Development of innovative Training contents based on the applicability of Virtual Reality in the field of Stroke Rehabilitation

Training Content Report

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Contents

1. Introduction

This document describes the intended structure, content and administrative arrangements for a training programme responding to the specific needs of professionals engaged in stroke treatment and rehabilitation.

As such, the addressed issues have their characteristics, circumstances, sizes concern, and unique design complexities, as well as product and market magnitude as well as potential demands for both contextual and socio-cultural uniqueness. It is expected that any training programme that aims to prepare students for such demanding realities need to be both flexible and capable of accommodating a wide range of individual application orientations that are seen as highly relevant for its participants. For this purpose, the programme is flexible, accommodative for the students to follow at own pace, using a variety of pedagogic methods.

The interactive parts can either be implemented through pre-programmed discussions, or alternatively, using e-learning methods to promote collaborative peer learning, where blogs, online discussion forums, online meetings services, chats, etc. are alternative methods to the traditional tutorial interactions with the participants using the online learning modality.

Considering the wide range of application areas, the competencies catered for in this training programme, the wide range of unique contexts in which these competencies are potentially being applied by the participants, as well as the competency range and experimental richness which the participants presumably already possess when entering into this programme, and what the programme also have to have catered for, including the capability to cater for in terms of the experiential and knowledge heterogeneity among its participants, it can easily be concluded that the programme has to be accommodative in its structure.

2. E-learning course methodology

Each module program has been designed according to a wide range of capabilities and existing skills of the trainees.

2.1 Course general resources section

The student will find the following general resources for the course:

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- **A bulletin board and news:** where the facilitator reminds students important dates for the course, and any news of interest.
- **The forum of the course:** with the participation of the lecturer and the facilitator of the course to answer all questions and queries from students.
- **Library:** a collection of resources, including peer reviewed journal articles, selected by the lecturer.
- **Utilities:** selection of programs that the student may require to follow the course (unzip, pdf and documents viewers, etc.).

Before you begin section:

This section is designed for students to review it before starting their online programme. Section consists the following:

- **FAQ**: is a collection of answers to questions often raised by most students on the operation of the online platform.
- **Teaching Guide**: a document specifically developed for each course which contains all the information needed by the students to get the most out of their efforts. This section is organized as follows: introduction, objectives, agenda, timing, methodology, resources, teaching and assessment team.

Course structure

The course is divided into different modules. Each module is divided into sessions which correspond to learning units and must have duration of about 3 hours. Figure 1 shows a flowchart summarizing the course structure.

Each work session starts with a short section in which the main objectives are stated. This section is followed by the corresponding didactic unit and ends with a reinforcement activity which must be completed by the student using the online platform. This activity consists of an exercise automatically corrected by the system and the results are reported to both the student and the course facilitator.

