Erasmus+

Development of innovative training solutions in the field of functional evaluation aimed at updating of the curricula of health sciences schools

Report on the results of the surveys following the Report- Temple

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Contents

1. Introduction

This activity is developed in the framework of the European Project TEACH. The aim of the Project is to enrich the training currently provided at health sciences schools and facing the deficit of skills that Europe suffers today in the field of functional evaluation in order to deal with the important healthcare challenges along 21th century. In addition, the main and quantifiable objective of the project is to develop a training tool addressed to the health sciences teachers, professionals of higher education sector and decision makers responsible for curricula definition to be imparted at Health Sciences Schools across European continent. This training tool will be based on up-to-date knowledge on functional evaluation (FE) in sustainable development. A specific innovative training program will be developed taking into account the wide spectra of needs and requirements of health sciences teachers from all over Europe. Hence, it will improve the links and communication between universities, innovation sector, and health professionals across EU countries.

The present report exposes the results of focus group sessions and interviews to professional teachers related to health science performed by:

- Valencia University group
- Charité – Universitätsmedizin Berlin (Charité), Berlin, Germany, performed by the AMSE group
- Authorities of School of Medicine with the Division of Dentistry in Zabrze, Medical University of Silesia
- Expert for physiology from the Jerzy Kukuczka Academy of Physical Education in Katowice.

The aim of these sessions was to collect information about teachers current knowledge about human biomechanics, current formation requirements and preferences about the TEACH course methodology. Additionally to the previously mentioned profiles, some groups involved in the project have interviewed a physical activity and sports science professionals group whose teaching area was pedagogy. The utility of this was to incorporate a pedagogic opinion to TEACH, maintaining nonetheless the formation, practice and experience in biomechanics.

In addition to the information gathered by performing of the focus groups above mentioned, the present report contains the results of the quantitative analysis derived from the fulfillment of a specifically designed online survey, which aimed to gather more information about the current state of training and preferences of University teachers. This will be describe more thoroughly in the pertinent section (section 4: Quantitative Results).

2. Material and Methods

The objective of this task was to conduct focus group sessions in order to obtain information concerning the training needs in biomechanics and instrumented analysis of professionals involved in teaching at health sciences universities. The following general objectives have been established:

- To characterize the current knowledge and background of Health Sciences University Professors, related with human biomechanics and instrumented techniques used for functional assessment.

- To identify the needs perceived by those professionals in the current training in biomechanics and instrumented techniques used for functional assessment for undergraduates within their respective fields.
- To determine the aspects related to the format and design of the courses and contents of the present project (length, availability, accreditation, cost, teachers, etc.) in order to be useful for our target population (University Professors)
- To determine the aspects related to the format and design of the courses and contents of the present project in order to eventually be used within certain subjects in the Health Science Universities, incorporating these contents to the degrees' curricula.
- To assess the interest in the training.

2.1. Spain

The material used to carry out the focus group and interviews was (Figure 1):

Moderator of the session: this person was in charge of leading the session, assuring that all planned issues were analysed and that the objectives were accomplished. The moderator controlled time assuring that all members participated in a relaxed environment.

Observer: this person was an expert who provided support to the moderator without participating in the session. He could ask the moderator about dealing with a specific or remaining issue.

In some cases, due to the limited time available of the medical teachers, instead of going to our laboratory to hold group sessions, it was decided to conduct interviews in the teachers' clinical work places (Figure 2). In the cases in which a group of teachers were brought together, the focus group session was held in the biomechanics laboratory of the Evaluation Unit within the premises of the Faculty of Medicine of the University of Valencia.

Figure 1: Development of the focus group sessions and interviews. Left: session held at the biomechanics laboratory, University of Valencia. Right: interview conducted in the clinical workplace of the teacher.

Four profiles of teaching professionals related to health sciences were interviewed: medicine teachers, physiotherapy teachers, physical activity and sports science teachers and trainers of trainers with a physical activity and sport sciences degree, as shown in Figure 2.

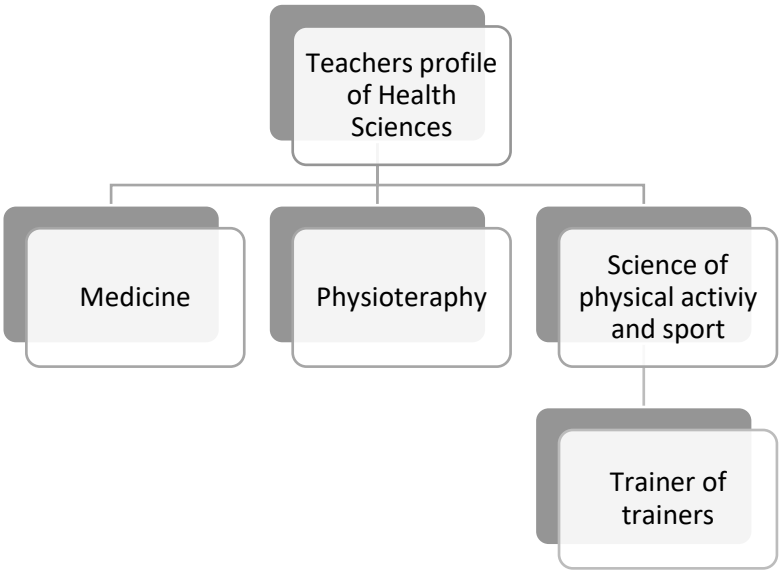


Figure 2: Profiles of the teachers interviewed from the University of Valencia.

The list of teachers who participated in the interview and focus group sessions, in addition to their relevant academic information, is shown in Table 1, 2 and 3. This personal information is not confidential since it is on the university's website. In this task, 7 medical professors, 5 physiotherapy teachers and 6 sports science teachers participated to date.

Table 1: Academic information from teachers of Medical school

Name	Teaching area	Years of teaching	Clinical specialty / Research area
User 1	Traumatology and orthopedic surgery	43	Biology of articular cartilage
User 2	Traumatology and orthopedic surgery	more than 10	Diagnosis of deformities without radiological tests
User 3	Traumatology and orthopedic surgery	10	Foot and ankle surgery
User 4	Traumatology and orthopedic surgery	29	Spine surgery, tumor research, prosthetic replacement for sacroctomy and lumbo-pelvic junction
User 5	Traumatology and orthopedic surgery	20	Reconstructive surgery of knee, hip, orthopedic oncology
User 6	Pathology of the locomotor system and general pathology	15	Systemic diseases
User 7	General anatomy / Anatomy of body systems	14	Clinical biomechanics of the lumbar region and pain

Table 2: Academic information from teachers of Physiotherapy school

Name	Teaching area	Years of teaching	Clinical specialty / Research area
User 8	Neurological physiotherapy	10	Neurological physiotherapy
User 9	Physiotherapy in primary care	15	Area of aging and pathologies of shoulder and knee
User 10	Statistics	11	Clinical biomechanics
User 11	Cardio-circulatory physiotherapy and Physical therapy assessment	18	Cardiovascular diseases / Stroke
User 12	Biomechanics and applied physics	11	Medical Physics and Orthopedic Knee Recovery

Table 3: Academic information from teachers of Physical activity and sports sciences school

Name	Teaching area	Years of teaching	Clinical specialty / Research area
User 13	Biomechanics	12	Sports biomechanics, gait and run.
User 14	Biomechanics	8	Run and cycling. Biomechanics of sports equipment. Projects related to sailing.
User 15	Sports education	4	Application of infrared thermography and sports physiology.
User 16	Didactics department of corporal expression. Physical education teaching Unit.	25	Spine and trunk stability.
User 17	Didactics department of corporal expression. Physical education teaching Unit.	10	Motor skills and motor development of the child. Perception of the kick in the discipline of Karate.
User 18	Didactics department of corporal expression. Physical education teaching Unit.	9	Energy costs in spinal cord injuries using accelerometers and regressive equations.

2.2. Germany

Setting and context. This focus group was performed at the Charité, Berlin, Germany. The Charité currently holds one educational program relevant to the training of health care students in the field of functional assessment in human biomechanics. This is an undergraduate program for medical training. In the following, we will characterized the program.

The Charité represents a large mid-European medical school and enrols 300 new medical students twice a year. In 2010, the undergraduate medical curriculum was transformed from a traditional, discipline-based curriculum into an fully integrated program from the first to the last semester. The program is competency-based and was planed based defined end-of-training outcomes. It is organized into 40 thematic modules over a five-year study time and a final clerkship year (Figure 1). The final year consists of three clerkship rotations with 3.5-month placements. The goal of the final-year clerkship is that medical students actively participate in the clinical workplace. More than 200 professors and 2000 faculty members, spread over some 100 departments, are involved in teaching of the undergraduate medical program. At the Charité, there are not other undergraduate programs providing undergraduate training to other health science education on functional assessment in human biomechanics. This setting it typical for medical faculties in Germany.

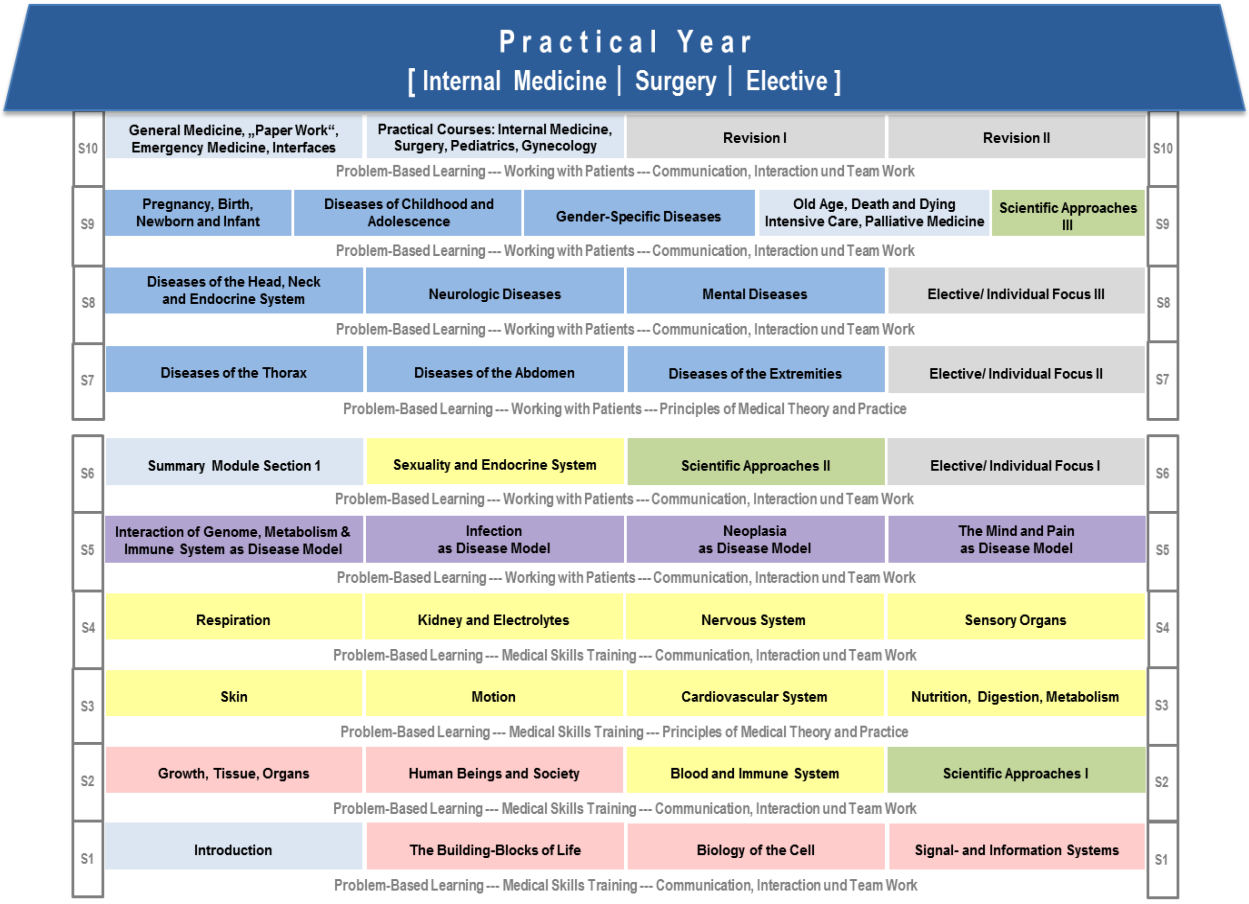


Figure 3: Overview on the modular structure of the undergraduate medical program at the Charité Berlin. S=semester.

Focus group methodology. We approached individual and groups of Charité professors and faculty who were potentially involved in the teaching of functional assessment and human biomechanics by phone calls. The Department of Physical and Rehabilitation Medicine responded positively. The Departments of Orthopaedics and Trauma Surgery indicated the training in functional assessment in the field of human biomechanics is not and likely will not be involved in their teaching at the Charité, Berlin.

Two sequential, focus group sessions were performed with physicians of the members of Physical and Rehabilitation Medicine department of the Charité. The first in the last week of February 2019 and second in first week of March 2019. The time between the focus groups were used to prepared written materials in response to the questions to be addressed by the experts. The questions were discussion in the first focus group round between the focus group members, the results were discussed of the second round. The text generated was fined subsequently by the focus group moderator and the focus group members.

