

# Application of the ADAPTED FRISCO framework in case-based learning activities

Rita Payan-Carreira, Caroline Dominguez,  
Maria João Monteiro &  
Maria da Conceição Rainho

## Abstract

---

Acquisition of clinical skills is of utmost importance for health sciences professionals, and a guarantee that safe and effective patient care will be provided. Clinical competencies may encompass a series of skills that are introduced through graduation and developed during professional activity, namely the technical skills, communication skills, clinical reasoning and reflexion in daily practice. Therefore, clinical competence is not a static skill, but it grows with practice and is lifelong learning. Case-based learning is frequently used to enhance learning in clinical reasoning and judgment for rational decision-making, competencies that are also associated to critical thinking. To be effective, case-based activities need to be structured, the learning objectives adjusted to each situation and students sought to be guided throughout the activity, so that they are actively engaged in the learning process bridging learning to professional environments. In this paper the authors present a model for a case-based activity aiming to enhance clinical competency in health science students. Framed by the application of the FRISCO guidelines adapted in previous work, the authors illustrate, by an example, how, in the proposed activity, congruence may be achieved among intended learning, instructional activities, and assessment methods while teaching diagnostic reasoning to health sciences students.

## Keywords:

---

critical thinking; case-studies learning; health sciences

## **Aplicação da grelha FRISCO adaptada à aprendizagem por estudo de casos**

**Resumo:** A aquisição de competências clínicas é da maior importância para os profissionais das ciências da saúde, garantindo aos pacientes a prestação de cuidados efetivos e seguros. As competências clínicas, que incluem as competências técnicas, de comunicação, de raciocínio clínico e de reflexão na prática diária, são apresentadas ao estudante durante a sua formação e serão desenvolvidas durante a sua prática profissional. As competências clínicas não são, por isso, estáticas, mas crescem com a prática e vão-se fortalecendo ao longo da vida. A aprendizagem baseada em casos é usada com frequência para melhorar o raciocínio e o juízo clínico com vista a uma tomada de decisão racional; estas competências encontram-se também associadas ao pensamento crítico. Para serem eficazes, as atividades baseadas no estudo de casos devem ser estruturadas, os seus objectivos de aprendizagem ajustados para cada situação particular e os alunos devem ser guiados ao longo da atividade. Desta forma, os alunos são também ativamente envolvidos no processo de aprendizagem, estabelecendo uma ponte entre a aprendizagem e o ambiente profissional. Neste trabalho apresenta-se o modelo de atividade baseada em estudo de casos que procura ajudar os alunos dos cursos superiores da área da saúde a desenvolver competências clínicas. Enquadrado pela aplicação da grelha de FRISCO adaptada em trabalho anterior ao estudo de casos clínicos, neste trabalho os autores mostram através de um exemplo, como, na atividade proposta, é possível estabelecer congruência entre os objectivos de aprendizagem, o desenho da atividade, o método de avaliação e os resultados.

**Palavras-chave:** pensamento crítico; aprendizagem por estudo de casos; ciências da saúde

## **L'application de la grille d'orientation FRISCO adaptée à l'apprentissage par l'étude de cas**

**Résumé:** L'acquisition de compétences cliniques est de la plus haute importance pour les professionnels des sciences de la santé, et une garantie que les soins prodigués aux patients seront sûrs et efficaces. Les compétences cliniques, à savoir, les compétences techniques, les compétences de communication, le raisonnement clinique et la réflexion de la pratique quotidienne sont introduites aux étudiants pour l'obtention de leur diplôme et se développent tout au long de leur parcours professionnel. Par conséquent, la compétence clinique n'est pas une compétence statique. Elle s'améliore avec la pratique et de forme continue. L'apprentissage par l'étude de cas est fréquemment utilisé pour améliorer le raisonnement et le jugement cliniques ainsi que pour développer les compétences de prise de décisions rationnelles, compétences qui sont également associées à la pensée critique. Pour être efficaces, les activités basées sur l'étude de cas doivent être structurées, les objectifs d'apprentissage adaptés à chaque situation et les étudiants doivent être guidés tout au long de l'activité. Ainsi, les élèves sont activement engagés dans le processus de transition vers les défis auxquels ils seront confrontés en environnement professionnel. Dans ce travail, les auteurs présentent un modèle d'une activité d'apprentissage par l'étude de cas qui renforce les compétences cliniques des étudiants universitaires dans le domaine de la santé. Utilisant la grille d'orientation FRISCO, adaptée à l'étude des cas cliniques dans un travail antérieur, les auteurs montrent qu'il est possible d'établir la liaison entre les objectifs d'apprentissage, les orientations de l'activité, la méthode d'évaluation et les résultats.