When the student has finished all the sessions of the module, he or she must complete the self-evaluation test. The student must pass the tests corresponding to all the modules before doing the final examination which will be necessary for the student to get the corresponding qualifications or certificate.
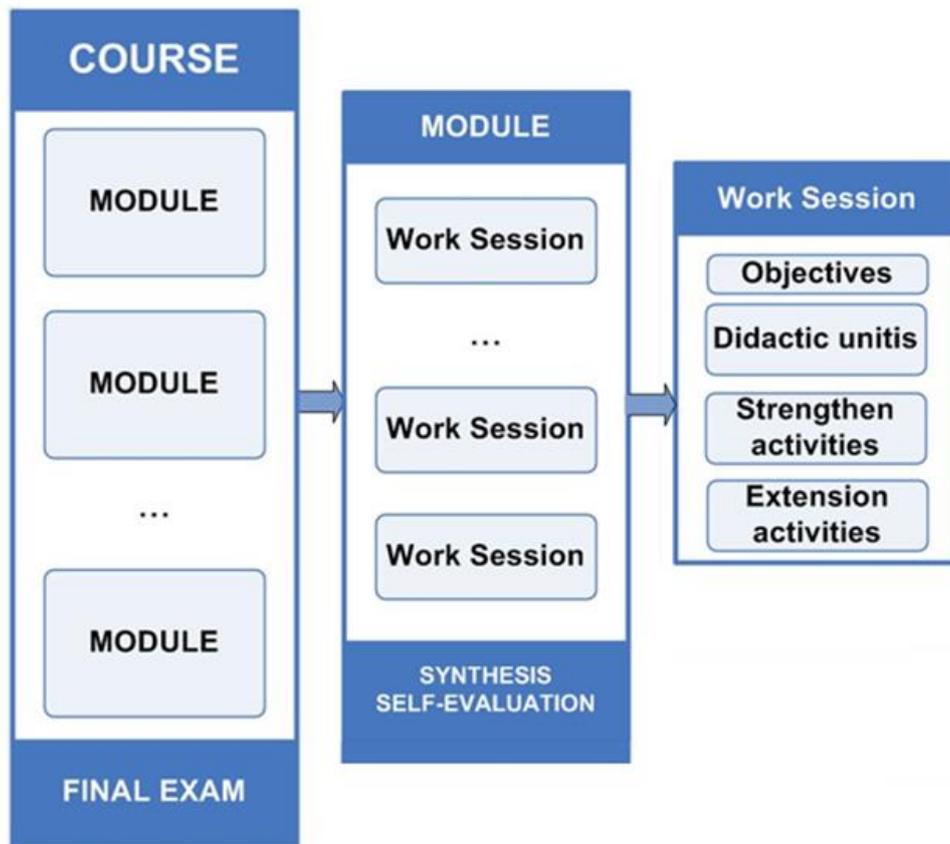
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Figure 1. Online course structure

The structure of a working session is:

Introduction: This is a brief presentation (or summary) to introduce the student about the main topics of the session. This is normally a plain text with ideas, thoughts, etc. It may also include activities, links or external documents to provoke a student for reflection. The previous ideas can also have a specific question, and the answer to this question can be shared with the other students and provoke a debate into the course forum.

Teaching unit: a downloadable pdf document containing the main topics to study. It is divided into:

Objectives: are the learning objectives of the working sessions,

Topics: are the main contents developed by the lecturer,

Key ideas: they are the fundamental concepts emphasized by the lecturer to be discussed in the session.

Activities: Each work session includes a series of exercises for the student to consolidate the knowledge acquired by putting them into practice.

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The general structure of each topic will include some of the following pedagogical resources:

Bibliography and references. Each unit will include both references cited into the text and additional bibliography recommended to expand the reading. The online structure of the course will permit that the citing is dynamic and each cite can lead to its reference.

Images and illustrations. All the contents will be widely enhanced and explained with images, tables and graphs. The images will allow not only to explain and expand some concepts treated in the text, but also to ease the student's understanding of the subject matter.

Insertions. To avoid plain text and transform the linear reading into more active reading, the text in each unit will have specific insertions with the purpose of reinforce the content. The main insertions considered for the Brain4Train course are the following:

Concept. Important concepts or cites.

Examples.

Remark boxes. Useful to emphasize or summarize some important concept that you have previously developed.

Enlargement of concepts. Additional information, that is not strictly necessary, but that can enlarge the knowledge about one particular topic.

Insertions:

Concept

An important concept can be put in this space

Example

You can put here an example to illustrate what you are explaining

□□□□□□□□□□□□□□□□□□□□□□□

This box can be used to emphasize or summarize some important concept that you have previously developed.

Enlargement of content: TITLE

You can put here additional information, that it is not strictly necessary, but that can enlarge the knowledge about one particular topic.