Focus group moderator. The focus group interview was moderated by an investigator having no formal interrelations with the participants. The discussion was moderated in order to answer the questions outlined by the TEACH interview guideline.

Focus group participants. Six of eight invited members of the Physical and Rehabilitation Medicine Department took part in the focus group (participation rate). All participants are physicians (five female, one male).

2.3. Poland

Focus group moderator. The role of the moderator was adopted by one of the contractors of the project on the SUT side. The task of the moderator was to conduct discussions with previously invited respondents, in accordance with pre-established assumptions.

The support for the moderator from the SUT site was an observer who supervised formal and methodological correctness. It was a person substantially and practically prepared for the implementation of qualitative research, a sociologist.

Focus group were extended to include an in-depth interview with one of the experts who could not attend the planned meeting.

Focus group and in-depth interview participants. All participants of the focus group are characterized by practical experience in the field of treatment and education (teachers) in healthcare.

Participants of focus group session (5 people) were authorities of School of Medicine with the Division of Dentistry in Zabrze, Medical University of Silesia including:

- The Dean of School of Medicine with the Division of Dentistry in Zabrze,
- The Vice-Dean for Students Affairs of School of Medicine with the Division of Dentistry in Zabrze
- Two Vice-Deans of School of Medicine with the Division of Dentistry in Zabrze

And additionally:

- Professor at The Jerzy Kukuczka Academy of Physical Education in Katowice

3. Qualitative results: Focus groups and interviews results

3.1 Analysis of current knowledge, background and training courses received applied to human biomechanics and technologies used to perform instrumented biomechanical analysis

3.1.1. Spain

All participants reported basic knowledge in biomechanics and in relation to the specific topics of their specialization and research field, except one of the medical teachers.

On the other hand, the teacher's knowledge about instrumental techniques for the measurement of biomechanical parameters was more limited in the case of medicine professional than that of the physiotherapists and sports science teachers. In fact, all physiotherapy and sports science teachers reported knowledge and experience in one or more instrumental techniques.

Of the 18 professionals interviewed, only five medical professors did not receive biomechanics training neither during undergraduate studies nor during post-graduate studies. The rest of the professionals have all received some training in biomechanics or instrumental techniques of biomechanical analysis.

The training received by the medical professionals were in postgraduate studies of specialized courses about a joint or locomotor system area of clinical interest for teachers. These courses included training in functional anatomy, normal and pathological biomechanics, as well as medical and surgical treatment.

On the other hand, teachers of physiotherapy and sports sciences had training in biomechanics during their undergraduate studies, however all interviewees said that this training was very general and basic. The specific knowledge was acquired during postgraduate studies.

The learning pathways in biomechanics and instrumental measurement techniques mentioned by all teachers.

Of the 18 interviewed, only 2 medical teachers said that knowledge in biomechanics was sufficient. The reason for this is that, as the subjects related to the locomotor system are organized in the medical career, it seemed to them that what they knew about the subject was suited to that program. In addition, these two teachers made reference to that when the clinical work is in multidisciplinary teams, it is not necessary to know in depth of biomechanics or instrumental techniques.

On the other hand, 16 teachers said that knowledge in biomechanics and instrumental techniques was not enough.

The main weaknesses of this are:

1. Less preparation in daily clinical practice.
2. Reduced ability to transfer specific knowledge to undergraduate students
3. It is not possible to develop research lines if they do not have specific and deep knowledge in biomechanics or instrumental techniques
4. In the case of conducting research work of undergraduate students in the area of biomechanics and instrumental techniques, there is not enough training to do it in a deeper way
5. There is a loss of objective validation of the professional act in the daily clinic. Especially when evaluating medical-surgical interventions. This in turn keep off students from being able to be self-critical and objective with the surgical techniques used in the locomotor system.
6. It is not possible to measure which medical interventions are more efficient.
7. In some cases, it will be necessary to go to another professional to cover the entire treatment of a patient.
8. It prevents to describe in depth certain subjects of the undergraduate studies. For example: Without sufficient knowledge in biomechanics of the locomotor system, the anatomy that is taught is more descriptive than functional.

3.1.2. Germany

The experience of the focus group participants in working and teaching in the field of functional assessment and human biomechanics ranges from 3 to 28 years, median 5 years). All focus group participants hold a formal degree as MD, i.e. being physicians. None of them received specific

structured training in functional assessment the human biomechanics. Their expertise in this field relays on workplace participation in their postgraduate phase. In detail, the focus group participants indicated having expertise in a broad spectrum of functional assessments including instrumented biomechanical analysis tools. Part of their specialty training is rehabilitation medicine (with many non-instrumented rehabilitation assessments), manual medicine (manual techniques for diagnostics and therapeutic use), functional use of diagnostic imaging (especially functional interpretation of ultrasound, also X-ray, and MRI), and physiotherapy (biomechanics analyses, including instrumented biomechanics analyses).

The focus group participants expressed their feeling that they are able to answer the questions raised in the focus group question guide for the undergraduate medical training in the German context.

The following objectives were formulated to be addressed in this focus group session.

The objectives are:

- to systematically display current areas of undergraduate training
- to assess further needs in undergraduate training

In the field of Functional Evaluation (FE) with a focus on human biomechanics and further, within this field with a focus on instrumented biomechanics analysis

- in the setting of a university hospital/medical school
- in the specialty of Physical and Rehabilitation Medicine (PRM).

In the following, the term FE will be used in the context as functional assessment of human biomechanics.

3.1.3. Poland

During an in-depth interview, the expert accented that biomechanics is one of the basic teaching subjects within the fields of education in physical education academies and is of a high standard. Universities of this type have substantial and technical facilities adequate for teaching in this area. However, experience indicates that this area should be constantly developed in the context of global trends.

During the conversation, attention was paid to the need to diversify the concepts of functional evaluation and holistic approach to the patient. There are many uncertainties in the meaning of the concept of functional assessment in the environment of various academic groups. It is influenced by the understanding of the word "functional", which refers to the physical implementation of actions by the human body. In this sense, there is no place for psychosocial aspects that have a place in the holistic approach.

Knowledge about FE is transferred additionally by literature in Poland:

- journal titled “Fizjoterapia funkcjonalna” (eng. “Functional Evaluation”)
- Book “Biomechanika kliniczna” (eng. “Clinical Biomechanics”) – book for students of medicine and physiotherapy and for orthopedics

3.2 Analysis if current state of training currently being performed at Health Science Universities related to human biomechanics and technologies used to perform instrumented biomechanical analysis

3.2.1. Spain

Although all professionals consider it important to have additional knowledge in biomechanics and measurement techniques for functional analysis, the reasons and applications for this differ among the teachers interviewed.

All the teachers interviewed, except one, said that the knowledge taught in undergraduate studies in biomechanics and instrumental techniques for functional analysis are not enough.

The reason why one medical teacher finds sufficient the teaching in biomechanics and functional analysis in undergraduate students is that the current program of the medical career does not allow introducing more specific knowledge. This happens because, after the implementation of the Bologna plan, the contents of the university studies have become so widespread that they do not allow for specific knowledge that students must acquire in the postgraduate course.

The comments received by teachers who believe that teaching in biomechanics and functional analysis are not enough in undergraduate students are:

- To introduce more specific knowledge, it should be dispensed with other content due to the time limited in each course
- One possible reason that teaching is not enough is the reduction of the time allocated to each subject after the implementation of the Bologna plan
- Teaching in biomechanics is not a formal content. Teachers with some experience in biomechanics introduce in their subjects the knowledge they have in biomechanics in a general and very timely manner
- In physiotherapy and sports science "Biomechanics" is a formal first-year course, however, the content remains basic and general. This happens because in order to provide more specific knowledge of biomechanics and functional analysis, undergraduate students must have completed the anatomy and physics subjects beforehand. As this does not happen, the subject of biomechanics is more general
- Teachers interviewed from the three careers indicated that it should be a formal subject in the middle or last years of undergraduate training
- The contents in biomechanics that are taught in undergraduate studies are insufficient, but those related to assessment techniques for functional analysis are even more deficient.

3.2.2. Germany

Background

ICF-based Functional Evaluation in Human Medicine

The term Functional Evaluation (FE) is varyingly referred to in different areas of science. In human sciences, especially in human medicine and its related professions, FE is usually referred to as a set of tests, practices and observations that are combined to objectively determine the ability of a person to function under different circumstances [1]. Other terms used in a similar manner are functional assessment or assessment of functioning.

In Human Medicine, FE plays a major role in the field of Physical and Rehabilitation Medicine. The basic model for understanding and quantifying human functioning is the World Health Organization's (WHO) standard model, the International Classification of Functioning, Disability, and Health (ICF). Further models for determining function include the WHO health strategies and initiatives like the World Report on Disability (2011), Global Disability Action Plan (2014), Rehabilitation 2030 – a call for action (2017), Recommendations Rehabilitation in Health Systems (2017), WHO Assistive Products List (2018), or the UN Convention of the Rights of People with Disabilities (2006) [2]. Many of these recommendations are connected or even integrated in the ICF. The ICF serves not only as a basic model in the bio-psycho-social approach to understanding the various aspects of human functioning, but it also provides medical sciences with a scientific framework to assess function from a rather global view to very detailed single functional aspects. In addition, the single ICF functioning items, sorted in domains and chapters, offer a reference to body structures and their impairment (loss of function). Therefore, the ICF provides a standard and a conceptual basis for measuring health and disability [3].

Functional Evaluation and Medical Diagnostics

A large scope of Functional Evaluation instruments reach into nearly any domain of human functioning. Assessments, instruments and test batteries find their application not only to measure structural performance, but also to include relevant functional domains. Examples relate to the physical and social functional status as well as to the fulfilment of tasks. Basically, physical and psychological abilities can often be measured directly (e.g. muscle strength, lung function, pain, orientations, memory and recall, attention an calculation), while certain modifiers of function exceed the possibilities of simple testing (e.g. psychological factors, motivation). Other modifiers of function are individual and societal opportunities, measured with sociometric test batteries. (e.g. family structures, social support, adequacy of living quarters). There is a considerable overlap of FE and medical diagnostics, as the same tools can be worthy measures for the assessment of performance or impairment as well as instruments in the diagnostic or therapeutic management of diseases.

Functional Evaluation of Human Biomechanics

Focusing on human biomechanics, assessment of functioning is closely related to assessments and diagnostics of structures, and their impairment (with consecutive loss of function), or aspects of performance physiology.

Due to the importance of FE in Physical and Rehabilitation Medicine (PRM) extensive competency-based learning goals are integrated in the specialty training for PRM doctors. This may partly be valid for other specialty disciplines, like general medicine, orthopaedic surgery, or neurology, too, but by far not in the extent like in PRM [4].

In the curriculum of undergraduate human medicine, especially in the field of PRM, aspects of training in Functional Evaluation can be identified in the current curriculum. Within the field of Functional Evaluation of human biomechanics, the instrumented biomechanics analyses are tools to measure

biomechanical (kinematic, dynamometric, and anthropometric) properties. There is a considerable overlap with functional diagnostic imaging in human medicine.

Considering future developments in technology and demographics, needs for further training possibilities can be clearly identified.

Analysis of the current situation

National perspective: Functional Evaluation (FE) is implemented in official learning objectives catalogues

Functional Evaluation (FE) is implemented in official German learning objectives catalogues for medical schools:

- German National Competence-based Learning Objectives Catalogue for Undergraduate Medical Education (NKLM) [5] and the
- Competence Based Catalogue of Learning Objectives for Rehabilitation, Physical Medicine, Naturopathic Treatment – Revised Version (Joint Recommendations of the German Society of Rehabilitation Science and the German Society of Physical Medicine and Rehabilitation) [6].

Table 4 shows NKLM learning objectives with contents related to functional assessments (in German). The most important ones are (**bold: instrumented biomechanics analysis-related**):

- **Functional examination of topic structures**
- Examination of autonomic (vegetative) functions
- **Choice and application of diagnostic instruments in rehabilitation according to the ICF** (**body functions and –structures,** activities and participation, context factors)
- **Deciding on the right rehabilitation services using instruments to assess functional impairments and resources**

On the level of learning objectives, there is no directly detectable reference to instrumented or technologic assessment of function. FE-related content is found in the examples level at most.

Table 4: NKLM learning objectives with contents related to functional assessments (in German; the following paragraphs show the translation in English)

14b.2.1.24	die funktionsorientierte Untersuchung topischer Strukturen durchführen.
14b.2.1.25	die Untersuchung vegetativ-reflektorischer Funktionen durchführen.
15.13.1	Sie wählen rehabilitationsdiagnostische Instrumente patientenbezogen und situationsgerecht entsprechend den Dimensionen der International Classification of Functioning, Disability and Health (ICF) aus und nutzen die Ergebnisse für weitere diagnostische und therapeutische Entscheidungen. Sie können …
15.13.1.1	die Instrumente zur Erfassung der Körperfunktionen und -strukturen nach der ICF auswählen und die Ergebnisse für weitere diagnostische und therapeutische Entscheidungen nutzen.
15.13.1.2	die Instrumente zur Erfassung der Aktivitäten und Teilhabe nach der ICF auswählen und die Ergebnisse für weitere diagnostische und therapeutische Entscheidungen nutzen.