**Mots clés:** pensée critique; l'apprentissage par l'étude de cas; sciences de la santé

## **Aplicación de la aproximación FRISCO adaptada a la aprendizaje por estudio de casos**

**Resumen:** La adquisición de competencias clínicas es de suma importancia para los profesionales de las ciencias de la salud, garantizando a los pacientes una prestación de cuidados eficaz y segura. Las competencias clínicas, a saber, las competencias técnicas, las de comunicación, las de razonamiento clínico y de reflexión en la práctica diaria se presentan a los estudiantes durante su formación y se desarrollan de forma continua durante su práctica profesional. Por eso, las competencias clínicas no son estáticas, sino crecen con la práctica se van fortaleciendo a lo largo de la vida. El aprendizaje basado en casos se utiliza a menudo para mejorar el pensamiento y el juicio clínico con el fin de tomar decisiones racionales; estas competencias también están asociadas con el pensamiento crítico. Para ser eficaces, las actividades incluidas en los estudios de casos deben ser estructuradas, sus objetivos de aprendizaje ajustados para cada situación y los estudiantes deben ser guiados a lo largo de la actividad. De esta manera, los estudiantes también participan activamente en el proceso de aprendizaje, estableciendo una transición eficaz para el mundo profesional. En este trabajo se presenta el modelo de una actividad basada en casos de estudio que pretende ayudar a los estudiantes de los cursos superiores de salud a desarrollar habilidades clínicas. Utilizando el instrumento orientador del pensamiento FRISCO previamente adaptado al estudio de casos clínicos, los autores muestran cómo, a través de un ejemplo, es posible establecer la congruencia entre los objetivos de aprendizaje, las directrices de la actividad, el método de valoración y los resultados.

**Palabras clave:** pensamiento crítico; aprendizaje basado en estudios de caso; ciencias de la salud.

## 1. Introduction

The ultimate goal in developing clinical competencies in health sciences is to bridge the theoretical knowledge into practice and to promote the transfer of learning to clinical practice (Su, Osisek, & Starnes, 2004; Ehrenberg & Hägblom, 2007). Clinical competence is not a static skill, but it grows with practice and lifelong learning.

Graduation goal should provide day-zero professionals with the basic skills needed to analyse a clinical case, namely the ability to mobilise/invoke a core background knowledge and/or some experience to solve complex clinical problems, to develop diagnostic reasoning and to deeper, lifelong learning and knowledge (Jenicek, Croskerry, & Hitchcock, 2011; Wojcikowski & Brownie, 2013). It is commonly accepted that clinical competence, along with the communication skills, are crucial for providing safe and effective patient care and for the overall success in health sciences careers (Thompson, 2010).

Nowadays, teaching clinical skills in universities offering medical or nursing graduations relies on approaches that often combine theoretical background with real-life case studies, team projects and discussions with practitioners, or small internships allowing the students to gain increased clinical reasoning, inter-disciplinary communication and cooperation skills (EUNetPaS, 2010). Problem-based learning can be an effective tool to develop clinical reasoning skills and to foster students' aptitude to interpret data and to skillfully utilize their knowledge in solving problems (Koritnik, Ragatz, Ficklin & Deal, 1996; Wojcikowski & Brownie, 2013). Additionally, problem-solving techniques can positively affect the students' attitudes to learning and enhance knowledge retention, compared with more traditional forms of teaching, while also improving self-directed learning and interpersonal skills (Pastirik, 2006; Wojcikowski & Brownie, 2013).

Case-based learning (CBL) is one of the most common forms of problem solving used in health sciences education, as it allows connecting theory with practice. Case-based learning and scientific reasoning are closely related with critical thinking; all use reasoning to solve a problem (the goal) valuing the clarity, relevance and accuracy while testing theories and searching for (new) solutions (Gambrell, 2005). Case-based learning encourages self-thinking to develop critical appraisal skills under the concept of "learning by doing" and serves as primer for professional clinical skills.

Real practice situations, in the form of scenarios (case studies), can be presented and analyzed to determine the best course of action for a specific situation (Brunt, 2005; Profetto-McGrath, 2005; LaMartina & Ward-Smith, 2014).

