, Gordon R. Diagnostic error in internal medicine. Arch Intern Med. 2005;165(13):1493-9

Hegland, P. A., Aarlie, H., Strømme, H., Jamtvedt, G. (2017). Simulation-based training for nurses: Systematic review and meta-analysis. Nurse Education Today, 54(1), 6–20. **(Suggested reading about curriculum development)** https://doi.org/10.1016/j.nedt.2017.04.004

Kuhn, T., P. Basch, M. Barr, and T. Yackel. 2015. Clinical documentation in the 21st century: Executive summary of a policy position paper from the American College of Physicians. Annals of Internal Medicine 162(4):301–303
Ober, K. P. 2015. The electronic health record: Are we the tools of our tools? The Pharos 78(1):8–14

Springer „3D Virtual Treatment Planning of Orthognathic Surgery“ , 2017 https://link.springer.com/book/10.1007/978-3-662-47389-4

Tamashiro LMC, Peres HHC. Desenvolvimento e avaliação de objetos de aprendizagem sobre administração de medicamentos por via intramuscular. Rev Latino-Am Enfermagem. 2014; 22(5):716-23.

Thomas S. Kuhn: The Structure of Scientific Revolutions. The University of Chicago press. 1996

Liaw, S., Chan, S., Chen, F. G., Hooi, S., Siau, C. (2014). Comparison of virtual patient simulation with mannequin-based simulation for improving clinical performances in assessing and managing clinical deterioration: Randomized controlled trial. Journal of Medical Internet Research, 16(9), Article e214. https://doi.org/10.2196/jmir.3322
Oxford Reference: link

Sawaya, R.D., Mrad, S., Rajha, E. et al. Simulation-based curriculum development: lessons learnt in Global Health education. BMC Med Educ 21, 33 (2021). https://doi.org/10.1186/s12909-020-02430-9
Suggested reading about curriculum development
WHO Focus Group on Artificial Intelligence for Health: https://www.itu.int/en/ITU-T/focusgroups/ai4h/Pages/default.aspx

Video “Using 3D models in virtual surgical planning in dentistry”: https://youtu.be/KgUfUkDIQoE
Video by Pratik Shah https://youtu.be/mhEYvrFOP88
Video lecture 1 https://youtu.be/xSyot-U0hrM
Video lecture 2: https://youtu.be/6O71XBqZ-wc
Video lecture 3: https://youtu.be/ryUCJHk2ckU
Video lecture 4: https://youtu.be/6pQbJKo1WsY

Number and name of the module:

Module 5: 3D printing of Digital Learning Objects (DLO)

Overall objective, methods and resources of this module:

Objective:
The general goal of this module is to provide basic understanding of the principles underlying the 3D printing processes with the aim of choosing the most appropriate combination of production material(s) and kind of 3D printer.

Methods:

- Reading documents
- Watching videos and tutorial
- Practice with own 3D printers (if available)
- Practice with own software (if available)
- In case of face-to-face teaching, discussions with teacher(s) and other colleagues

Resources/materials:

- Computer with internet access
- Free reading software (Adobe Acrobat Reader)
- Free design software (es.g. 3D Slicer). A basic knowledge should be acquired before the course in order to explain to students the concepts.
- Free slicing software (depending on 3D printer; we'll explore PreForm). A basic knowledge should be acquired before the course in order to explain to students the concepts.
- Understanding of standard DICOM fomat
- Understanding the concept of set of planar imaging (CTs, MRIs, ECO3D)

Content:

SECTION 1 INTRODUCTION

SECTION 2 CAD PRINCIPLES

- what a CAD is and why we need it?
- INPUT data: TC, MRIs, ECO3D, 3D Scan

SECTION 3 3D PRINTING IN BIOMEDICAL FIELD

- from DICOM to STL and vice versa
- use case of anatomic replicas

SECTION 4 CURRENT 3D PRINTING TECHNOLOGIES

- FDM (fusion deposition modeling)
- SLA (sterolitography)

SECTION 5 3D PRINTING MATERIALS

- available materials for DLOs
- choosing the right material(s)

SECTION 6 3D DESIGN

- available materialsfor DLOs
- choosing the right material(s)

Learning outcomes:

- ☐ Knowledge about 3D printing
- ☐ Ability to choose the right design software
- ☐ Ability to choose the right production machine
- ☐ Acquire basic principles of 3D productions
- ☐ Acquire basic understanding of 3D printing materials

Hours of total learning for the module:

Online = 3 hours 36 minutes
Face to face = 2 hours

The unit will be delivered through :

☒ presentation
☒ online course
☒ additional materials
☒ self-reading
☒ practical work
☒ educational films and videos
☒ group-discussions

The unit will be assessed through

Students will be evaluated using quizzes
In person and with the availability of proper software and 3D printers, practical tests can be performed.

References

PUBMED articles on simulation:
https://pubmed.ncbi.nlm.nih.gov/24958045/
https://pubmed.ncbi.nlm.nih.gov/24776857/
https://pubmed.ncbi.nlm.nih.gov/26438547/
https://pubmed.ncbi.nlm.nih.gov/27366318/

The use of anatomic replicas in dental surgery : https://youtu.be/MJQgtuGoYpg

The use of soft tissues anatomic models https://youtu.be/NDDRxivHoYw
Anatomic models for surgical planning: https://youtu.be/-ZmbBYR-3e4

Number and name of the module:

Module 6: Using DLO's in conjunction with Virtual Reality

Overall objective, methods and resources of this module:

Objective: The general goal of the module is to equip learners with basic understanding of Virtual Reality (VR) technology and how it can be used in medical training, especially to study and visualize Digital Learning Objects (DLOs) from Al3xandria online library.