15.13.1.3	die Instrumente zur Erfassung der Kontextfaktoren nach der ICF auswählen und die Ergebnisse für weitere diagnostische und therapeutische Entscheidungen nutzen.
15.13.1.4	die Bedeutung aller Beeinträchtigungen und Ressourcen mit ihren Zusammenhängen für die Indikationsstellung von rehabilitativen Leistungen nutzen mit Differenzierung der Rehabilitationsbedürftigkeit, Rehabilitationsfähigkeit, Rehabilitationsziele und Rehabilitationsprognose einschätzen.
15.13.1.5	die Bedeutung aller Beeinträchtigungen und Ressourcen für die sozialmedizinischen Begutachtung mit Berücksichtigung rehabilitativer Leistungen einschätzen.

The learning objectives for undergraduate training in Physical and Rehabilitation Medicine, as recommended by the scientific societies, show more content related to functional assessments (in German). The most important ones are (**bold: instrumented biomechanics analysis-related**):

- Rehabilitation assessments: assessment questionnaires and checklists, clinical assessments, interpretation of assessments, **use of diagnostics and assessments to outline rehabilitation plans**
- **Instruments to measure body functions and –structures according to the ICF (measurement of vigilance, pain, muscle strength, range of motion, diagnostic imaging under functional aspects, instrumental posture gait analysis)**
- Instruments to measure activities and participation according to the ICF (measurement of ADL, cognition, mobility, assessments of body regions and specific diseases, social participation, functional working capacity, mood and depression)
- Instruments to measure context factors according to the ICF (social support, personality traits)
- **Functional examination of topic structures**
- Examination of autonomic (vegetative) functions

<u>Medical faculty perspective: PRM undergraduate training at Charité Berlin and training of FE / instrumented biomechanics analysis</u>

During undergraduate training in PRM at Charité Universitätsmedizin Berlin, Functional Evaluation assessments can be found in several classes. However, instrumented biomechanics analyses are found, as displayed the following table (table 2), in a few classes only. The identified function-related learning goals and their corresponding instrumented measurement tools are:

- Range of motion: goniometry, inclinometry
- Muscle atrophy: circumference measurements
- Limb volume: optoelectronic volumetry (perometry)

Table 5: PRM undergraduate training at Charité Universitätsmedizin Berlin and training of FE/ instrumented biomechanics analysis (partly in German, corresponding translation into English to the left).

Curriculum	Classes	Module	Type	Functional Evaluation learning objectives	Instrumented Biomechanics Analysis learning objectives
MSM2	Grundlagen des Umgangs mit bewegungs-eingeschränkten Menschen	M01	Praktikum (Großgruppe)	**Basic knowledge of immobility and its consequences**	
MSM2	Das Muskuloskelettale System | Einführung	M10	Patienten-vorstellung (Vorlesung)	**Basic diagnostics of gait and posture**	
MSM2	Klinische Untersuchung des Hüftgelenks	M10	Unter-suchungskurs	**Manual diagnostics of structures and function, (posture), neutral-0 method of ROM assessment**	**Goniometry**
MSM2	Klinische Untersuchung von Patienten/innen mit Knie-Beschwerden	M10	Unter-suchungskurs	**Manual diagnostics of structures and function, neutral-0 method of ROM assessment**	**Goniometry**
MSM2	Muskelatrophie nach Entlastung und Immobilisation	M10	Patienten-vorstellung (Vorlesung)	**Diagnostic measurement of atrophy and muscle function (knowledge)**	**Circumference measurements (atrophy)**
MSM2	Einstieg klinische Untersuchung bei Patienten mit Beschwerden des Schultergelenkes	M10	Unter-suchungskurs	**Manual diagnostics of structures and function, neutral-0 method of ROM assessment**	**Goniometry**
MSM2	Mensch, beweg Dich! - Prävention und Therapie am Beispiel von Rückenschule und Lauftraining	M10	Praktikum (Großgruppe)	**IPAQ (International Physical Activity Questionnaire**	
MSM2	Klinische Untersuchung bei Patienten/innen mit Rückenschmerz	M10	Unter-suchungskurs	**Manual diagnostics of posture**	**Inclinometry**
MSM2	Die wichtigsten Untersuchungstechniken am Bewegungsapparat	MUV III	Modul-unterstützen-de Vorlesung	**Neutral-0 method of ROM assessment, manual examination and functional evaluation**	**Goniometry, inclinometry**
MSM2	Multimodale Schmerztherapie bei rheumatoider Arthritis	M20	Inter-disziplinäre Vorlesung	**Functional assessments of joint function (examination, DASH, WOMAC, KOOS etc.)**	
MSM2	Rehabilitation von Herz und Lunge: "Fit und leistungsfähig werden!"	M25	Praktikum (Großgruppe)		
MSM2	Dickes Bein.....	M27	eLearning Vorlesung	**Functional assessment of lymphoedema patients**	**Perometry (optoelectronic volumetric measurement)**

MSM2	"Wieder auf die Beine kommen!": Nachbehandlungskonzepte und physiotherapeutische Verfahren	M27	Praktikum (Großgruppe)	**Rehabilitation assessments for acute and postacute rehabilitation (e.g. Barthel Index)**	
MSM2	Einatmen, ausatmen…….! Physikalische Therapie und Rehabilitation bei COPD	MUV VII	Modul-unterstützen-de eVorlesung	**Lung function diagnostic assessments**	
MSM2	Physikalische Therapie und Rehabilitation bei Mammakarzinom und Prostatakarzinom	M35	Praktikum (Großgruppe)		
MSM	Physikalische Therapie: Wann wird was verordnet?	M38	Fachvor-lesung		
MSM	"Viele Hände verbessern das Reha-Ergebnis…..!": Interprofessionalität am Beispiel eines Rehabilitationsfalles	M38	Blended Learning (Vorlesung)	**Examples of functional assessments in interprofessional rehabilitation case**	
	(without/ohne POL, KIT, UaK, Allg. U-Kurs)				

FE in PRM undergraduate training is not focused on instrumented biomechanics analysis

Despite PRM doctors being trained in instrumented FE tools during their residency, PRM undergraduate training is not focused on instrumented biomechanics analysis, since the priority lies on non-instrumented, manual and other clinical assessments. As seen in table 5 there are only instrumented biomechanics analyses of ROM, muscle properties, and limb volume among the current leaning objectives.

The estimated curricular time for teaching those assessments of body functions and structures is not easy to evaluate. Approximated values, calculated by percentage of learning objectives of each course with instrumented FE topics, lead to an estimated cumulative curricular time of about less than one hour for instrumented biomechanics analyses.

3.2.1. Poland

Interviews and focus meetings were the basis for an analysis current state of educational standards in the field of biomechanics or, more broadly, functional evaluation at polish universities. The analysis of education programs in Poland has shown that the topics related to Biomechanics or Functional Evaluation are implemented as part of compulsory courses at the directions of Physiotherapy or Physical Education. The table presents a list of subjects and the number of didactic hours carried out within the scope of study programs realized at medical universities and physical education academies.

Table 6 shows the scope of subjects (regarding to biomechanics and FE) carried out at medical universities and physical education academies along with their assignment to the field of study.

Table 6. The scope of subjects (regarding to biomechanics and FE) carried out at medical universities and physical education academies

Academies of Physical Education

Subject	Direction	Type of education	Number of hours
Biomechanics	Physical Education	Bachelor degree; 2nd year of education (full-time and part-time studies)	45
Biomechanics of motion - measurement methods	Physical Education	Master's studies ; 1st year of education (full-time studies)	30
		Master's studies ; 1st year of education (part-time studies)	18
Biomechanics of sport	Sport	Ist degree (Bachelor); 2nd year of education (full-time and part-time studies)	60
Biomechanics and ergonomics	Physiotherapy	One-degree studies, 2nd year of education	60
Biomechanics	Physiotherapy	Ist degree (Bachelor); 2nd year of education (full-time and part-time studies)	45
Clinical biomechanics	Physiotherapy	One-degree studies, 2nd year of education	30
Clinical biomechanics	Physiotherapy	Master's studies ; 1st year of education (full-time studies)	45
Functional diagnosis in movement system dysfunctions	Physiotherapy	One-degree studies, 3rd year of education	90
Functional diagnosis in internal diseases	Physiotherapy	One-degree studies	60
Functional diagnosis in developmental age	Physiotherapy	One-degree studies	90
Functional diagnosis	Physiotherapy Specialty: Adapted physical activity and disabled sport	Master's studies ; all semesters	150
Kinanthropomery	Direction: Sport Specialty: Coaching	Master's studies ; 1st year of education (full-time studies)	30

		Medical Universities	
Biomechanics with elements of ergonomics	Physiotherapy	One-degree studies; 2nd year of education	50
Functional diagnostics in motor organ dysfunctions	Physiotherapy	One-degree studies; 2nd year of education	35
Functional diagnosis in internal diseases	Physiotherapy	One-degree studies; 3rd year of education	45
Functional diagnosis in developmental age	Physiotherapy	One-degree studies; 4th year of education	25

3.3 Analysis of the knowledge areas and resources required for the inclusion of this area of knowledge into the curricula of Health Sciences Universities

3.3.1 Spain

A general answer from all interviewees is the preference for more practical than theoretical content. In relation to the platform and organization of the course, the type of preferences are *virtual platform with some practical face-to-face sessions*. The suggestion to carry out a modular course was widely referred by the teachers spontaneously, since it allows a very specific teaching with respect to a subject and, therefore, it could be more attractive to students with different medical specialties.

In addition to the preferences regarding the course platform, the teachers also suggested methodological issues such as:

- Downloadable content.
- For each unit of knowledge, perform short evaluation tests that allow repeating several times if mistakes are made.
- Include a virtual repository of prior knowledge.
- Constant tutoring of the course teachers.
- In the countries where the course will be taught, the organizing centers should schedule. practical sessions on instrumental assessment techniques.
- It is suggested to include theoretical classes recorded on video.
- Creation of forums to talk about specific topics.
- Consider real-time virtual sessions as an alternative to face-to-face classes.
- The theoretical content must be structured according to the time the student will have to dedicate to his study.

Although each professor had preferences for a number of hours to develop the course, highlights the options *between 30 - 50 hours* and *the appropriate number of hours to be valid in the professional*

curriculum. The professors of the medical career pointed out that the decision to carry out a postgraduate course influenced the importance of the course in the professional curriculum.

In relation to the adequate hours of training in biomechanics and instrumental assessment techniques for undergraduate students, these is *implement a complete subject dedicated to biomechanics (obligatory or optional)*.

Appropriate subjects in which contents in biomechanics and analysis techniques could be introduced:

Medicine	**Physiotherapy**	**Sports science**
• Traumatology and orthopedics • Pathology of the locomotor system • Neurosurgery • Pathology of the nervous system • Anatomy and neuroanatomy • Physiology	• Neurological rehabilitation • Sports physiotherapy • Physiotherapeutic assessment • Pathology of the locomotor system • Clinical subjects that involve rehabilitation of the locomotor system • In applied physics and biomechanics	In all subjects except those related to "teaching".

All teachers said that they would like the course to offer material that can be used in their classes. The kind of material that they would prefer:

- *Practical multimedia contents*
- *Self-assesment tests that could be used by students*
- *Theorical multimedia contents*

The general response of the teachers was that they preferred very dynamic and visual content, such as videos or multimedia tools, which is more useful to capture the attention of the students. In addition, the professors reported that clinical-pathological audio-visual examples would be interesting.

Teachers' training preferences are *knowledge of instrumental techniques and functional assessment, pathological biomechanics (joint and functional)* and *biomechanics of human functions at different ages*. All the professionals demonstrated a great interest to learn or improve their knowledge in instrumental measurement techniques for functional biomechanics analysis. The objective of this is: 1) to objectify the medical and surgical clinical practice in addition to transmitting to the undergraduate students the objective critical thinking, 2) to find the most efficient treatment techniques for the functionality of the patients, 3) to improve the performance.

The objectives of the teachers with respect to the learning they want to receive about biomechanical assessment techniques are:

1. Fundamentals, method of use and utility of instrumental techniques
2. Content applied to the calibration of measurement techniques
3. Bibliographic references of reliability and validity of measurement systems

4. Knowledge related to the result variables of each measurement instrument and analysis of result graphs
5. Possibility of doing face-to-face practices related to the use of measurement techniques.

The second topic most mentioned by the teachers was the interest in biomechanics of the joints and human functional gestures when a pathological process occurs. For example, how gait and balance changes in patients with prostheses, joint injuries or neurological pathologies.

3.3.2 Germany

The focus group participants expressed the following troughs regarding the future developments and their needs in teaching functional assessment in the field of human biomechanics in the context of undergraduate medical training in Germany.

Future developments in 3 main areas will expectedly have an impact on needs in FE training

There are foreseeable future developments in three main areas, which will expectedly have an impact on needs in FE training.

Firstly, the development of technologies will predictably provide growing availability of technical devices for analysis, diagnostics, and treatment of functional status or impairment. Additionally, the changing culture of medical assessments from hands-on medicine to device-based assessment supports the needs and desire for objective – or perceived objective – quantification of functioning.