If used in a routine way, it creates a core background that can empower students to solve similar problems in their professional environments (LaMartina & Ward-Smith, 2014). Being time-consuming however is a common complaint to the systematic use of case-learning methods in the classroom since it can interfere with the completion of the course syllabus (Brunt, 2005). Another drawback of its use may be the size of the class: CBL usually demands small groups of up to 12 students allowing the teacher to monitor the activity and the quality of the students' work, perform a closer assessment of the process, give a constant feedback and ask the necessary questions to orientate the reasoning and thinking (Pastirik, 2006). This latter complaint however can be overcome with the formation of several small groups of students who work in a restricted unit and who share their work with the other groups at specific moments of the activity (Pastirik, 2006).

The use of problem based learning strategies is often embedded in some subjects of the final years of Medical and Nurse graduations to sustain the acquisition of clinical and decision-making skills. It often includes medical cases issued from the professional practice. However, these activities are seldom structured in order to potentiate learning outcomes and engage the students into an active learning process, which may raise additional difficulties and may limit the final outcomes. So, to be effective, designing and delivering case-based activities for students requires reflection from health science educators which should cover the case selection, the establishment and assessment of learning objectives and the orientation of the activity. The latter includes the use of questioning, framework guidance to self-learning tasks and the provision of on-time feedback to maintain motivation (McArdle, 2010).

Different models are available to help engage and motivate students as well as to model professional thinking and action (Irby, 1994). Their effect increases when regularly used, particularly when supplemented with feedback. Among them, the Bloom's revised taxonomy of Learning Domains, Paul-Elder's Elements of Thought, or the Ennis's FRISCO guidelines may be used for clinical skills upward.

The Bloom taxonomy or the modified Bloom taxonomy is based on the identification of six progressive cognitive abilities, disposed as a pyramid, essential to achieve a high degree of critical thinking (Duron, Limbach & Waugh, 2006). This framework is often used to assist the construction of a curriculum or syllabus, to establish learning objectives and to determine the competencies to be assessed (Krathwohl, 2002; Mikol, 2005; Larkin & Burton, 2008). It is less frequently used in case-based learning/teaching approaches used in case-based learning teaching approaches (Su et al., 2004).

The eight Elemental Structures of Thought proposed by Elder and Paul (Paul & Elder, 2003), usually represented in a circular checklist, are often used to guide a critical thinking analysis through specific components. As students follow the circle they may perform a thorough analysis of a broad range of materials from articles, reports, novels or films. The Elements of Thought are the Purpose (Goal or Function), Question at issue (Problem or Issue), Information (Facts, observations or Reasons), Inferences (Interpretation, Solutions or Conclusions), Concepts (Definitions, Theories or principles), Assumptions (Presuppositions or Axioms), Implications (Effects or Consequences), and Point of view (Perspective, Opinion or Orientation).

The FRISCO guidelines were developed by Ennis (1996) as standard criteria to support the critical thinking process, providing guidance for structured reasoning and problem analysis; it is used also for fostering individual's learning abilities under structured pedagogical situations (Dominguez et al., 2015). The acronym stands for Focus, Reasons, Inferences, Situation, Clarity and Overview. Still this framework is less used in the clinical area, compared to the fields of Humanistic and Linguistics, or of science, technology, engineering and math (STEM).

Descriptions of clinical cases usually follow a particular format and texts are usually restrictive in content to an almost telegraphic description of events, symptoms and results of complementary analysis. This characteristic raises additional difficulties for students (who analyse or review a text) to apply the FRISCO guidelines. Therefore, the authors recently proposed an adaptation for those guidelines so that students could best cope with a case-description analysis (Payan-Carreira, Monteiro, Rainho, & Dominguez, 2015). Following this baseline, the purpose of this paper is to present the design of a case-based activity exploitable in any clinical subject in medical and related health sciences education using the adapted FRISCO guidelines. This paper intends to present a case-based learning activity model that uses the adapted FRISCO guidelines to support development of clinical competencies in students in Health Sciences. Through an example, the activity framework is described. The coherence of the use of adapted FRISCO guidelines with the proposed learning outcomes and the instructional activities are presented, while the proposed assessment methods aiming to enhance the clinical reasoning are also focused.

## 2. Overall presentation of the activity design

The proposed activity is designed for small groups of students (around 4 to 6 students per group). If the activity is to be developed in a larger frame class, a randomly distribution in several groups can be achieved. The entire activity is intended for cooperative groups.

It is supported by an online environment (Google Drive), containing: a copy of the case, auxiliary images (related to the patient examination, medical image complementary files, for example), a template to write on the answers of the case and a document that instructs the students through the assignment and that contains also the questions to be addressed during the activity (if not included in the template to be used for the tasks). The content may be wide open or selectively released to students, depending if the case refers to a single appointment or describes a sequential evolution of a clinical situation. A copy of the activity instructions is given in class (in particular the explanation of the adapted FRISCO framework). The students should submit their completed assignment in this template in the Google Drive.

