



Ergonomics Intervention Project in Undergraduate Physical Therapy Program. A Curricular Innovation Approach

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Abstract. Competency-based education in ergonomics was incorporated into the physical therapy undergraduate educational program in the University of Chile in 2009 in conjunction with the construction of the graduation profile. The course “Ergonomic Intervention Project” is developed in the last year of the career (5 years of duration). The aim of this non-experimental, cross-sectional analytical design study was to evaluate the academic performance of the course and the students’ perceptions regarding the pedagogical and disciplinary domain. Forty-three students took the course. The academic performance was recorded and a survey was applied in order to evaluate pedagogical domain, disciplinary domain and general aspects. Academic performance average was 5.94 (min 5.28 max 6.51) on a scale of 1 to 7 with all the students approved. Thirty-three students answered the survey sent. Pedagogical dimension obtained a 2.87 score and the disciplinary domain a 3.41 score (Likert 1–4). Regarding the evaluation of the general aspects of the course, 73% was satisfied/very satisfied with the performance of the faculty team, 87% declared to know the evaluation criteria of the subject in a timely manner, 91% considered requirement of the course adequate. Student perception in the pedagogical and disciplinary domain were satisfactory. Teaching-learning strategies based on the experiential learning cycle, in context guided by expert teachers considering an educational competencies model, allow the habilitation in ergonomics themes in undergraduate students.

Keywords: Undergraduate education · Ergonomics · Curricular innovation

1 Introduction

1.1 Institutional Academic Undergraduate Degree Context in Physical Therapy

The educational model of the Universidad de Chile and the Faculty of Medicine have been considered for the construction of the formation plan for the career of physical therapy and the determination of competencies that contribute to the profile of the

graduates within a process of curricular innovation. Competencies of the undergraduate program are organized in five domains, which must act in an integrated manner to allow graduates to perform as pertinent, responsible, highly qualified professionals, committed to the needs of the country, along with an institutional seal that sets them apart. The five domains of competencies that are described in the current formation plan are Health and Study of the Human Movement; Investigation; Public Health and Management; Introduction to Teaching, and Transversal Generic Domain.

In the organization of the Department of Physical Therapy today, there are eight specific lines of development, in which the teachers must organize their undergraduate courses, articulating their domains of competencies in order to fulfill the declares profile of the graduate. The line of ergonomics is one of these subjects.

The process of teaching and learning of the students within this formation plan by competencies is based on active learning, on the foundation of the knowledge of structure and function of human anatomy integrated with the pertaining psychological and social aspects.

1.2 Ergonomic Competencies in Undergraduate Physical Therapy Students

Ergonomics is “the scientific discipline concerned with the understanding of interactions among humans and other elements of a system and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance” (IEA 2001). In this sense, an undergraduate education with professors that stimulate critical and reflexive thinking, integrating the physical and mental existence of the human being and his environment, would allow them to solve problems associated to the efficiency and effectiveness of human tasks (Barbosa and Pinheiro 2012a, b).

The competencies domains associated with undergraduate Ergonomics courses were constructed on the design of an infrastructure that allowed the organization of a progressive learning sequence of relevant content and disciplinary aspects. After this design, three specific courses were identified, based on the expected realization of each course, the associated learning goals and the pertaining strategies of teaching-learning, along with its evaluations. The Ergonomics courses based on competencies have been monitored since their launch and their development is evaluated in cycles, considering self-regulation and flexible learning options (Gruppen et al. 2012).

This proposal composes an innovative and unprecedented paradigm in the disciplinary area of professional formation in undergraduate ergonomics when we consider the health needs of society, which represent a challenge for academics involved in the development of teaching in ergonomics.

The branch of ergonomics in the Department of Physical therapy is composed of academic and disciplinary experts. The coursed related to Ergonomics have a representation of eight credits (27 h per credit) within the study plan and it considers the proposal of curricular innovation as a response to current disciplinary ergonomic needs. These courses are: (1) Course of Analysis of the relationship of the person to the environment, two credits; (2) Course of Ergonomic Evaluation, three credits;

(3) Course of Ergonomic Intervention Project, three credits. This takes place at the end of the career which lasts five years in its entirety.