All working sessions have the same structure of content, except the last session of each module: the session "to finish". This session can have the following items:

- **To learn more:** a space to expand knowledge about the topics covered in the module.
- **Glossary:** a space where the student can study the most important concepts explained during the module.
- **The forum of key ideas:** in this forum the student will have to present to the rest of the group the most important aspects learnt during the module in order to summarize them and obtain a list of key ideas.
- **Self-assessment questionnaire:** the student must pass an assessment or fulfil a questionnaire to move to the next module. The student can undertake the assessment as many times as he or she wants. The system will display their successes and mistakes and give information about what content should be

reviewed based on their answers. In the case of a formal training system, the realization of the self-assessment is not reflected in the final grade.

- **Multimedia materials:** a collection of multimedia resources which show in graphical way the application, in real context, of the contents described during the module.

When the student starts the online course, he or she will obtain help from two external experts:

- Academic tutors: They are members of the organizations involved in the creation of the learning contents, and solve academic doubts or questions from participants in the course. In addition, they have a dynamic participation in the different communication channels available for the participants: forum, conversations and electronic mail. Their mission is to create a collaborative learning environment, offering the participants support and orientation.
- Facilitator: Acts as a link between the students and the tutors and technicians of the course. Each partner will appoint a facilitator who will communicate with the participants in the course in their native language and with IBV in English. The facilitator guides the participants along the development of the course, tracking their advance and providing diverse information (welcome message, instructions, reminders, qualifications, etc.).

After performing the e-learning course, the student has to pass a final examination in order to obtain the Certificate of Completion of the course.
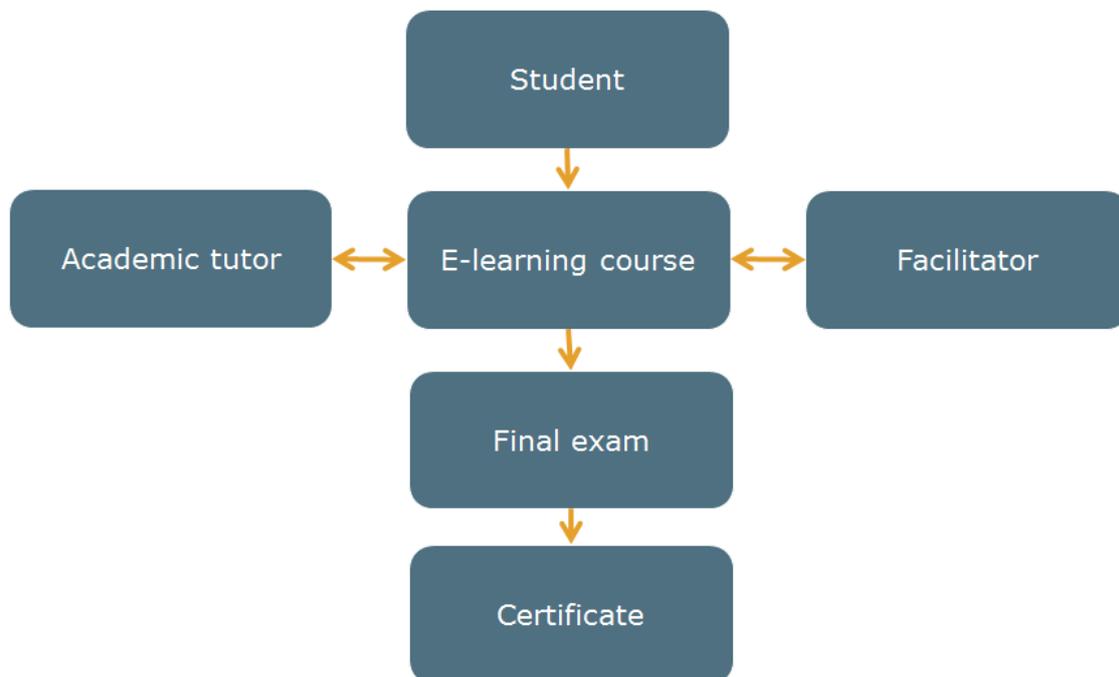

Figure 2. Overview of the online course

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2.2 Implementation of the online course

Access to the online course

The application will be placed on the telematics platform of the IBV (Virtual Campus IBV https://campus.ibv.org). In order to access the online course, the user must identify himself or herself introducing the passwords that will be provided after their enrolment in the course.