For each case situation, the intended learning outcomes are identified and the assessment methods and scoring established. Feedback originating from the teacher should be provided as form of guidance through the activity; it may be provided on an individual group base, using the Drive template shared with a particular group (written feedback), or it can be diffused to the entire class (oral or written feedback) in briefing or discussion sections, to clarify any distressful issue or as a form of appraisal.

Each activity has an expected maximum length of 2 weeks: 7 to 10 days for the group of students to accomplish its assignments, followed by a 5 days period the analysis and discussion of the final work within an in-class open forum.

### 2.1. Instructional Activities

In preparation for the activity, targeting to maximise its success, it is necessary to contextualise the students for the aims for the activity. This could be achieved through an introductory explanation on Critical thinking, namely on its skills and dispositions, how it relates with excellence in clinical competencies and on the utility of the FRISCO guidelines for a structured, disciplined process of thinking. The process of diagnostic reasoning should also be reviewed. Thereafter, the adapted FRISCO guidelines should be presented to the students, bridging the acronym concepts to the expected outcomes for the activity.

Instructional activities should be selected from the recognition of the links between knowledge domains and the achievements in cognitive process:

conceptual, procedural, and metacognitive. These may be limited to one question addressed in the activity or may issue from two or more different model of requests (direct question to be answered, construction of concept maps or tables, description of an image, or even to ask students to play the role of a health professional when proposing a treatment to the patient in class). It is important that the activity design includes different steps allowing the students to build blocks of achievements (Su et al., 2004) that will help them to reach the remaining or advanced objectives.

At the beginning of the activity, the teacher should always contextualise the student in the topic, making a small review of the disease to be tackled in a particular case study, and refer the students for additional pedagogical supports, if needed. In addition, one example on how to construct a concept map (or a clinical algorithm) may be needed, if the students are not used to them. Concrete examples may also be considered useful to explain or highlight some aspect of the activity such as how to draw inferences, how to discuss differential diagnosis, or how to determine a cause-effect association.

Instructional activities also sought to include the presentation of the adapted framework to be used for the case analysis. In the FRISCO adapted guidelines (Payan-Carreira et al., 2015), F(ocus) stands for the key-issue at the origin of the consultation/appointment, the central issue in the case history. Under R(easons), the student should assess the relevant facts/symptoms and their pertinence to the clinical description and the diagnosis; it should also allow the student to grade the relative importance of the symptoms described, from the most relevant to the more obscure or superfluous. Relevant symptoms would point out to a list of putative diseases. This is usually assessed in I(nferences) which comprehends the steps that guide the reasoning, and the soundness assessment of an argument or solution; in the analysis of the clinical situation, it would correspond to the identification of pathologies that present a particular, common symptom. Taking together, R and I would allow students to discuss differential diagnosis, decide on the need for additional clinical exams or a referral, to prioritize the clinical condition according to its severity (Manchester scoring) and present a core of therapeutic options. Assessment of S(ituation) will then allow to define the context of the problem, the identification of partners or traits involved, which during the analysis of clinical files/cases may correspond to the identification of environmental, social, affective/familiar, etiological and therapeutic elements having determined the clinical situation or influence its outcome. Together with I, it should help students to review the case with the patient and discuss the available therapeutics (medical or surgical options) and to perceive his/her receptivity for the treatment to be proposed. Classically,

C(arity) is associated with a clear, sound proposition, and this kind of questions retain its relevance in the analysis of clinical cases: often, the patients attribute distorted importance for particular symptoms, either because they exaggerate or neglect them; or the clinical story presents gaps impairing to obtain a definite diagnosis, or some aspects of the anamnesis or medical exam needs clarification, or additional exams need to be performed. The O(overview) corresponds to the final critical evaluation of the situation and of the proposed resolution. When assessing the clinical cases, at this point students should be coached to review the entire process of clinical decision-making, to test the soundness of the diagnosis they reached comparing to the anamnesis and clinical symptoms, to search alternatives approaches to justify the therapeutic decision-making and to present a prognosis. Overview will also foster meta-cognitive skills when students review their process of clinical reasoning and criticise themselves with respect to their own reflection, by asking: did I think on this? Did I think about that? or, what if...?

When presenting the activity, the intended learning objectives and the proposed assessment established for the students participation and the group success should be discussed at the beginning and maintained available during the process. To mobilise and improve the students' engagement in a more active learning, as well as to reward their effort, the performance in the activity should contribute to the final mark of the curricular subject.