The educational goal of the third course, the Ergonomic Intervention Program, is to promote critical thinking of patient-environment interaction in an ergonomic evaluation in order to promote interventions in a real-life setting. The associated learning outcomes are to analyze an ergonomic intervention, to identify main associated variables and propose a systematization of interventions in specific clinical areas.

The final competency defined for the course is to “apply ergonomic principles and criteria in different stages and levels of intervention of the physical therapist in human activity in areas of day to day activities such as work, recreational and within a clinical field and, as an associated subfield, identifying and evaluating the conditions of the relationship between a person and his or her environment, taking into account the physiological, biomechanical, histological, anatomical, sensorial, anthropometric, physical, environmental, dimensional and physio-cognitive factors.

On the other hand, there is an evaluation on a yearly basis, that is carried out by the students in order to revise the activity planning and programming as well as a proposal, carried out by the professors, for improvements, which transforms this course program into a dynamic structure around the definition of ergonomic competencies that were initially proclaimed (Gruppen et al. 2012).

Even though core competencies have been defined in ergonomics for work performance (Williams, IEA 2001), these can be initiated at an undergraduate level to allow a progressive articulation to postgraduate to answer to the continuing formation and the professional challenges that the ergonomic discipline involves in the particular context of Chile. Core knowledge, as well as basic applications of this core knowledge, the correct use of tools, processes and system integration, are the levels considered for the construction of courses in ergonomic (see Fig. 1). The focalization and advance in each level depend on the selection of content by the teachers for each course, as will the learning objectives that are set and the educational context.

The levels that are considered according to the educational needs of the undergraduate students, and the professional perspectives that the graduate must meet, correspond to a core knowledge and basic application, allowing the possibility to advance in the levels of tools and processes and system integration, in the formation courses that follow the graduation of that study plan. It will serve as a foundation for the specialization that follows.

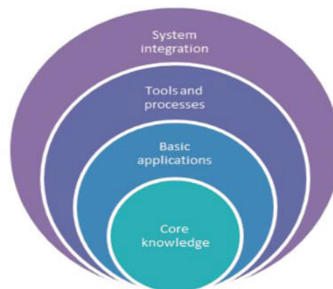


Fig. 1. Levels of knowledge in ergonomics education (Bures 2015).

1.3 Learning, Teaching and Evaluation Strategies in Ergonomic Intervention Project Course

The content prepared by the professors has the basic structure that follows the educational purposes proposed by the IEA (IEA 2001; Bridger 2012), in the two first levels:

Core knowledge: In this course, the knowledge and competencies of the two courses that have come before, in the branch of Ergonomics, are put into use in a way that we can identify work systems, carry on an analysis of a task and the relationship of a person with his or her environment and/or tools (first course). Following this, comes an ergonomic evaluation (as seen in the second course), which will be integrated into the third course in the process of an ergonomic intervention project in a clinical, work or day to day aspect, in order to improve the quality of people's lives in any health-related situation. It also integrates competencies of the clinical courses of the career, in order to generate integral physical therapy evaluations in the context of an ergonomic intervention, which is the foundation for the future professional's performance.

Basic Applications: they are founded on the use of basic knowledge so as to analyze and evaluate, using quantitative and qualitative criteria, the conditions and elements with which a person or a group of people interact in a real context. This will be the focus of the ergonomic intervention project, in order to generate a proposal to improve the conditions of the environment, interface adjustments and over life quality of the people.

The third course, Ergonomic Intervention Project, is in the last year of the career of physical therapy. It has three credits which correspond to 19 in-person hours and 62 non-present hours. It has two modules: the first is called, "Fundamentals for the development of Intervention Projects" and has a duration of three weeks which total 16 in-person hours and 14 non-present hours, and presents tools in audiovisual communication for the Intervention Project, as well as the conceptual foundation for the structure of the project, alternative configuration analysis of intervention systems and strategies, with learning strategies from lectures, non-present independent work, workshops and case-based learning (De Miguel Díaz 2005).