Didactic units

According to the defined modules and sessions, the didactical material will be compiled and classified. Each session will be developed using the LESSON Module of Moodle.

This resource presents a series of HTML pages to the student who is usually asked to make some sort of choice underneath the content area. The choice will send them to a specific page in the lesson. In a Lesson page´s simplest form, the student can select a continue button at the bottom of the page, which will send him or her to the next page in the Lesson.

What the student sees:

- A student clicking on a Lesson will see an introductory page with one or more buttons which they chose from to select the path they wish to take.
- The display may vary according to how the tutor has set up the lesson in Lesson settings. For example: there may or may not be a list of pages down side; there may or may not be an ongoing score.
- Students' progress through the lesson with either content pages or various types of question pages. When a question page is used, the following page gives the answer and feedback if offered:

- The lesson is ended when the student has met the criteria set by the tutor. This could be answering a certain number of questions correctly, accessing a certain number of pages with content or following a certain navigational path. A final page appears where the student can check their score, if applicable, a return to the main course page.

Each session will be presented in two ways:

- Lesson Module.
- PDF file which contains a summary of the contents presented in the Lesson Module.

Reinforcement activities

The different activities included in each work session will be included and programmed within the online application so that they are automatically corrected, and as a result the correct answers are displayed. These activities consist of several questions in

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which the student must complete multiple choice tests, match images with the corresponding definitions, etc.

Self-evaluation tests

Before finishing a module, a self-evaluation test must be performed before starting the next module. The self-evaluation tests will be normally questions of 3 or 4 answers, where the user must select the correct one. When finished the test, the application will correct it automatically and will show the mark obtained.

Final examination

After finishing every module, the last step is to take the final examination. It will consist of questions for every module, where the user must select the correct answer. The final examination will not be available to the user at any time, but it must be done only during one day (the date of the final examination will be stated before starting the online course). The user will perform it at home, but he or she will have only 45 minutes to complete it. That means that the user will have to study for passing it if he or she wants to complete it before finishing in time.

Duration of the online course

The time needed to complete the entire online course has been estimated in 50 hours; to be performed during a period of time of two months. A calendar will be prepared as a help for the users to finish the course on time. Depending on the extension and number of sessions of each module, the calendar will suggest the number of days needed to study them. As explained in the previous section, the final examination will be performed the last day of the course.

Grades

A final mark will be calculated from the results of the final examination, as well as from the self-evaluation tests and reinforcement activities of each module.
The following points summarize the grading system:
- The 60% of the global grade corresponds to the result of the final exam, and the remaining 40% corresponds to the score obtained from the three modules.
- The mark obtained for each module is calculated as the weighted sum of the marks obtained in the activity and the self-evaluation test (both are graded from 0 to 10). These weights are:
  o Reinforcement activities: 50%
  o Self-evaluation test: 50%

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The results of the exam and self-evaluation tests are graded from 0 to 10. The contribution of each mark to the global grade is calculated by multiplying this by the assigned weight.

Course certificate

After doing all the modules with their respective activities and self-evaluation tests, and passing the final exam, the user will get a Certificate of Completion of the course.
The Certificate of Completion will contain a description of the learning outcomes (knowledge, skills and competences) acquired by the student once he had completed the course.

3. Brain4Train online course

From the obtained results of formative detection phase described in the Survey Report (ID.1.2), the proposal of modules and sessions of the complete online course is shown below:

MODULE 1: INTRODUCTION TO STROKE REHABILITATION

Session 1: Stroke: clinical features, impairment and functional evaluation from a holistic point of view **(IBV)**

DESCRIPTION

Overall insight about physiopathology, epidemiology, clinical features, prognosis and functional evaluation in stroke. Highlighting the importance of a comprehensive evaluation of impairments.