## *2.2. Intended learning*

Clinical competency results from the integration of a strong professional knowledge into practice; it is more than to possess core knowledge or be able to understand a topic. It relies on the ability to mobilize these two traits in order to make a decision, to foresee the evolution of a condition or to find on the best solution for a particular situation.

The proposed model of activity takes this into consideration. Bellow we give an example for a case scenario that is currently under use in a pilot study with a group of Clinical Supervision students in the Nursing Bachelor at the University of Trás-os-Montes and Alto Douro. From this point on, the description of the activity design will address to this case specifically.

### *The case*

For this particular activity, the intended learning was to develop clinical reasoning skills in the context of human patients with leg ulcers, in particular to distinguish between a venous from an arterial ulcer and to act according to the

clinical diagnosis, to adjust the therapeutic approach to the evolution of the situation.

### **Scenario**

Mrs E., a 46 years-old female low-income patient; she's married, with two sons. She was presented to a Family Health Unit due to a lesion on her left limb she describe as "similar to a knife cut" [it may be shown a file-image A]. She also complains of pain in the left limb that is constant and limitative of joint motion.

She was diagnosed with chronic skin ulcers since 21th October 2014. She presents the following antecedents: emboli and deep venous thrombosis in the left limb (21/08/2003, a second episode occurring on day 21/12/2010) and recently a generalised cutaneous rash (20/01/2015). The patient did not report smoking habits or alcohol consumption; she also refers to eat a varied diet. Physical activity is only related with the domestic activities.

On the clinical exam, it was observed an ulcer in the medial aspect at the middle of the left leg [it may be shown a file-image B] showing:

- Loss of dermis thickness;
- Granulation tissue (~60%) and fibrin (~40%) were present in the ulcer bed;
- The edge of the ulcer are macerated due to a moderate amount of exudate;
- The lesion has 7cm x 4cm x 2mm, is well-circumscribed and located above the malleolus in the left leg;
- Hyperpigmentation of the skin adjacent to the ulcer, lipodermatosclerosis and skin atrophy. Erythema around the lesion was observed, the tissues showing purple areas and tissue breakage areas, some of them presenting devitalized tissue (brown crust).

The ankle-brachial index was determined (arterial systolic pressure –100 mmHg – in the left arm coincident with that of the left ankle) and equalled 1. The patient showed a peripheral arterial oxygen saturation (SpO<sub>2</sub>) of 93% collected in the left hand thumb and of 95% at the left foot hallux.

### ***The application of the FRISCO guidelines***

Using the adapted FRISCO guidelines, presented above, students are requested to answer the following questions addressing the scenario presented before:

- (Focus) – Which condition lead to the patient attendance to the nursing services at the Health Centre?
- (Reasons) – Identify the most relevant facts for the diagnosis. [If images were used with the case, the following question may also be made: Observing the images, grade the severity of the ulcer]. List the differential diagnosis to be taken into

consideration in this particular case. Distinguish the pathophysiology of venous and arterial ulcers.

- (Inferences) – First, associate the symptoms presented by the female patient with their causes. Then distinguish between the different pathologies where ulcer is commonly a clinical sign, using a concept map template (it is possible to use any free application available on-line for the task easiness) and/or develop an algorithm tree for diagnosis.
- (Situation) - Identify putative determining factors that were involved in the onset of the clinical situation and those that may interfere with the treatment success. Present a panel for the most suitable therapeutic approach in this situation.
- (Clarity) Do you have all the information needed to establish a tentative diagnosis (do data gaps exist)? Are there any issues needing to be clarified by using additional complementary exams?
- (Overview) – Review your reasoning and the diagnostic conclusions you have drawn (self evaluation step). Does any other diagnosis exist for the current situation? Consider that the evolution has evolved as described below. Does this evolution contradict your diagnosis? Why? What should be changed (if necessary)?

### **Case evolution**

The first choice therapeutic approach for the situation described included a compressive Zinc paste bandage and a dressing with activated charcoal (recommended by the vascular surgery team). It was also prescribed with antimicrobials (Amoxicillin and Clavulanate, 875 + 125 mg).

The female patient developed pruritus and cutaneous rash, She also complains of pain during the bandage that extends for 30 minutes. The pain reflected on the maintenance of reduced daily life activities leading to a suspension of her work as auxiliary in a foster home.