The second module is called "Intervention Project Development", it has a duration of 14 weeks and it is structured in a way that the student can draft and carry out the development of a project of ergonomic intervention in a real case in a clinical context, determining criteria for evaluation, evaluating and generating an intervention proposal. This module counts on the following learning strategies: external practice in a clinical field, self-studies, tutorials with assisted feedback, non-present independent work and procedure logbook (De Miguel Díaz 2005; Williams 2008).

The strategies for evaluation that are used by stages in the project are rubrics for the procedure logbook, a brief presentation of the pre-project and for the oral defense of the final project. The evaluation strategies are based on the Miller framework for assessing competencies in health, science, and education (Downing and Yudkowsky 2009; Gruppen et al. 2012) (Fig. 2).

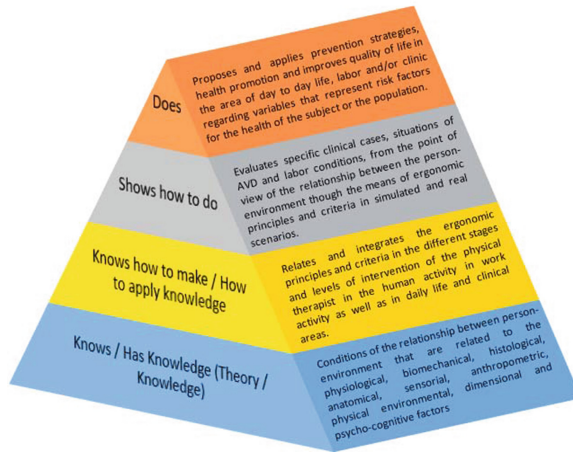


Fig. 2. Levels of competencies. Evaluation in ergonomics (Miller framework)

The comprehension of the learning strategies to solve, in an effective manner, the problems that are presented in ergonomics and in prevention, can contribute to the process of transition from the undergraduate program to the professional practice (Adam et al. 2014). The course involves strategies of teaching and learning individually and in small groups. The strategies of teaching and learning in small groups is based on the principles of experiential learning as well as the principles of constructivism, which proposes that people construct their own learning through experience, solving problems in a context of complexity given by their cognitive development, guided by a professor that oversees and serves as a sort of scaffold of knowledge that is built on a known foundation (Bures 2015; Taylor and Hamdy 2013).

The strategies used in a small collaborative group are (1) Case-based learning: Students must carry out the processing of the information among the members of the group for the resolution of real problems, utilizing the material prepared by the teachers and their independent work, stimulating the intrinsic motivation by delimiting interventions in a real context and within their own culture (Pintrich 2012). (2) Workshops: Based on the analysis of real life and simulated cases, students are guided by a team of teachers to develop approaching strategies to deliver a problem-solving proposal that applies to different scenarios. They are given and shown the diverse use of audiovisual communication tools to design digital solutions (blueprints, environments and the design of 3D tools), which has already been a formative and summative evaluation in the first module.

Another methodology used in the course is the Procedure logbook. This is enclosed at the beginning of the second module, so as the student can establish the different phases in the development "Ergonomic Intervention Project" in the procedure logbook. The second module coincides with the beginning of the student's first clinical internship, which is how the project focuses on a real clinical case, where the student must identify a problem and define it in his or her procedure logbook under the item: "Problem Statement based on a clinical case". Next to this item, they must state their project objective (General Objective and Specific Objectives). In the course of this phase, the students can lay out their doubts by means of a digital classroom (a platform

arranged by the university), which is managed by the mentor professor who has been assigned for each student.

The development of this process is stipulated in the procedure logbook recording the daily or weekly progress of the project on a timeline as well as the problems they are faced with and each step and decision made. This method is evaluated with a grade when it is sent digitally and also when it is explained in person to the mentor, who will then give a feedback.