Secondly, the demographic development will inevitably lead to a larger share of elderly patients in human medicine in Europe, but also to higher functional demands of the elderly. This will consecutively change the needs of functional evaluation especially in prevention and rehabilitation medicine.

Thirdly, developments in the direction of a value-based medicine open up new opportunities for functional evaluation techniques as quality indicators for measuring the quality of therapy results. This may apply to non-instrumented assessments, too.

Needs assessment

Needs in PRM undergraduate training in the field of biomechanics functional evaluation

Undergraduate training of instrumented biomechanical analyses should be expanded (by time and content) and intensified (by level of competency), with a clear relation to the above-mentioned future developments.

Instrumented biomechanics analyses must be integrated in the whole concept of functional assessment and diagnostic imaging in human medicine, as their role is supporting diagnostics and therapy control.

Technologies and instruments must be available and accessible for training.

What should be trained?

The following table (Table 6) contains a suggestion of training topics in instrumented FE of biomechanics. There are kinematic, dynamometric, and anthropometric analysis tools, as well as diagnostic imaging tools, to be respected in the suggestions. The learning objectives recommendations

(as displayed above) were used as reference. Additional topics were taken from the *Guidelines for Undergraduate Biomechanics* of the American *Society of Health and Physical Educators (SHAPE)* [7].

Table 6: Suggestion of learning objectives in instrumented Functional Evaluation of biomechanics for human medicine undergraduates in PRM.

Topic	Modality	Examples	Proposed competency level
Muscle strength	Dynamometry	Isokinetic dynamometry, hand pull gauge	Knowledge/ experience/skills
Grip strength	Dynamometry	Hand dynamometry	Knowledge/ experience/skills
Muscle function	Electromyography	Surface-EMG	Knowledge
Muscle tone and stiffness	Soft tissue assessment	Handheld stiffness "myometry" devices	Knowledge
Range of motion	Goniometry	Computed/electro-goniometry	Knowledge/ experience/skills
Posture and Balance	Posturography	Static forceplates, dynamic forceplates	Knowledge/ experience
Regional locomotion function	Motion analysis	Motion analysis tools for TMB joints or cervical spine	Knowledge
Gait	Gait analysis	Treadmill/camera systems, sensor mat systems, wearable systems (insoles)	Knowledge/ experience
Swelling	Perometry (optoelectronic volumetry)	Limb oedema volume measurement	Knowledge/ experience
Diagnostic imaging	Sonography, elastography	Muscle sonography, nerve sonography, elastrography	Knowledge/ experience/skills
Diagnostic imaging	X-ray	functional interpretation of lumbar spine X-ray imaging	Knowledge/ experience/skills
Diagnostic imaging	Magnetic resonance imaging (MRI)	functional interpretation of lumbar spine magnetic resonance imaging	Knowledge/ experience/skills

Needs of PRM educators in the field of instrumented biomechanics FE

In order to expand and/or intensify the undergraduate training in the field of instrumented biomechanics assessment, educators of instrumented biomechanics need to:

- be equipped with teaching resources by means of curricular time
- be equipped with teaching resources by means of availability of instruments and technical support (infrastructure)

The suggested training topics offer possibilities for interdisciplinary teaching. Interdisciplinary courses with radiologists could be created for teaching diagnostic imaging techniques and their functional interpretation in regards of biomechanics assessments. Interdisciplinary courses could also be established for performance physiology aspects, mainly kinematic topics of biomechanics assessments. Potential partners for this kind of interdisciplinary teaching could be sports therapy, sports medicine, or muscle physiology.

Formats of specialized FE training courses should be very hands on and display the performance physiology part of FE (biomechanics of the healthy) as well as the diagnostic part (patients) with reference to impairment, loss of function, and functional rehabilitation goals.

3.3.3 Poland

Biomechanics is a subject of physiotherapist and rehabilitation domain of medical schools and first of all schools of physical education. The curricula are mostly connected with such topics like: testing of forces and speed capabilities; testing of postural stability; biomechanical gait analysis, human motility, functional anatomy, holistic rehabilitation, functional physiotherapy.

More often encountered concept in medical schools is functional diagnosis - this is topic connected to physiotherapy and rehabilitation. The training contents can be directed to this domains.

There are no formal trainings regarding instrumental biomechanics and especially FE.

Regarding medicine normally if you think about FE as a holistic approach to diagnosis and treatment, you should be aware that any additional interview or test with patient means more time for visit. Taking into account that usually statistical patient has 15 minutes per visit it will be very problematic to implement FE approach. It is recommended to create a procedure explaining for who, when, under what kind of conditions doctors could use FE approach.

3.4. Preferences regarding training and type of resources to be developed within the project. Requirements needed for a suitable material concerning training

3.4.1. Spain

a) Length of the courses

Regarding the duration of the course, the answers varied among the teachers. While some indicate the number of exact months of preference, others indicate the number of hours of dedication per month of work, regardless of the number of months that the course includes.

Teachers, who prefer a course of 6 months or a semester, previously indicated that they prefer between 30 and 50 hours of training. On the other hand, teachers who prefer the year-long course, previously indicated that around 100 hours of training would be appropriate.

b) Type of contents

In this section, teachers indicated similar answers to those related to the type of content they prefer to receive to transfer their own subjects from undergraduate studies. In summary, teachers prefer to receive very practical content applied to daily clinical practice, including pathological biomechanics of the locomotor system of different diseases. In addition, it was pointed out that the content should be specialized and specific in each unit and for each professional profile. This content must be dynamic and audio-visual, with the support of theoretical content. The suitable content types of the TEACH project are:

Applied to clinical practice

Mainly practical

c) Suitable timetable

The majority of teachers said that an online course should not have established hours, but deadlines for activities and evaluations.

d) Which are the advantages and inconveniences that you associate to an E-learning course?

The main advantage of an online course is the flexibility of time and that the students of the course can study the contents from anywhere and access it as many times as they want.

However, all teachers named disadvantages as:

The online course does not allow for sufficiently practical sessions, which will be very necessary to learn and understand the use of the different biomechanical measurement techniques

It is possible that there is a loss of interest of the students if they do not receive frequent tutoring and communication with the teachers

The student may not attend to the contents and activities of the course in time because they do not give sufficient priority to other daily work activities.

In an online course, is not possible to have direct contact with other professionals, students of the course. The interaction with others partners is beneficial to share experiences and learn from each other

Online courses require self-discipline on the part of students that is difficult to follow with the daily workload

In the case of content related to measurement techniques, it cannot be used to measure with them

An exclusively online course can result in an overly theoretical or poorly applied methodology to clinical practice

The course platform and multimedia activities may not always be operational due to computer failures

f) Which method to evaluate the accomplishment of the course do you consider most adequate?

In relation to the methodology of evaluation of the course, teachers prefers *final research project*, *clinical case to be developed by the student* and *self evaluation (test or development)*. However, an interesting alternative mentioned is to be able to choose how the student wants to evaluate the knowledge acquired. This may be appropriate from a pedagogical point of view, since people have different ways of learning and assimilating concepts and also promotes the flexibility of the course and its adaptation to different professional profiles.

g) Training should be more theoretical or practical?

The comments to this answer are unanimous among the teachers: the training should be more practical than theoretical.

h) Who should organize and give the training?

The answers of the teachers in relation to who should organize the information is variable, but it seems that they prefers a *clinical disciplinary team*. However, everyone thinks that the contents should be

applied to clinical practice. So, regardless of the type of professional who develops the contents, this focus of view should not be lost.

i) Which qualifications should be provided and who should give it?

Regarding the type of course evaluation, the professionals prefers *califications number from 0 to 10*. One of these responses was to use a numerical scale from 0 to 10, as the evaluations of the undergraduate studies are graded. The foundation of this is recognizing the performance of the course students who will work harder than others.

j) Who should pay for them? How much should the courses cost?

With respect to who should pay for the course, teachers of health sciences careers differ in their answers, but most prefer that the students pay. An alternative indicated by the teachers was share the cost between the student of the course and the university to which it belongs. In fact, one of the interviewed commented on the possibility of the student does not pay for the TEACH course if he completes the course within the deadlines. On the other hand, the student must pay for it if he does not complete the course within the established deadlines or if he abandons it. In relation to what price would be appropriate, most teachers interviewed did not have a clear answer (does not know).

3.4.2. Germany

The focus group participants expressed the following needs regarding the type of learning materials/courses. Learning materials and courses for training of instrumented biomechanics assessment tools in human medicine/PRM should be built on functioning-oriented manual examination courses. Functioning-oriented manual examination techniques on the other hand require a certain knowledge of the structural examination courses of joints, tendons, and muscles. Therefore all three types of examinations have to be taught building one on another with the instrumented biomechanics analyses either integrated in the examination courses or, preferably so, at the end of a consecutive row of courses.

Biomechanics FE courses for human medicine undergraduates should be split in different course types:

- Kinemetric, dynamometric, and anthropometric measurement of functions and physiologic properties in the healthy subject
- Biomechanics Functional Evaluation as diagnostic tools and therapy surveillance tools in the patient
- Functional interpretation of diagnostic imaging techniques

These different courses require individual intensity and length depending on the previously acquired competencies of the students. In advanced students with consolidated anatomical knowledge and musculoskeletal examination skills, the focus should lie on measurement tools and their clinical application, while in earlier stages of training, students should rather focus on basic locomotor function before learning about its measurement.

Conveniently some of the learning objectives could be reached with E-learning methods to achieve acceptable skills and competence levels. Especially for swelling measurement (perometry, optoelectronic volumetry), motion analysis tools for single joints and complex movements, posturography (forceplates), and dynamometry this is the case.

Other skills should rather be trained in a hands-on courses under supervision of a trained educators: Goniometry, surface-EMG, and gait analysis can practically not be learned without manually performing the measurements and their evaluation. Diagnostic imaging tools have to be trained hand-on (ultrasound) or at least be discussed (X-ray, MRI).

Suggestion for a Functional Evaluation timetable for human medicine undergraduates, with didactic examples (**bold: instrumented biomechanics**) and proposed curricular time:

- Basics I: clinical musculoskeletal examination (including **goniometry**)
- Basics II: functional clinical examination (chains of function, tissue palpation, functional musculoskeletal disorders) – at least 90-120 mins.
- **Course 1 (E-Learning): Theory of Functional Evaluation, kinemetrics, dynamometry, posturography and instrumented motion analysis – 60 mins.**
- **Course 2 (hands-on training) – 60-90 mins.**
    - **Repetition of E-learning goals (course 1)**
    - **Surface-EMG muscle analysis in healthy subjects and back pain patients**
    - **Gait analysis in health and impaired subjects**
- **Course 3: Diagnostic imaging (musculoskeletal ultrasound *or* MRI in back pain patient *or* functional X-ray interpretation) – 45-90 mins.**

Documentation: Apart from the contents, complementing documentation would be valuable for didactic examples of patients with different losses of function, who may not be available for hands-on teaching at any time.

Evaluation: Learning objectives of basic FE assessments could be included in interdisciplinary multiple-choice exams. Learning objectives on the skills level (from the hands-on courses) could be included in OSCE format evaluations. On the other hand, the educators and the courses' didactics should be evaluated by the students, and the courses' concepts by didactic professionals.

Other aspects concern the utility of the instrumented biomechanics analysis for assessments in the cognitive field and social integration: In the theoretical basics (course 1) the use and value of biomechanics analyses in the holistic context of ICF-based functioning assessments should be included. While technically the training is focused on musculoskeletal function, it should not be forgotten that functional evaluation encompassed much more than single body functions, and includes significant value for measurement of treatment quality, treatment success, and diagnostics.

Being part of a comprehensive range of assessment instruments, functional evaluation of biomechanics can play a distinctive role in assessing global function of human health. Many functional domains like mobility and activities of the daily living imply biomechanical function. While these functional domains often do not seem to be biomechanics-related at first sight, any biomechanical loss of function may relate to a loss of function elsewhere for example in more complex domains such as social domains, or even cognitive function.

4. Quantitative results

The following section shows the results concerning the quantitative phase of the analysis, namely the survey performed to gather information concerning the training needs in biomechanics and instrumented analysis of professionals involved in teaching at health sciences universities, by means of a questionnaire diffused in all European countries.

4.1. Sample

A total of **104 responses** were gathered from 12 different countries, mainly located in Europe.