LEARNING OBJECTIVES

- To introduce the general aspects of stroke accidents including classifications, symptoms, risk factors, functional disabilities,
- To know about physiopathology, epidemiology, clinical features in stroke,
- To introduce functional evaluation in stroke,
- To expose comprehensive approach to evaluation of impairments.

Session 2: Stroke and rehabilitation. State of the art and scientific evidences. Clinical Practice Guidelines **(IBV)**

DESCRIPTION

This session will focus in present scientific evidence on rehabilitation in stroke. This will be done by an exhaustive review of literature, with a special interest in CPGs. All kind of functional impairment should be considered (cognitive, motor, sensitive).

LEARNING OBJECTIVES

- To know the up-to-date research outcomes about rehabilitation in stroke,
- To identify functional impairments in the fields of cognitive, motor and sensitive,
- To introduce scientific evidence on rehabilitation regarding cognitive, motor and sensitive functional impairments,
- Motivation aspect of rehabilitation process in stroke.

*Session 3: Introduction to new technologies in rehabilitation. Neurophysiological basis and State of the art. **(FPM)***

DESCRIPTION

The scope of this session is to show how technology can help in the rehabilitation process of patients with acquired brain injury (ABI). From the use of robotic devices (like Lokomat or other kind of exoskeleton devices), to the most accessible and usable systems (like apps aimed to enhance cognitive&language skills). A brief introduction to biomechanics and Virtual Reality should be done. In addition, it is important to support contents with scientific evidence available in each case.

LEARNING OBJECTIVES

- To introduce the technology-based rehabilitation of people with ABI,
- To introduce the biomechanics and Virtual Reality,
- To know a typology of devices that support stroke rehabilitation,
- To know the functionalities of different robotic devices supporting stroke rehabilitation,
- To know evidence-based cases of using different type of robotic devices in stroke rehabilitation,
- To know the positive (strength) and negative (weaknesses) aspects of using innovative technologies in stroke rehabilitation,
- To understand the importance of robotic devices in post-stroke rehabilitation – how to motivate patients to rehabilitation process

General topics:

IBV can collaborate in the development of contents related to neurophysiological foundation of each technology/device, and on how they would produce any improvement in patients` impairments.

MODULE 2: BIOMECHANICS IN STROKE REHABILITATION

Session 1: Introduction to Biomechanics. Clinical Basis&Usefulness in the Rehabilitation Field **(IBV)**

DESCRIPTION

Throughout this session, the trainee will find content related to the basis of biomechanics, and the ways in which it can provide support during the rehabilitation process in stroke.

LEARNING OBJECTIVES

- To know the scope and definition of biomechanics,
- To know how to biomechanics can support rehabilitation process of post-stroke patients,
- To know the range of application of biomechanics in post-stroke rehabilitation,
- To know how to monitor patients' rehabilitation progress with biomechanics support,
- To know how to integrate biomechanics with Virtual Reality tools,
- To understand the importance of including biomechanics in rehabilitation process.

Session 2: Biomechanics and functional assessment of Gait in Stroke **(FPM)**

DESCRIPTION

This session will focus on biomechanical aspects of normal and pathological gait, typical findings in stroke, and how this function can be objectively evaluated by means of specific instrumentation.

LEARNING OBJECTIVES

- To introduce gait rehabilitation concept,
- To introduce gait biomechanics (parameters, walking patterns),
- To introduce gait impairments in stroke patients,
- To know how to measure gait parameters,
- To know the procedures of how to assess and control gait ability of stroke patients,
- To know the tools and methods for gait functions assessment,
- To know gait training devices and how to use them,
- To know how to motivate stroke patients in gait rehabilitation and gait re-education.

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General Topics:

IBV can provide resources and develop contents related to biomechanics of normal and pathological gait, typical findings in stroke etc. In addition, we can provide with some examples of measurements made to real patients.