The development of the proposed activity will allow students to go beyond the mere understanding of the concepts on venous and arterial ulcers. Students will need to demonstrate higher order cognitive skills in the domains of procedural and metacognitive knowledge. They will be challenged to go beyond the simple memorization of facts (knowledge) and mobilize their core knowledge in diverse parameters, such as Analysis (e.g., to score the severity of the ulcer), establishment of Inferences (to associate a symptom to the factor that originates it, or to create an algorithm tree for diagnosis), Comprehension (to identify the

causal or contributor factors to the situation or its evolution upon the implementation of a treatment) and knowledge Application (for example, to relate the side-effects of the bandages to the need to change the local treatment). Moreover, the final Metacognitive stage (overview) would make them question what went wrong in the situation: was another diagnosis possible? Or did another factor contribute for the therapeutic outcome? What else could it done to solve the clinical situation?

### *2.3. Assessment methods proposed*

Assessment is an important element in this activity. Not only it is a way to provide feedback (informative and aiming to influence learning) but it also adds summative information on the student learning achievements (marking or scoring for students knowledge, understanding and clinical reasoning). Measurement of knowledge and/or performance is needed because the proposed activity is intended to contribute to the final grade of the student in the curricular subject.

Assessment is often considered a controversial issue (Norton, 2009). Assessment criteria should be presented and discussed to the students, both to improve quality and to avoid unintended effects.

Using the case-scenario given as example of the proposed activity, the FRISCO-based questioning would allow students to acquire/demonstrate (and therefore, to score accordingly) different knowledge dimensions (Anderson & Krathwohl, 2001): the factual knowledge (on isolated content or elements needed to be acquainted with a topic/discipline), the conceptual knowledge (dealing with the interrelationships among the basic elements and a larger or complex structure, allowing them to function together), procedural knowledge (on how to do something, method of inquiry, organization, techniques and methods) and metacognitive knowledge (the awareness of one's own cognitive processes). The assessment grid proposed for this activity focus on the relationship between the type of aimed knowledge and the questioning used to direct reasoning through the application of the adapted FRISCO framework, as illustrated in Table 1.

A combined dual-criterion system is proposed for grading the written component of the activity, using both the quality of the students' responses (criterion A; content assessment) and the knowledge dimensions (criterion B). For Criterion A, the scoring system reflected a personal adaptation of McMurray's Rubrics for the assessment of Concept Maps (Coutinho, 2014), whereas for Criterion B an attempt was made to differently quantify increasingly higher levels of CT.

Criterion A, the quality assessment, sought to consider the completeness, clarity, background knowledge, the level of understanding, the ability to mobilise knowledge and the ability to solve problems (Table 2). The proposed quality score is as follows: fair (1) represents a poor answer that may contain errors, 2 corresponds to a fair quality response, 3 represents a satisfactory (moderate quality) answer, and 4 denotes a good quality response.

Criterion B focuses on the knowledge attributes that the activity aims to enhance, according to their relevance to clinical competences. Thereby, a different weighing score will be used for the different classes of knowledge: the proposed scaling factor is 1.5 for the factual knowledge, 2.5 for the conceptual knowledge and 3 for both the procedural and metacognitive types of knowledge. The value of the scaling factor was established aiming to attribute increasing points to more complex and higher levels of knowledge.

**Table 1 – Relation between the type of knowledge to be achieved and the structured questioning of the adapted FRISCO guideline**

Knowledge dimensions/ Typology	Adopted FRISCO framework associated questioning					
	F	R	I	S	C	O
Factual knowledge	Identification of the motive for the nursing appointment	Identify the most relevant facts for diagnosis.		Present a panel for available therapeutic approaches for the situation		
Conceptual knowledge		- [In case of the use of images) Based on the images, grade the severity of the ulcer - List the differential diagnosis for this particular case. - Distinguish the pathophysiology of venous and arterial ulcers.	Associate the symptoms with their causes		Do you have all the information needed to establish a tentative diagnosis (do data gaps exist)?	
Procedural knowledge			Construct a concept map for "Ulcer"	Identification of putative determining factors for the clinical situation Identification of factors that may determine the treatment success.	If not, which additional complementary exams are needed?	
Metacognitive knowledge						- Review reasoning - Is there a need for changing?