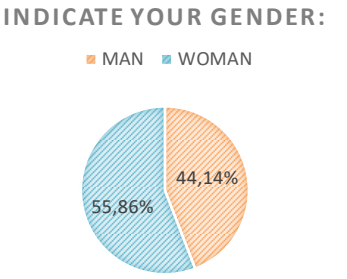


Figure 1. Gender

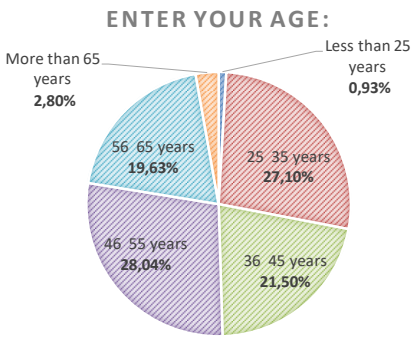


Figure 2. Age

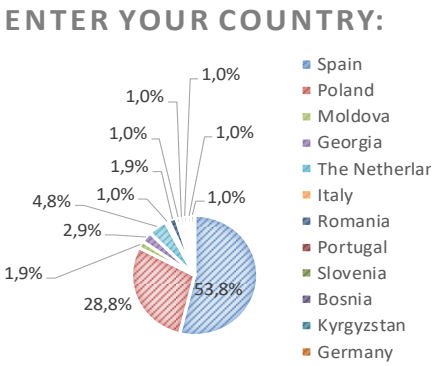


Figure 3. The distribution of respondents by country

Gender, Age and Nacionality

The vast majority of the respondents were women: 55,86% of the professionals (see Figure 1), regarding the age of survey participants, see Figure 2, most of the respondents were aged between *25 and 35 years* (27,10% of the sample) and *46 and 55 years* (28,04%), but there was also a high percentage of aged, expert professionals.

In the Figure 3, the distribution of respondents by country is presented; the largest number of responses is from Spain (53,8%) and Poland (28,8%).

4.2. Field specialitzation

Most of the respondents have a specialization in **medicine and physiotherapy** (see Figure 4). And their actual position are *Professor at university* (35,58%) and *Associate professor* (30,77%), view all responses in Figure 5.

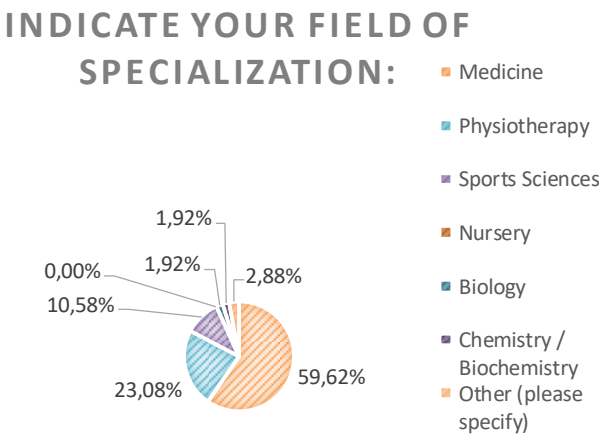


Figure 4. Field especialitzation

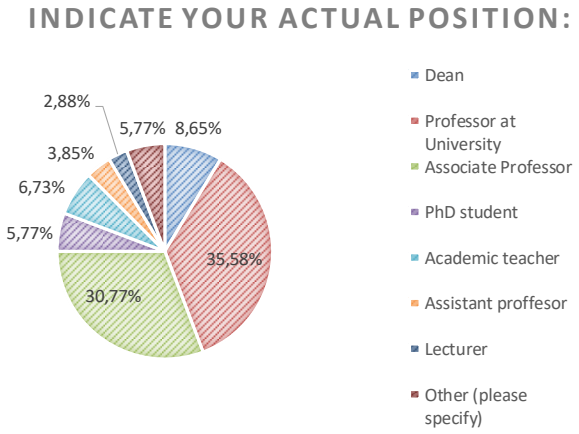


Figure 5. Actual position

4.3. Experience in health sciences education field

The most experienced group of respondents**, more than 15 years of experience,** was represented by **45,63% of the professionals,** (see Figure6). These numbers give greater validity to the sample.

The field or subject/s of teaching most represented are Internal medicine / Medicine / Internal disease (17%), Biomechanics (9%) and Physotherapy (9,0%). (Figure 7)

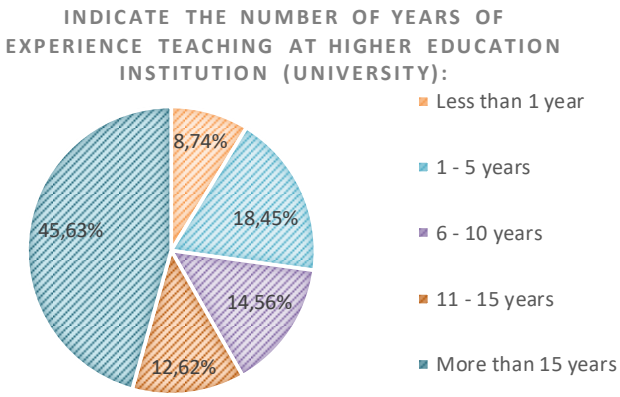


Figure 6. Number of years of experience

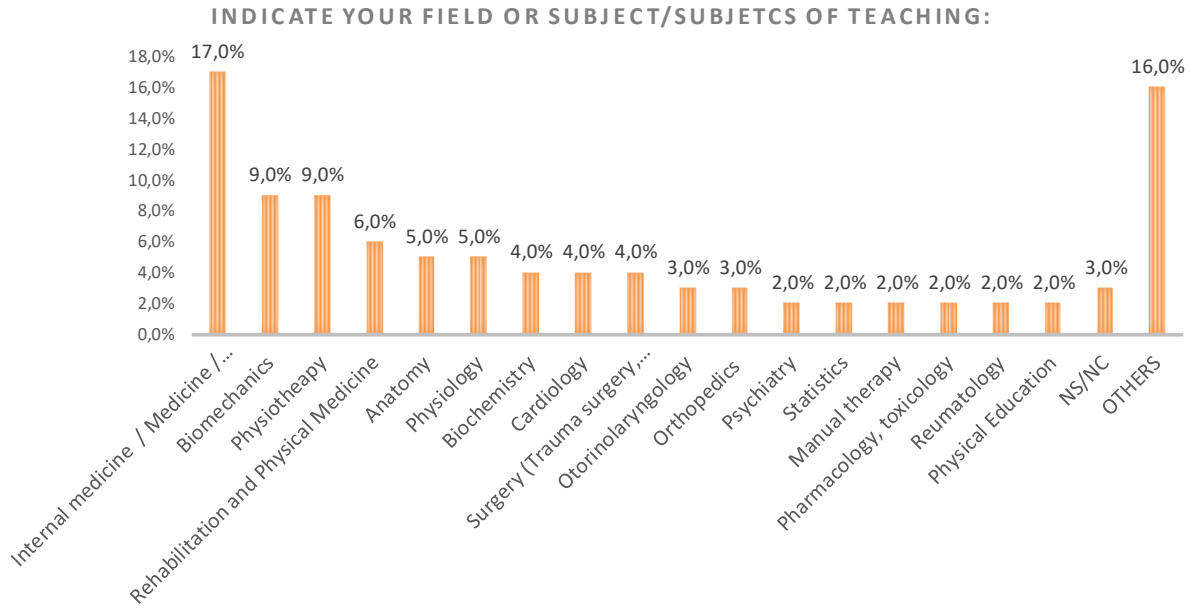


Figure 7. Field or subject/s of teaching

When asked if there is a biomechanical laboratory within their universities, respondents have responded:

- **Yes** (66,32%)
- **No** (33,67%)

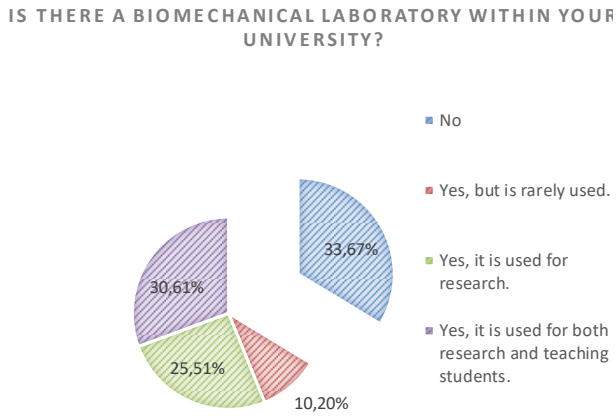


Figure 8. Biomechanical laboratory in their universities

4.4. Previous knowledge in biomechanics and functional evaluation (FE)

Regarding knowledge in Biomechanics, respondents answered (see Figure 9):

- 13,98% *have no knowledge about it*.
- 44,09% have not received any formal training.
- And 47, 31% *received some or specialized training* in biomechanics

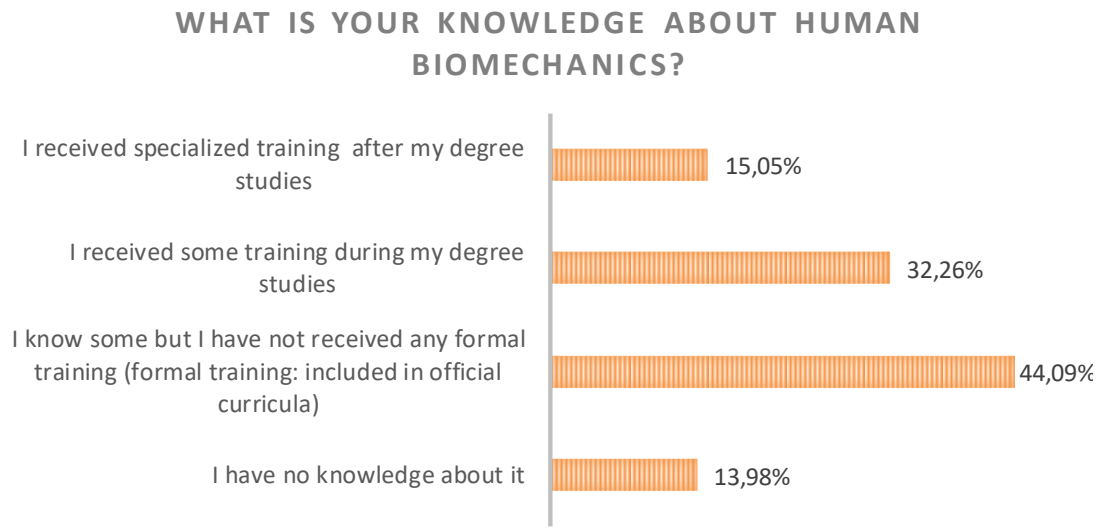


Figure 9. Knowledge about human biomechanics

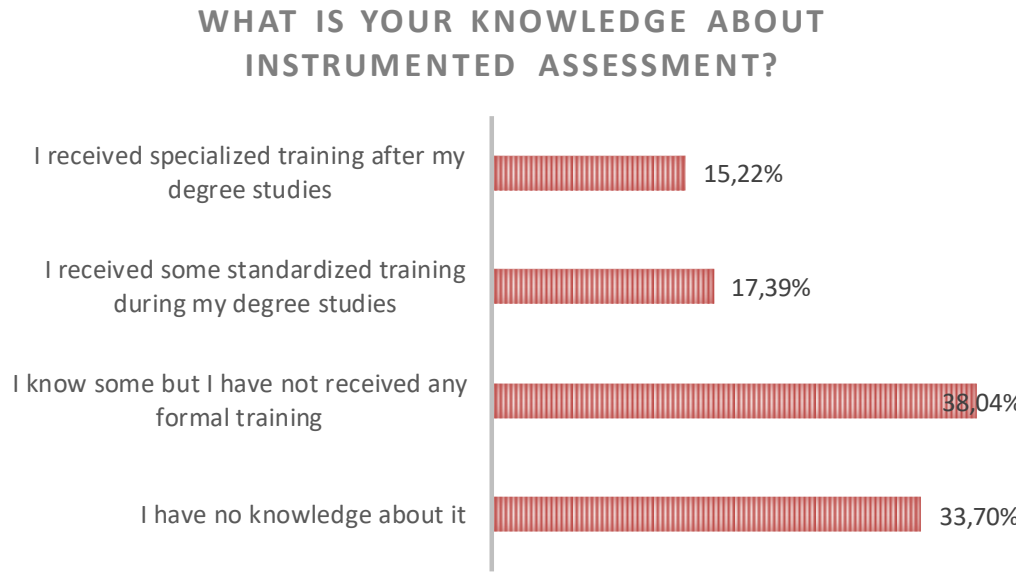


Figure 10. Knowledge about human biomechanics

Regarding knowledge in Instrumented Assessment, respondents answered (see Figure 10):

- 33,70 % *have no knowledge about it*.
- 38,04% have not received any formal training.
- And, only the 32, 61% of respondents, are *received some or specialized training* in biomechanics.

Clearly, the knowledge in Biomechanics is greater than that of Instrument Assessment.

The modality of *no formal training* most frequently are:

- *I have not received any of these trainings* (38,04%)
- *Internet resources* (26,09%)
- *Specialized books or journals* (26,09%)

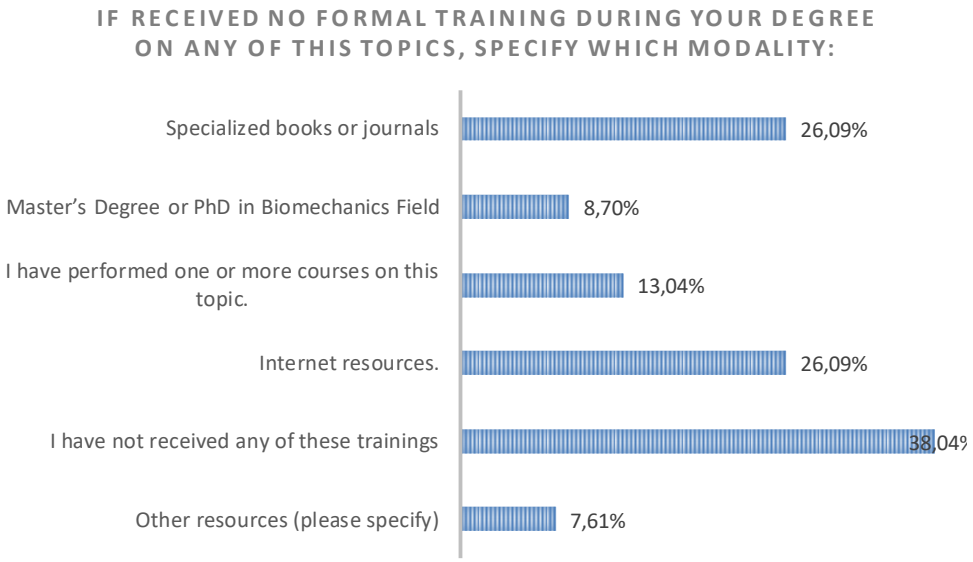


Figure 11. Modality of no formal training

To the question, *Have you ever met Functional Evaluation concept?*, They have responded mostly: NO (54,17%).