Session 3: Biomechanics and functional assessment of Balance in Stroke **(IBV)**

DESCRIPTION

This session will focus on biomechanical mechanisms to maintain balance and stability in normal and pathological subjects, and how they tend to be modified in stroke. In addition, it should explain how this function can be objectively evaluated by means of biomechanical systems and how these devices could be used as treatment assistants.

LEARNING OBJECTIVES

- To introduce balance rehabilitation concept,
- To introduce balance biomechanics (parameters, walking patterns),
- To introduce balance impairments in stroke patients,
- To know how to measure balance parameters,
- To know the procedures of how to assess and control balance ability of stroke patients,
- To know the tools and methods for balance functions assessment,
- To know balance training devices and how to use them,
- To know how to motivate stroke patients in balance rehabilitation and balance re-education.

Session 4: Biomechanics and its role in therapeutic decision-making **(IBV)**

DESCRIPTION

The contents of this session will expose the ways in which biomechanical instrumented analysis can provide help clinicians making decisions.

LEARNING OBJECTIVES

- To introduce the decision-making process of stroke rehabilitation,
- To know how to adjust biomechanical tools to different stroke therapies,
- To know the effectiveness and usability of biomechanical analysis in different stroke therapies,
- To know how to construct decision tables in the use of biomechanical instrumented analysis in stroke rehabilitation procedures.

MODULE 3: VIRTUAL REALITY IN STROKE REHABILITATION

*Session 1: Introduction to Virtual Reality. Clinical Basis&Usefulness in the Rehabilitation Field (**SUT**)*

DESCRIPTION

Throughout this session, the trainee will find content related to the basis of Virtual Reality, and the ways in which it can provide support during the rehabilitation process in stroke. It is important not to skip the neurophysiological foundation of how Virtual Reality would work.

LEARNING OBJECTIVES

- To know the scope and definitions of Virtual Reality – concept, hardware, software,
- To know how to Virtual Reality can support rehabilitation process of post-stroke patients,
- To know the range of application of Virtual Reality in post-stroke rehabilitation in regard to motoric and cognitive functionality improvements,
- To know how to use Virtual Reality tools in self-rehabilitation,
- To understand the importance of including Virtual Reality in rehabilitation process.

General Topics:

IBV can collaborate in the development of contents related to neurophysiological foundation of virtual reality, and on how they would produce any improvement in patients' impairments.

*Session 2: Virtual Reality as an assessment tool (**SUT**)*

DESCRIPTION

The scope of this session is to show how Virtual Reality can help assessing impairment in stroke.

LEARNING OBJECTIVES

- Introduce the role of Virtual Reality in assessing impairment in stroke – the scope of usability,

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- To know how to monitor patients' rehabilitation progress with Virtual Reality support,
- To know therapeutic effect of Virtual Reality on post-stroke patients,
- To know what kind of Virtual Reality tool can be used to asses cognitive and motoric functionality of post-stroke patients.

Session 3: Virtual Reality as a treatment assistant (SUT)

DESCRIPTION

The scope of this session is to show how Virtual Reality can help enhancing cognitive, motoric and coordination skills in patients suffering from ABI. .

LEARNING OBJECTIVES

- To know the procedures of how to assess and control gait ability of stroke patients,
- To know cases of using Virtual Reality tools in enhancing cognitive, motoric and coordination skills in post-stroke patients,
- To know how to adjust Virtual Reality tools to patients needs and expectations (motivation and effectiveness aspects),
- To know overview of games and Virtual Reality tools in stroke rehabilitation process.

MODULE 4: CASE STUDIES

Case Study 1: Assessing gait and balance in stroke (FPM)

DESCRIPTION

Focusing on practical aspects of measurement and the usefulness of the results in a clinical field.

General Topics:

IBV can provide with some examples of stroke patients in which biomechanical assessment of balance and gait has been performed.

Case Study 2: Virtual Reality used as assistant in motor and cognitive rehabilitation (SUT)

Case Study 3: New horizons: examples of use of other devices (FPM - SUT)

Brain4Train

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