**Table 2 – Proposed scores and criteria for the assessment of the responses quality.**

Scores	Quality of answers
1	Incorrect assessment of the situation Most important concepts are missing Poor background knowledge Fail to correctly categorise data/clinical signs Poor domain of the terminology Vague descriptions or concepts Infrequent reasoning
2	Incomplete propositions/answers Fair knowledge on the relation between two or more concepts Incomplete analysis of a situation Inability to identify interventions Lack of clarity in exposition Limited knowledge mobilisation Confuse reasoning
3	Complete propositions/answers Partial knowledge on the relation between two or more concepts Good analysis of a situation May present minor limitations in the diagnosis Some difficulties in the identification of particular interventions Irregular clarity in exposition Good knowledge mobilisation that may not be constant
4	Excellent answers It presents complete and correct propositions. Easy categorization of data It shows a deep understanding of background knowledge and of the relation between two or more concepts Good in the establishment of cause-effects relationship and easily explores alternatives

To apply this dual-criterion system, the final mark for the activity is obtained in 3 steps: after grading the quality of the answers, the average of marks is estimated for each dimension of knowledge and then multiplied by its weighing score.

### 3. Conclusions and Challenges

In this paper the authors propose a case-based activity structured by adapting the FRISCO guidelines as a teaching motion to enhance the clinical skills in students of the health sciences field. The activity was described with the aid of a case-scenario example that supported the proposed intended learning and

the proposed model of questioning. Also, the bridge between the objectives for the activity and a dual-criterion assessment method was presented, aiming at ensuring the coherence of the proposed activity. Further research should be conducted to implement this model as a teaching method to facilitate Health Sciences students to acquire clinical competencies.

The example presented was a challenge in itself, since it has recently been put into practice in a core subject of clinical supervision in the Nursing Bachelor. In the future, it is planned to test the activity in the subject of reproductive pathology in the integrated master in Veterinary Medicine. The intention is to test the model in these two areas of the Health Sciences in order to evaluate its possibility of generalization. In this testing phase, it will be important to examine the level of difficulty that the activity represents to the students, as it may influence the number of the group elements; also it is important to study the effects of the interactions between teammates and the individual contributions to the group's achievements as well as the weight's relevance of proposed scores. And finally it would be important to determine if the students would benefit for a more extensive support in critical thinking and clinical reasoning that could gain from the introduction of additional open learning resources as preparatory or instructional tools.

#### **4. Funding**

This work was sponsored by the Portuguese Science and Technology Foundation (FCT) under the Project 'Pensamento crítico em rede no ensino superior' (131/ID/2014).

#### **5. References**

- Anderson, L. W., & Krathwohl, D. (2001). The knowledge dimension. In: L. W. Anderson, & Krathwohl, D. (Ed.) *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives* (pp. 38-62). New York: Longman.
- Brunt, B. (2005). Models, measurement, and strategies in developing critical-thinking skills. *Journal of Continuing Education in Nursing*, 36, 255-262.
- Coutinho, E. (2014). Concept Maps: Evaluation Models for Educators. *Journal of Business and Management Sciences*, 2(5), 111-117.
- Dominguez, C., Nascimento, M. M., Payan-Carreira, R., Cruz, G., Silva, H., Lopes, J., ... & Morais, E. (2015). Adding value to the learning process by online peer review activities: towards the elaboration of a methodology to promote critical thinking in future engineers. *European Journal of Engineering Education*, 40(5) 573-591.

- Duron, R., Limbach, B., & Waugh, W. (2006). Critical thinking framework for any discipline. *International Journal of Teaching and Learning in Higher Education*, 17(2), 160-166.
- Ehrenberg, A. C., & Häggblom, M. (2007). Problem-based learning in clinical nursing education: Integrating theory and practice. *Nurse Education in Practice*, 7(2), 67-74.
- Ennis R. H. (1996). *Critical Thinking*. Upper Saddle River, NJ: Prentice Hall.
- EUNetPaS [European Union Network For Patient Safety] 2010. Diversified teaching programs for medical and nursing schools and continuing professional development. Retrieved from: [http://ns208606.ovh.net/~extranet/images/EUNetPaS\\_Publications/diversified\\_teaching\\_programs\\_final\\_july2010.pdf](http://ns208606.ovh.net/~extranet/images/EUNetPaS_Publications/diversified_teaching_programs_final_july2010.pdf)
- Gambrill, E. (2005). *Critical Thinking in Clinical Practice: Improving the Quality of Judgments and Decisions*. Hoboken, NJ: John Wiley & Sons, Inc.
- Irby, D. M. (1994). Three exemplary models of case-based teaching. *Academic Medicine*, 69(12), 947-53.
- Jenicek, M., Croskerry, P., & Hitchcock, D. L. (2011). Evidence and its uses in health care and research: the role of critical thinking. *Medical Science Monitor: International Medical Journal of Experimental and Clinical Research*, 17(1), RA12-7.
- Koritnik, D. R., Ragatz, B. H., Ficklin, F. L., & Deal, D. W. (1996). Nurturing critical-thinking skills with clinical applications in a medical pharmacology course. *Teaching and Learning in Medicine: An International Journal*, 8(2), 69-76.
- Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: An overview. *Theory into practice*, 41(4), 212-218.
- LaMartina, K., & Ward-Smith, P. (2014). Developing critical thinking skills in undergraduate nursing students: The potential for strategic management simulations. *Journal of Nursing Education and Practice*, 4(9), p155.
- Larkin, B. G., & Burton, K. J. (2008). Evaluating a case study using Bloom's taxonomy of education. *AORN Journal*, 88(3), 390-402.
- McArdle, G.E.H. (2010). *Instructional design for action learning*. New York: American Management Association.
- Mikol, C. (2005). Teaching Nursing Without Lecturing Critical Pedagogy as Communicative Dialogue. *Nursing Education Perspectives*, 26(2), 86-89.
- Norton, L. (2009) Assessing student learning. In: H. Fry., Ketteridge, S. & Marshall, S. (eds) *A Handbook for Teaching and Learning in Higher Education: Enhancing Academic Practice*, 3<sup>rd</sup> Ed. (pp 132-149). Abingdon, UK: Routledge.
- Pastirik, P. J. (2006). Using problem-based learning in a large classroom. *Nurse Education in Practice*, 6(5), 261-267.
- Paul, R., & Elder, L. (2003). *The Miniature Guide to Critical Thinking: Concepts and Tools*. (4th ed). Dillon Beach, Calif, USA: The Foundation for Critical Thinking.