Experiential learning allows the student to have a concrete means of experience, on which the student can produce a reflexive observation. It is through these reflections that the student is able to formulate abstract concepts and propose appropriate generalizations. For this, this cycle –that involves concrete experience, reflexive observation, abstract conceptualization and active experimentation– needs to consolidate itself by being applied to new situations that allow the student to cement the learning (Taylor and Hamdy 2013). This type of learning is built on the interaction in small groups (Seen in Fig. 3).

Students finalize their course with the presentation of their intervention projects in front of a teaching commission and are evaluated with a rubric with criteria for specific tasks, previously validated in content by the faculty team.

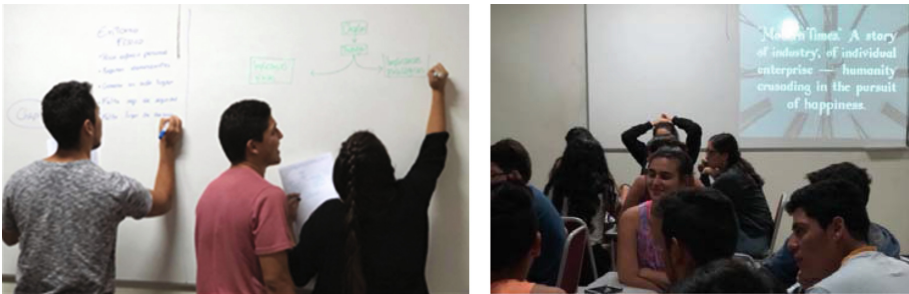


Fig. 3. Images in reference to work in small groups.

2 Methods

An analytic, non-experimental, transversal study was performed. 43 students fulfilled the course, 48.9% men and 51.1% women with an average age of 22 years (min 22 years, max 30 years). Academic performance was recorded, and an electronic survey was applied in order to evaluate general aspects, pedagogical and disciplinary domains. The analyses were performed using SPSS V. 21.

3 Results

Academic performance average was 5.94 (min 5.28 max 6.51) on a scale of 1 to 7 and all the students approved. 33 of 43 students answered the survey sent by academic electronic platform. In a Likert Scale from 1 to 4, a 2.87 score was obtained in the

pedagogical domain and 3.41 in the disciplinary domain. In regards with general aspects, 73% of the students felt satisfied/very satisfied with the faculty team performance, 87% described themselves as familiar with the criteria used for evaluation, 91% considered requirement of the course as adequate.

Table 1. General aspects evaluation and pedagogical – disciplinary domain

General Aspects				
	Categories			
	<i>Very Unsatisfied</i>	<i>Unsatisfied</i>	<i>Satisfied</i>	<i>Very Satisfied</i>
In general terms, I feel satisfied with the performance of the faculty team	3%	24%	67%	6%
Evaluations:				
	Categories			
	<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Agree</i>	<i>Strongly Agree</i>
I was given knowledge of the criteria of evaluation of the subject in a timely manner	3%	10%	52%	35%
	Categories			
	<i>Too low</i>	<i>A little low</i>	<i>Adequate</i>	<i>Too high</i>
In general terms, I consider that the level of demand of the course is:	0%	0%	91%	9%
Pedagogical Dimension				
	Categories			
	<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Agree</i>	<i>Strongly Agree</i>
The teaching methodology used in the course favored my learning and participation.	6%	25%	56%	13%
During the course, there were moments where I was presented with appropriate and challenging problems.	6%	15%	67%	12%
The activities and examples used in the course were closely related to the tasks of my profession.	3%	3%	81%	13%
The evaluations applied were coherent with the purpose and methodology of the course.	6%	3%	66%	25%
The feedback on the evaluations allowed me to reinforce my learning.	10%	23%	52%	16%
The faculty was clear when exposing, answering questions or clarifying doubts that I had.	6%	6%	66%	22%
Disciplinary Domain				
	Categories			
	<i>Strongly Disagree</i>	<i>Disagree</i>	<i>Agree</i>	<i>Strongly Agree</i>
In my opinion, the faculty showed domain over the subjects treated.	0%	0%	53%	47%
In my opinion, the bibliography of the course is pertinent and updated.	0%	6%	52%	42%