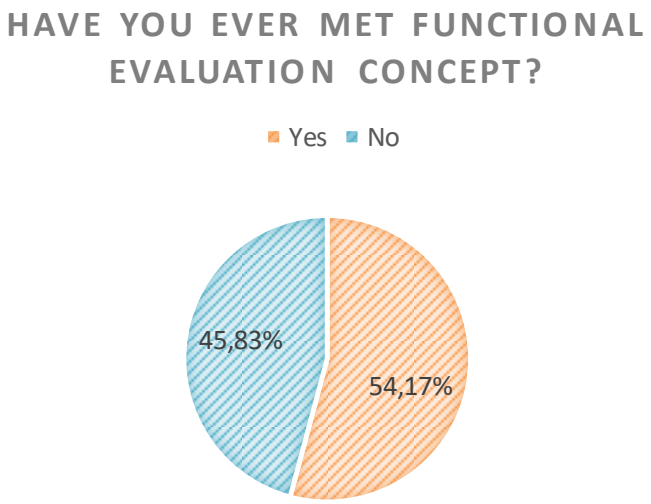


Figure 12. Functional evaluation concept

The vast majority of the respondents *knowns some, but they haven´t received ant formal training* (44,23%), see all responses in Figure 13.

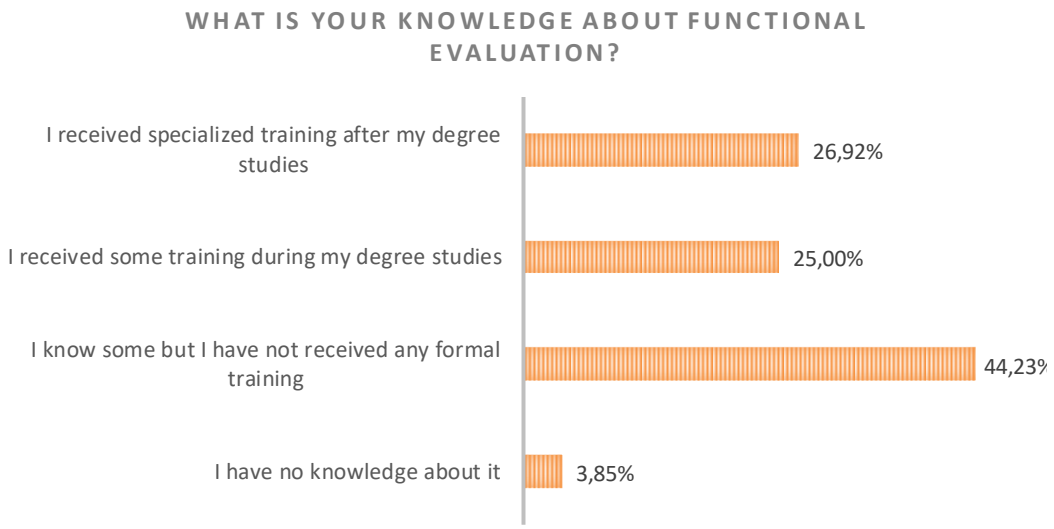


Figure 13. knowledge of functional evaluation

4.5. Personal interest and current state of training in Biomechanics

Only 11,46% of respondents, consider that to count standarized official training in human biomechanics and instrumented assessment is not important. The remaining 88,54% consider that YES.

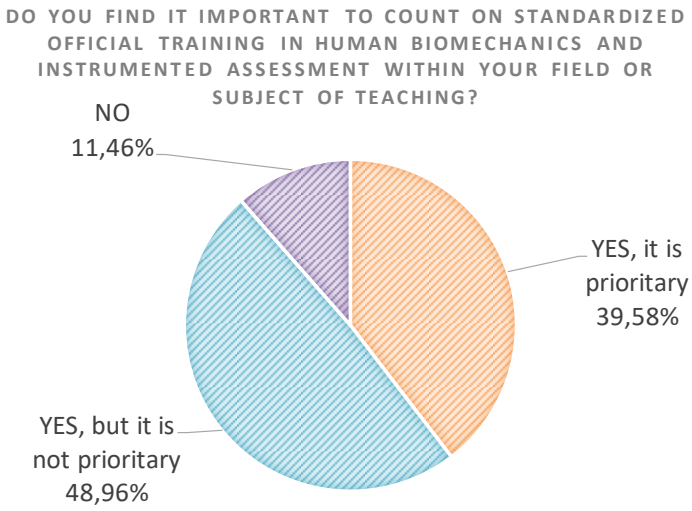


Figure 14. Importance to count on standarized official training in human biomechanics and instrumente assessment within your fiel or subject

The reality is that *Very few contents on these topics are being taught* both in *Biomechanics and instrumented assessment* (42,55%), and in *Teaching of functional evaluation concepts* (46,24%). See in figure 15 and 16.

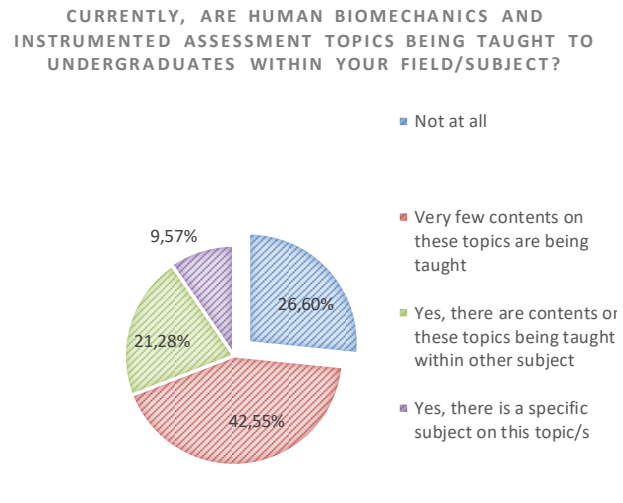


Figure 15. Biomechanics and instrumented assessment topics within your field/subject

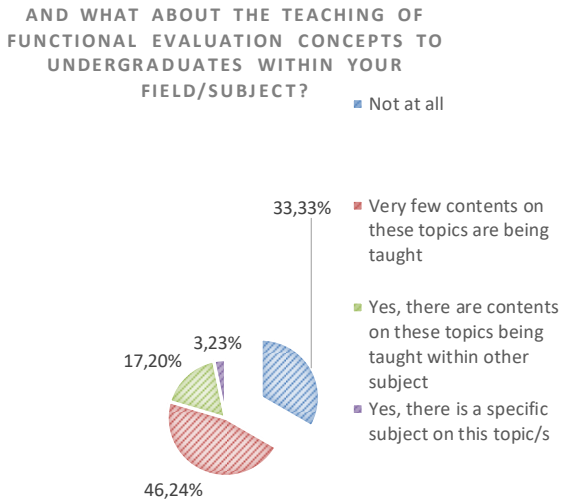
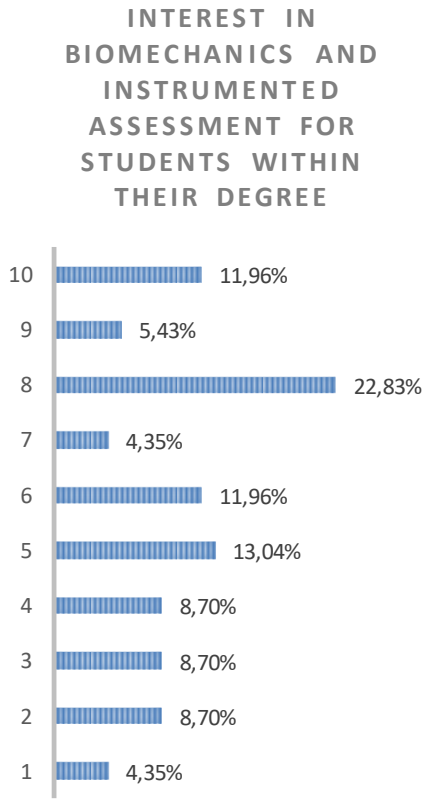


Figure 16. The teaching of functional evaluation (FE) concepts within your field/subject.

The average interest in biomechanics and instrumental evaluation for students within their degree is: **6,0**. And the average interest in formal contents on functional evaluation (FE) within their degree is: **6,3**. See Figure 17 and 18.



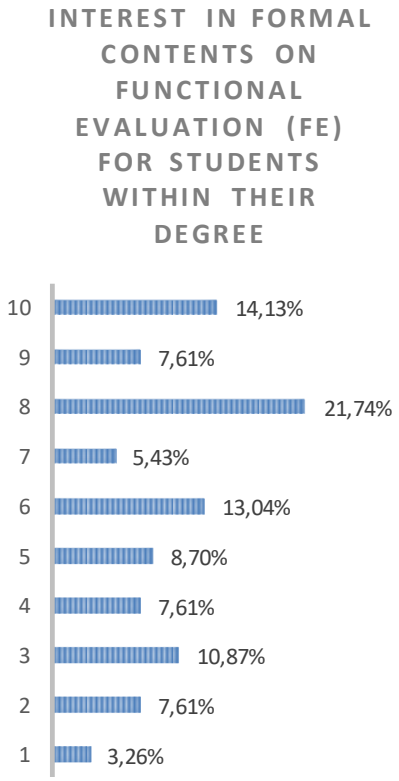


Figure 17. Interest in Biomechanics and instrumented assessment (from 1 to 10)

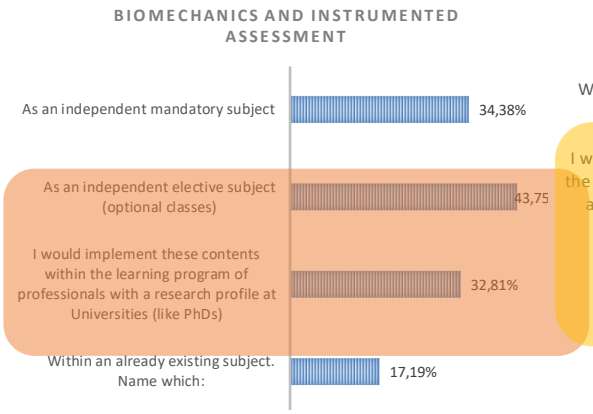


Figure 18. Interest in Formal contents on functional evaluation (FE) (from 1 to 10)

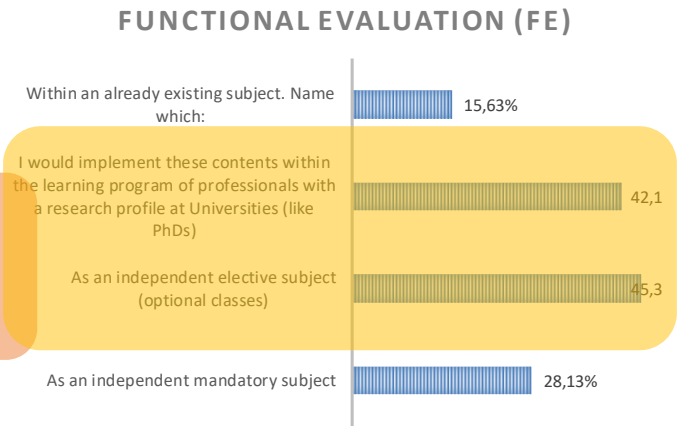


Figure 19. Biomechanica and insturment assessment.

Figure 20. Functional evaluation (FE)

Most of the responses consider **biomechanics and instrument assessment** *as an independent elective subject (optional classes)* (43,75%). (See Figure 19). And most of the responses consider **Functional evaluation (FE)** *as an independent elective subject (optional classes)* (45,31%) too. (See Figure 20).