- Payan-Carreira, R., Monteiro, M. J., Rainho, M.C., & Dominguez, C ( 2015). Learning Through Case Studies in Health Sciences: Proposal for Adaptation of the Frisco Guidelines. In: Pensamento Crítico na Educação: Desafios Atuais. (pp. 65-76) C. Dominguez (Coord.). Vila Real: UTAD.
- Profetto-McGrath, J. (2005). Critical thinking and evidence-based practice. *Journal of Professional Nursing*, 21(6), 364-371.
- Su, W. M., Osisek, P. J., & Starnes, B. (2004). Applying the Revised Bloom's Taxonomy to a medical-surgical nursing lesson. *Nurse Educator*, 29(3), 116-120.
- Thompson, E. M. (2010). Critical thinking skills: Learned or nurtured?. *OR Nurse*, 4(6), p.3
- Wojcikowski, K., & Brownie, S. (2013). Generic reflective feedback: An effective approach to developing clinical reasoning skills. *Journal of Computer Assisted Learning*, 29(4), 371-382.

**Rita Payan-Carreira**

Professora auxiliar com agregação no Dept. Zootecnia  
Universidade de Trás-os-Montes e Alto Douro (UTAD), Vila Real, Portugal  
Centro de Ciência Animal e Veterinária (CECAV), UTAD, Vila Real, Portugal  
Email: rtpayan@gmail.com

**Caroline Dominguez**

Professora auxiliar no Dept. de Engenharias,  
Universidade de Trás-os-Montes e Alto Douro (UTAD), Vila Real, Portugal  
LabDCT/CIDTFF - Laboratório de Didática de Ciências e Tecnologia  
/ Centro de Investigação Didática e Tecnologia na Formação de  
Formadores, Universidade de Aveiro, Aveiro, Portugal  
Email: carold@utad.pt

**Maria João Monteiro**

Professor Coordenador  
no Dept. Enfermagem de Saúde Mental e Comunitária,  
Escola Superior de Enfermagem de Vila Real,  
Universidade de Trás-os-Montes e Alto Douro, Vila Real, Portugal  
CIDESD - Centro de Investigação  
em Desporto, Saúde e Desenvolvimento Humano  
UTAD, Vila Real, Portugal  
Email: mjmonteiro@utad.pt

**Maria da Conceição Rainho S. Pereira**

Professor Coordenador  
no Dept. Enfermagem de Saúde Mental e Comunitária,  
Escola Superior de Enfermagem de Vila Real,  
Universidade de Trás-os-Montes e Alto Douro, Vila Real, Portugal  
CIDESD - Centro de Investigação  
em Desporto, Saúde e Desenvolvimento Humano  
UTAD, Vila Real, Portugal  
Email: crainho@utad.pt

**Correspondência**

Rita Payan Carreira  
Universidade de Trás-os-Montes e Alto Douro (UTAD),  
Escola de Ciências Agrárias e Veterinárias/Departamento de Zootecnia.  
Quinta de Prados, 5000-801 Vila Real, Portugal

Data de submissão: Julho 2015

Data de avaliação: Novembro 2015

Date de publicação: Abril 2016