Regarding pedagogical dimension, 69% considered that methodologies promote participation and learning; 79% considered reflection instances were promoted when appropriate and challenging problems were raised; 94% considered activities and examples used were related with the profession requirements. 93% considered that the evaluations applied were coherent with course purpose and methodology; 68% considered that the received feedback allowed them to reinforce the learning process and 88% that the teachers were clear in the resolution of doubts.

Regarding to the disciplinary domain, 66% recognized teacher's commitment with students learning processes, 100% considered that teachers showed a complete management of knowledge of topics, and 96% considered the bibliography as relevant and updated (Table 1).

4 Discussion

This study presents the planning of competencies in ergonomics in a undergraduate course, the strategies of teaching and learning utilized and the evaluations carried out in a context of curricular innovation. The perception of the students as to the pedagogical and disciplinary domains of the course was satisfactory and all the students achieved the approval of the course, demonstrating an effective process of education by competencies.

There is a correspondence between the proposal of the authors regarding the international recommendations in education in Ergonomics (Bures 2015; IEA 2001), allowing for the preparation of the students in the career of Physical therapy of the University of Chile to fulfill their profile of competent graduates to analyze persons that present a certain degree of alteration in their functionality in an integral way and to make decisions for their reinsertion in their activities on a day to day basis and also their work lives.

Education with innovative methods, with perspectives that involve the progressive development of the content of professionals, focused on the needs of the community, that promote a proactive stand and that uses assessment strategies relative to the educational objectives proposed to allow the students to face their problems in context, to solve them in an effective way considering the context of complexity that it involves (Barbosa and Pinheiro 2012a, b). The physical therapist has a fundamental role in the rehabilitation of persons that suffer different work-related injuries and diseases. Prendushi has highlighted the importance of physical therapy students give to the subject of work disability, as an interesting subject of study (Prendushi 2016), as it is a relevant aspect to approach in the contexts that involve the teaching of evaluation and basic procedures in Ergonomics.

The process of effective teaching and learning in the course of ergonomic intervention involves the exposure to real problems, allowing for the mobilization of knowledge for its resolution, utilizing the necessary core knowledge to carry out basic applications in a relevant manner, coinciding with the importance assigned to the structure of the competency-based programs (Furniss et al. 2017).

The collaborative work that involves the methodology of small groups inside the course, along with the autonomy of the students to choose their cases and resolve them, stimulates the intrinsic motivation, the disposition for learning, self-directed and self-regulated learning, fulfilling the principles of andragogy as a concept of permanent education (Knowles et al. 2012). Teachers within the process act as enablers in a context of social constructivism (Taylor and Hamdy 2013), promoting the consolidation of a significant educational experience.

Inside of the methodologies of small groups, the use of a logbook as an instrument for keeping records and for evaluation allows for the participation of the student in an active manner in his or her process of formation, due to the assigned deadlines that the tutor designates to complete specific tasks and, in the way, analyze the impact of learning and achieve an effective communication with students (Barrios Castañeda et al. 2012). The logbooks have been proposed as educational strategies in ergonomics on an expert level (Williams 2008; Barrios Castañeda et al. 2012). In this study, they have been set forth in accordance with the level of the educational objectives to achieve an effective monitoring of the work carried out.

5 Conclusions

The course of ergonomic intervention project contains active learning strategies in small groups like case-based learning, workshops and procedure logbooks lead by skilled teachers in a supervised context which promote ergonomic competency achievements by undergraduate students in a learning process based on constructivism. Students fulfilled the competencies regarding the application of principles and ergonomic criteria in the different stages and possible intervention levels. The process of teaching, learning and student assessment was consistent with the principles of the experimental learning cycle and effective practice-based learning.

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