4.6. Training needs

The most important contents are (from most to least important):

- **General aspects of human biomechanics (including definitions of physical concepts like forces and accelerations).** (2,25 of average)
- **Integration of physical health, cognitive (mental) health and social integration in diagnosis and treatment of musculoskeletal impairments.** (2,19 of average)
- Basic concepts on instrumented techniques for functional assessment and interpretation of data provided by each. (2,18 of average)

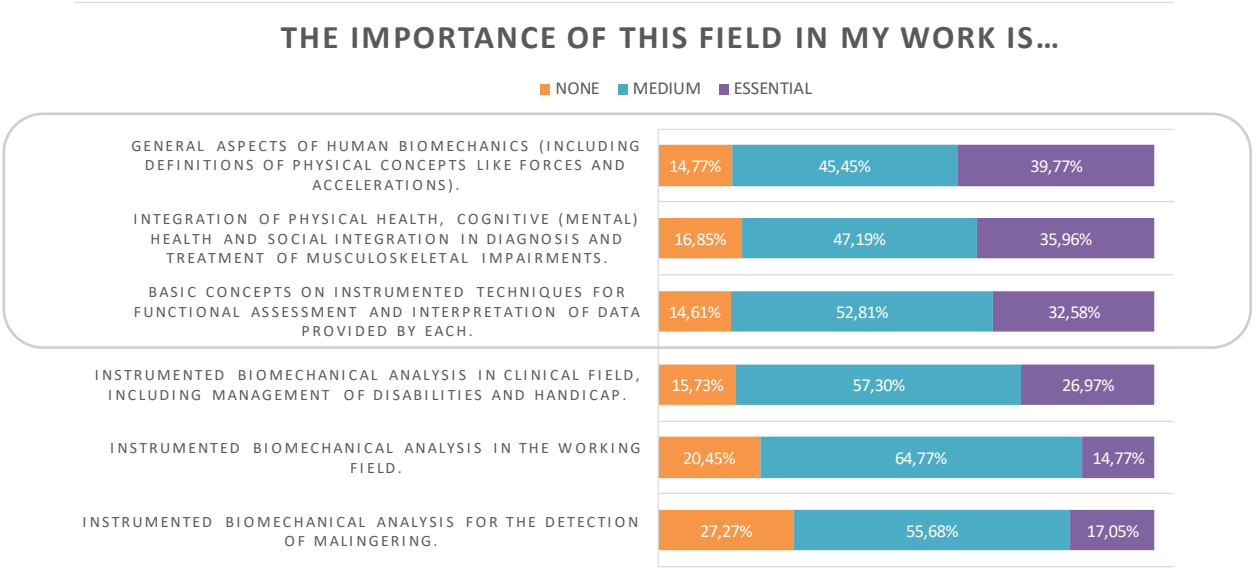


Figure 21. Importance of this fields

4.7. Contents features

- 86,91% of the sample considered appropriate online training in Biomechanical Assessment. (See Figure 22)
- 67,42% of the sample thinks that the quality of online training and the content directly communicated from lecurers will grow because of the use of the methods that encourage the own work of students / listeners. (See Figure 23)
- The most useful methods are: *instructional videos* and *project based learning*. (See Figure 24)

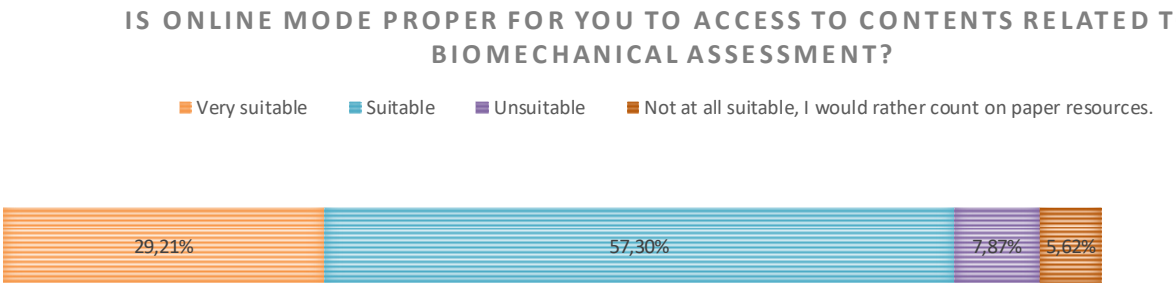


Figure 22. Online mode

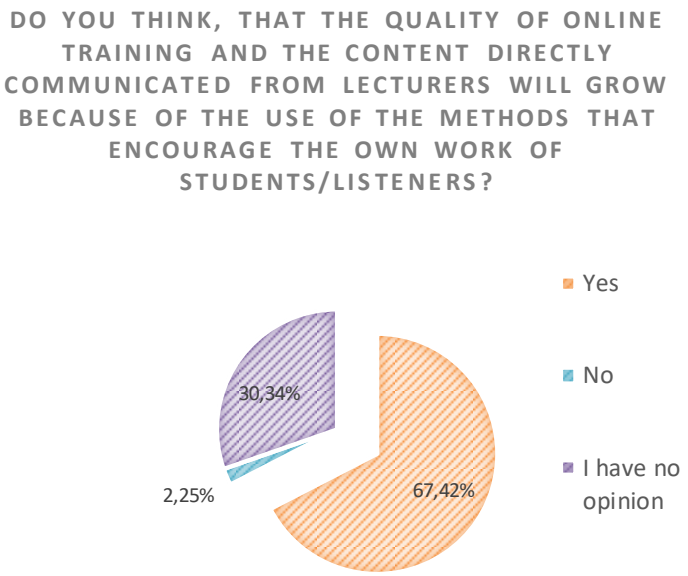


Figure 23.

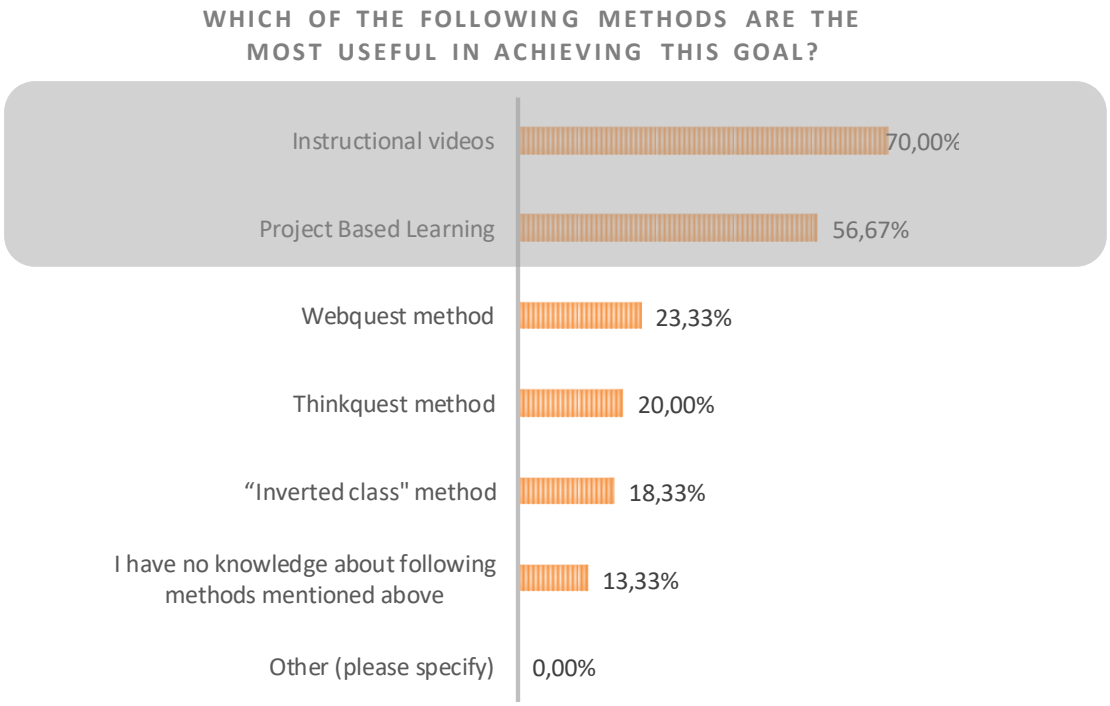


Figure 24. Methods more useful

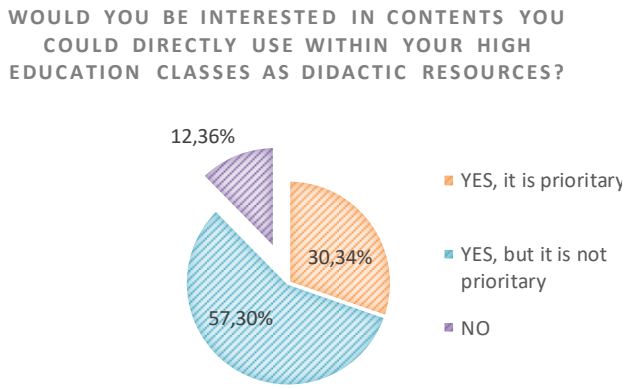


Figure 25.

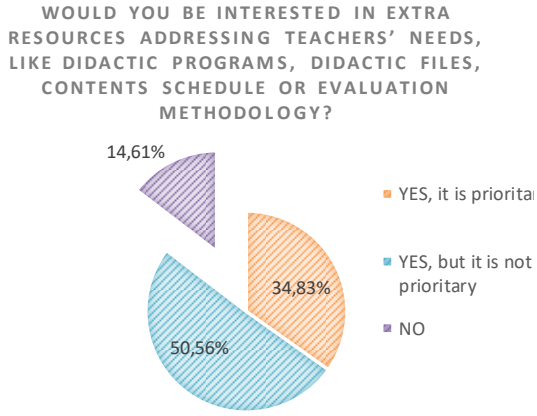


Figure 26.

The kind of content that professionals consider most interesting are:

- Theorical multimedia contents (videos, presentations, etc.) (71,59%)
- Clinical cases to use when teaching students (71,59%)
- Multimedia exercises that could be done by students (like virtual labs, virtual consultations, etc.) (50%)

The lenght most appropiate for the contents is:

- 30 minutes or less of content per file. (57,95%)
- Up to 60 minutes of content per file (36,30%)