Methods: Lectures, presentations, self-study, discussions based on case studies, group discussions, self-assessment, videos.

Resources/materials:

- Access to 3DdigitalVet e-Learning Platform, Access to Al3xandria library
- Paper, flipchart, markers
- Laptop (for presentation), Monitor/projector,Internet connection
- Personal computers with the *3D Slicer* application installed
- Useful links

Content:

SECTION 1 INTRODUCTION

SECTION 2 WHAT IS VIRTUAL REALITY?

- Types of Virtual Reality
  - Non-immersive VR
  - Semi-immersive VR
  - Fully-immersive VR
- VR equipment
  - Head-mounted display (HMD)
  - Smart glasses
  - Haptic gloves

SECTION 3 VIRTUAL REALITY IN THE MEDICAL FIELD

- VR applications in the medical field
  - Healthcare education
  - Exposure therapy
  - Patient education
  - Pain management
  - Cognitive rehabilitation
  - Social cognition training
  - Stroke rehabilitation
- Benefits and limitations of VR in the medical field
- The future of VR in the medical field

SECTION 4 VIRTUAL REALITY IN MEDICAL TRAINING

Benefits of VR in Medical Training
Challenges for VR in Medical Training
Applications of VR in Medical Training

SECTION 5 VIRTUAL REALITY AND DLOS

DLOs visualisation with VR
VR combined with 3D-printed models
VR versus 3D-Printing

Learning outcomes:

By the end of the module, participants will be able to:

- Get to know the basics of VR technology and its applications in the medical field
- Gain knowledge on the uses of VR in medical training
- Demonstrate the understanding of VR applications for visualization and analysis of DLOs
- Understand how VR can be used to study and visualize DLOs from Al3xandria

Hours of total learning for the module: 5 hours

Online = 3 hours 36 minutes
Face to face = 2 hours

The unit will be delivered through :

☒ presentation
☒ online course
☒ additional materials
☒ self-study
☒ case studies
☒ educational films and videos
☒ group-discussions
☒ self-assessment

The unit will be assessed through

Quizes, self-assessment

References

1. D. Hamilton , J. McKechnie, E. Edgerton and C. Wilson, “Immersive virtual reality as a pedagogical tool in education: a systematic literature review of quantitative learning outcomes and experimental design,” Journal of Computers in Education, vol. 8, pp. 1-32, 2021.
2. “Health Scholars,” [Online]. Available: https://healthscholars.com/. [Accessed January 2022].
3. U. Sarkar, J. E. Lee, . K. H. Nguyen, S. Lisker and C. R. Lyles, “Barriers and Facilitators to the Implementation of Virtual Reality as a Pain Management Modality in Academic, Community, and Safety-Net Settings: Qualitative Analysis,” JOURNAL OF MEDICAL INTERNET RESEARCH, vol. 23, no. 9, 2021.

4. “FDA Approves a New Virtual Reality Device to Help Ease Chronic Pain,” [Online]. Available: https://www.healthline.com/health-news/fda-approves-a-new-virtual-reality-device-to-help-ease-chronic-pain. [Accessed January 2022].
5. H. Shin and K. Kim, “Virtual reality for cognitive rehabilitation after brain injury: a systematic review,” Journal of Physical Therapy Science, vol. 27, no. 9, p. 2999–3002, 2015.
6. M. R. Kandalaft, N. Didehbani, D. C. Krawczyk, T. T. Allen and S. B. Chapman, “Virtual Reality Social Cognition Training for Young Adults with High-Functioning Autism,” J Autism Dev Disord, vol. 43, no. 1, pp. 34-44, 2013.
7. N. Didehbani, T. Allen, M. Kandalaft, D. Krawczyk and S. Chapmanm, “Virtual Reality Social Cognition Training for children with high functioning autism,” Computers in Human Behavior, vol. 62, pp. 703-711, 2016.
8. J. Bui, J. Luauté and A. Farnè, “Enhancing Upper Limb Rehabilitation of Stroke Patients With Virtual Reality: A Mini Review,” Frontiers in Virtual Reality, vol. 2, p. 146, 2021.
9. M. E. Moan, E. K. Vonstad, X. Su, B. Vereijken, M. Solbjør and N. Skjæret-Maroni, “Experiences of Stroke Survivors and Clinicians With a Fully Immersive Virtual Reality Treadmill Exergame for Stroke Rehabilitation: A Qualitative Pilot Study,” Frontiers in Aging Neuroscience, vol. 13, p. 662, 2021.
10. E. Chang, H. T. Kim and B. Yoo, “Virtual Reality Sickness: A Review of Causes and Measurements,” International Journal of Human–Computer Interaction, vol. 36, no. 17, pp. 1658-1682, 2020.
11. T. Baniasadi, S. M. Ayyoubzadeh and N. Mohammadzadeh, “Challenges and Practical Considerations in Applying Virtual Reality in Medical Education and Treatment,” Oman Medical Journal, vol. 35, no. 3.
12. J. Pottle, “Virtual reality and the transformation of medical education,” Future Healthcare Journal, vol. 6, no. 3, pp. 181-185, 2019.
13. D. Lerner, S. Mohr, J. Schild, M. Göring and T. Luiz, “An Immersive Multi-User Virtual Reality for Emergency Simulation Training: Usability Study,” JMIR SERIOUS GAMES, vol. 8, no. 3, 2020.