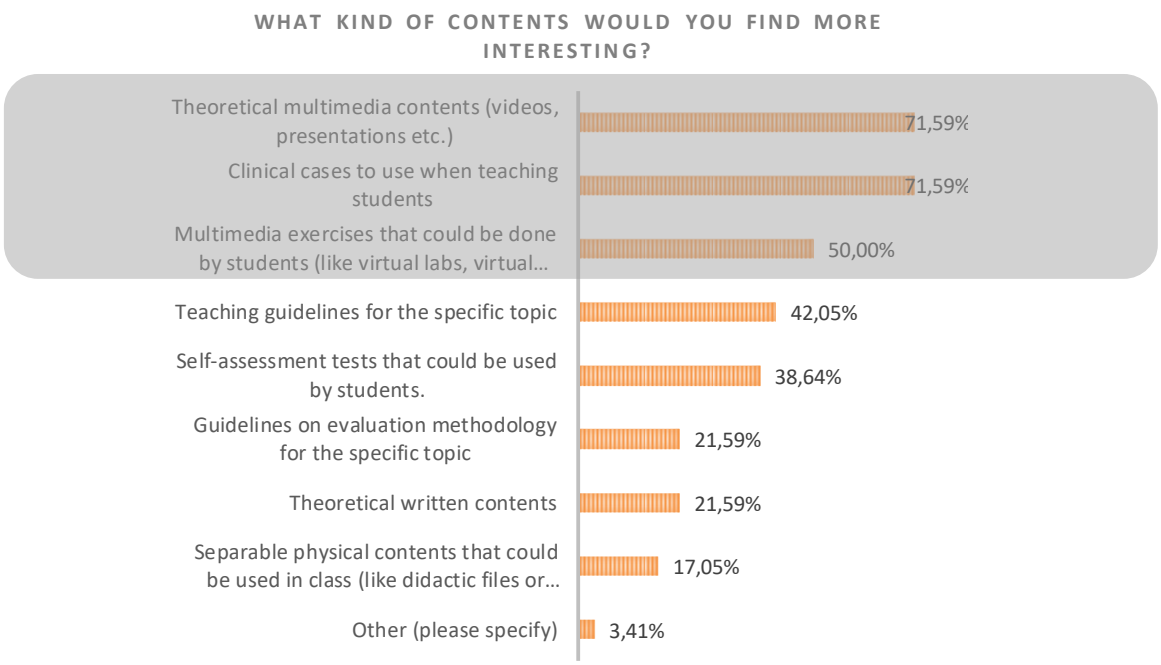


Figure 27. Contents more interesting

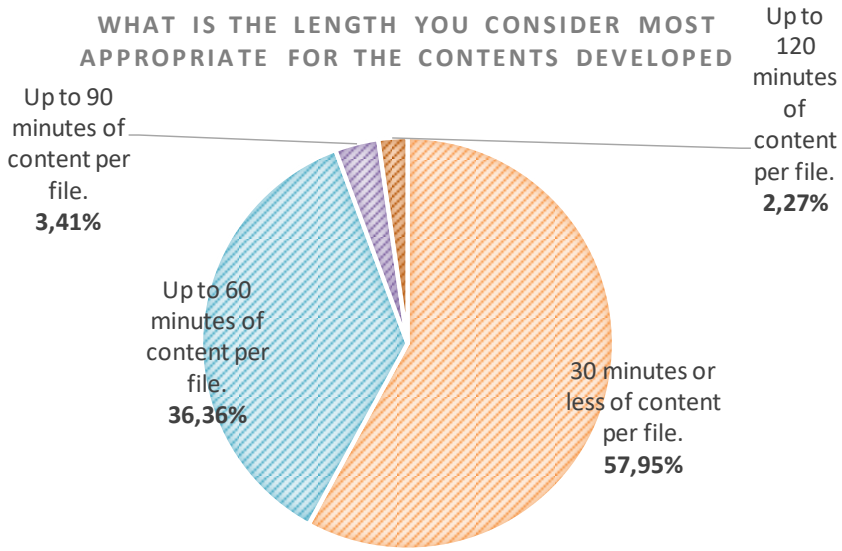


Figure 28. Lenght per file

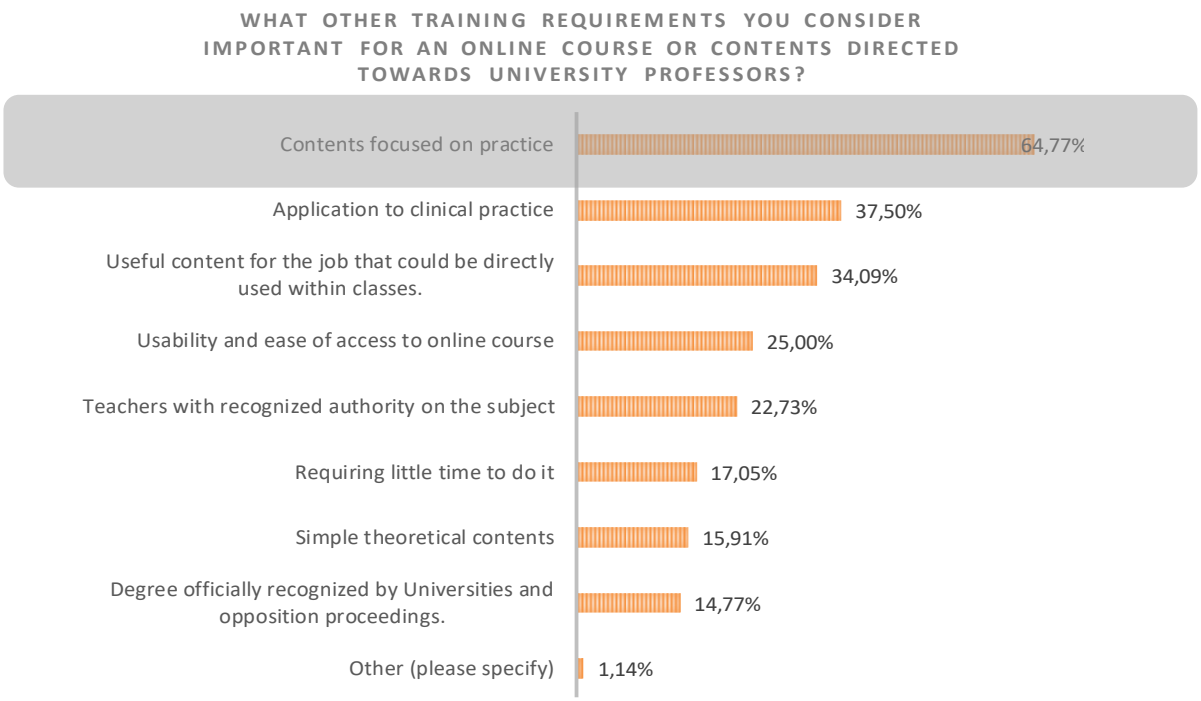


Figure 29. Other training requirements

Finally, the most important requirements for a course are (from most to least important) (Figure 29):

- **Contents focused on practice (64,77%)**
- **Application to clinical practice (37,5%)**
- Useful content for the job that could be directly used within classes (34,09%)

5, Conclusions

5.1. Qualitative results

Spain

- The knowledge about biomechanics in the teachers of health sciences of the University of Valencia is limited, general and not very specialized.
- The biomechanical training of health sciences teachers could help to introduce more contents in biomechanics in the subjects that are already offered in the different undergraduate studies.
- The limited non-work time of health science teachers could limit enrolment in the TEACH course or end it.
- The preferences of the teachers in relation to the methodology of the course are: dynamic, practical, audio-visual, downloadable content and with some face-to-face sessions if possible.
- In relation to the contents of the course, each profile has interest in different topics of biomechanics according to their specialty. However, there is a general interest to learn the use and usefulness of biomechanical assessment instrument and functional analysis techniques.

- The preferences of the duration and schedule of the course vary among teachers. However, the option of a course with modules so that each profile can choose which training area they want, seems to be a good alternative.

Germany

FE in Health Sciences and Human Medicine:

- There are relevant connecting points and differences between Health Science Universities and a Human Medicine curriculum relating to functional evaluation with focus on instrumented biomechanics techniques. It is obvious that FE of biomechanics plays a role in many health professions especially physiotherapy, occupational therapy, and sports sciences or sports therapy, all of which have a strong relation to the locomotor system. In human medicine though, there may be differently focused views on biomechanics assessments, emphasising the role of FE in medical diagnostics and therapy control, also in connection with diagnostic imaging.
- Medical research in the field of FE also includes implanted sensors (instrumented implants), which is omitted here as a topic due to its minor relevance in undergraduate training.
- When taking decisions based on diagnostic information derived from instrumented biomechanics analyses, any doctor should be well trained in the evaluation of this information and be able to interpret the possible measurement biases. The quantification of human biomechanical properties underlies individual internal and external influences that must be taken into account to reach comparable and reliable measurements values.
- This all seems only possible to integrate in undergraduate training, if there is enough curricular time and specialized courses with FE-related diagnostics available.

"High touch" vs. high tech:

- Manual diagnostics and palpation skills play an important role in medical functional assessments. They are the basis for many other skills in the instrumented analysis of biomechanics and should be trained in undergraduate PRM with considerably higher intensity, and with a more intense relation to function than to structures only. The current curriculum teaches basic skills in joint examination but lacks the holistic functional aspects of a thorough bodily examination of the locomotor system. Training in instrumented Functional Evaluation tools would optimally accompany this learning objective. A proposed course in Functional Evaluation techniques, manual as well as instrumented ones, could be called: "High touch and high tech – assessing physical function and impairment with manual palpation techniques and instrumented biomechanics analysis tools" ("high touch": quote of G. Jonitz, Berlin, Germany). Contents should follow the above-mentioned learning goals in table 3 for instrumented tools. For non-instrumented tools a concise hands-on course of basic manual palpation techniques could be implemented, amending the current structure-oriented examination courses.
- In the PRM specialty training it is necessary to achieve competences on both sides: the manual skills and the non-instrumented assessments, and the instrumented assessments of human biomechanics. Both complement each other, but the interpretation of instrumented analyses in many cases is limited if there is not enough basic knowledge in the field of non-instrumented

assessments. This experience should be taken into account when planning instrumented FE analysis training for undergraduates.

Variation of technical systems:

- Often, technology for instrumented biomechanics analysis is based on technical systems which have unique propositions or branded company elements and thus cannot be used interchangeably from facility to facility or from hospital to hospital. Few biomechanics analysis technologies have successfully reached a prevalence that allows a generally valid operation of comparable systems. For example, instrumented gait analysis or posturography can be learned with certain systems as available in the training facility. Yet, due to the large variation of analysis systems, one would usually not be able, without further training, to perform a gait analysis or a posturographic analysis with a system of a different manufacturer. The training level for those instrumented biomechanics analyses will thus be on example level at the maximum.

Conclusions:

- Physical and Rehabilitation Medicine is the specialty which is predestined to teach Functional Evaluation skills in undergraduate training of human medicine. The current possibilities of the actual training curricula are (largely) exceeded by the above identified training needs. The displayed needs imply more curricular time for teaching FE competencies as well as specialized didactic competencies and teaching equipment on the side of the educators.
- Future developments like demographics, technical possibilities, and value-based medicine with functional outcomes of therapies as quality indicators or even pay-for-performance models of reimbursement, will underline the role of Functional Evaluation training, not only in PRM specialty training, but also in the general training of undergraduates. This encompasses functional evaluation technologies or instrumented analysis of biomechanics.
- In human medicine, it should be acknowledged that training in instrumented analyses of functioning have to be integrated into a generic set of assessments, which also includes diagnostic imaging under a functional viewpoint as well as a larger scope of non-instrumented assessments.

Prospects:

- Due to the expected reform of German learning objectives for human medicine and the implication of competency-based learning objectives, there is a new chance of integrating functional assessments - and instrumented biomechanics analyses - on the basis of the International Classification of Functioning into the curricula.

Poland

- Generally speaking the topic of Functional Evaluation is not obvious regarding understanding. Each medical domain interprets this concept in different way. That is why it is strongly recommended to define FE clearly in the certain context.
- These ambiguities are also connected with biomechanics. This topic is e.g. known and it is a matter of education in dentistry domain. However in this domain FE is not known.

- FE is rather connected with health prevention and education.
- Normally Biomechanics is a subject of physiotherapist and rehabilitation domain of medical schools and first of all schools of physical education. The curricula are mostly connected with such topics like: testing of forces and speed capabilities; testing of postural stability; biomechanical gait analysis, human motility, functional anatomy, holistic rehabilitation, functional physiotherapy.
- There is known concept functional diagnosis - this is topic connected to physiotherapy and rehabilitation. The training contents can be directed to this domains.
- There are no formal trainings regarding instrumental biomechanics and especially FE.
- Regarding medicine normally if we think about FE as a holistic approach to diagnosis and treatment, we should remember that any additional interview or test with patient means more time for visit. Taking into account that usually statistical patient has 15 minutes per visit it will be very problematic to implement FE approach. It is recommended to create a procedure explaining for who, when, under what kind of conditions doctors could use FE approach.
- In order to identify specific needs in terms of education related to the topic of biomechanics and functional evaluation recommends research questionnaire among a single group of respondents. Respondents should be characterized, among others similar professional experience. It is recommended to test:
    - *final-year students* from various medical faculties and about the medical (eg. The Faculty of Medicine, rehabilitation, physical education academies)
    - *doctors and physiotherapists* with low professional experience (eg. under 3 years). There is a presumption that a person entering the career path will be able to identify the lack of knowledge and identify gaps in the curricula.

5.2. Quantitative results

Sample:

- The vast majority of the respondents were women, aged between *46 and 55 years*, and the largest number of responses is from Spain and Poland.

Field specialitzation:

- Most of the respondents have a specialization in **medicine and physiotherapy**, and their actual position are *Professor at university* and *Associate professor*.

Experience in health sciences education field:

- The most experienced group of respondents**, more than 15 years of experience**, and the field or subject/s of teaching most represented are Internal medicine / Medicine / Internal disease, Biomechanics, and Physotherapy.
- 66,32% of respondents have a biomechanical laboratory within their universities.

Previous knowledge in biomechanics and functional evaluation (FE)

- 44,09% have not received any formal training of Biomechanics.
- 38,04% have not received any formal training of Instrumented Assessment
- Clearly, the knowledge in Biomechanics is greater than that of Instrument Assessment.
- The modality of *no formal training* most frequently are: *I have not received any of these trainings*.

- To the question, *Have you ever met Functional Evaluation concept?* They have responded mostly: NO. In addition, the vast majority of the respondents *knowns some, but they haven´t received ant formal training*.

Personal interest and current state of training in Biomechanics

- Only 11,46% of respondents, consider that to count standarized official training in human biomechanics and instrumented assessment is not important. The remaining 88,54% consider that YES.
- The reality is that *Very few contents on these topics are being taught* both in *Biomechanics and instrumented assessment* and in *Teaching of functional evaluation concepts*.
- The average interest in biomechanics and instrumental evaluation for students within their degree is: **6,0**. And the average interest in formal contents on functional evaluation (FE) within their degree is: **6,3**.
- Most of the responses consider **biomechanics and instrument assessment** *as an independent elective subject (optional classes)* and most of the responses consider **Functional evaluation (FE)** *as an independent elective subject (optional classes)* too-

Training needs

The most important contents are (from most to least important):

- **General aspects of human biomechanics (including definitions of physical concepts like forces and accelerations).** (2,25 of average)
- **Integration of physical health, cognitive (mental) health and social integration in diagnosis and treatment of musculoskeletal impairments.** (2,19 of average)
- Basic concepts on instrumented techniques for functional assessment and interpretation of data provided by each. (2,18 of average)

Contents features

- 86,91% of the sample considered appropriate online training in Biomechanical Assessment.
- 67,42% of the sample thinks that the quality of online training and the content directly communicated from lecurers will grow because of the use of the methods that encourage the own work of students / listeners
- The most useful methods are: *instructional videos* and *project based learning*.
- The kind of content that professionals consider most interesting are:
    - Theorical multimedia contents (videos, presentations, etc.).
    - Clinical cases to use when teaching students.
    - Multimedia exercises that could be done by students (like virtual labs, virtual consultations, etc.).
- The lenght most appropiate for the contents is *30 minutes or less of content per file*.
- Finally, the most important requirements for a course are (from most to least important):
    - **Contents focused on practice**.
    - **Application to clinical practice**.
    - Useful content for the job that could be directly used within classes.

Politechnika Śląska

IBV INSTITUTO DE BIOMECÁNICA DE VALENCIA

VNIVERSITAT DE VALÈNCIA

AMSE THE ASSOCIATION OF MEDICAL SCHOOLS IN EUROPE

Erasmus+

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