

Education of Ergonomists in France: From the CE2 actions to the Master program in Ergonomics at Aix-Marseille University (Aix-en-Provence)

Nathalie Bonnardel

Aix-Marseille Univ, PSYCLE (Centre of Research in the Psychology of Cognition, Language and Emotion) EA 3273, Aix-en-Provence, France
nathalie.bonnardel@univ-amu.fr

Abstract.

To contribute to a reflection on Education and Training of Ergonomists, the actions performed in France by the CE2 (Collège des Enseignants-Chercheurs en Ergonomie) are first presented. Then a program of Master's degree in Ergonomics is described: the professional and research Master specialized in Ergonomics: human factors and information system engineering, which is proposed at Aix-Marseille University (in Aix-en-Provence, France). This program is conceived in order to fit French and European recommendations about education and training of ergonomists. It includes classes in cognitive, organizational and physical ergonomics as well as specific trainings on risks prevention, work conditions, information system engineering, user interface and UX design, etc. Therefore, graduates from this Master's degree can access to a large variety of positions in Ergonomics and a part of graduates pursue their studies with a Ph.D thesis.

Keywords: Education, Training, Ergonomists.

1 Introduction

The trainings in Ergonomics are the object of reflections and evolutions in France. To favor this evolution, the content of the trainings are discussed in different French associations, such as the SELF (Société d'Ergonomie de Langue Française), ARPEGE (Association pour la Recherche en Psychologie Ergonomique et Ergonomie) and the CE2 (Collège des Enseignants-Chercheurs en Ergonomie). These associations play a crucial role in Ergonomics and their actions are complemented by other associations and, especially, ARTEE (Association pour la Reconnaissance du Titre d'Ergonome Européen en Exercice), or by the collective ORME (Organisation Représentant les Métiers de l' Ergonomie), which contribute to the practice of Ergonomics. Due to the topic of this symposium, the actions performed by the CE2 will be more particularly presented. Then, I will describe the Master's degree

specialized in Ergonomics: human factors and information system engineering, which is proposed at Aix-Marseille University, in Aix-en-Provence. More precisely, I will evoke the history of this training and present the content of this program in Ergonomics.

2 Role of the CE2 towards trainings in Ergonomics in France

The CE2 (College of professors and assistant professors in Ergonomics) gathers full professors, associate and assistant professors of French high education institutions (Universities, engineering schools, CNAM) who are trained in ergonomics and who are training students in ergonomics. Members of this association are committed to promote and defend training and research in ergonomics.

The main actions in the recent years are in favor of the recognition of ergonomics training, associated to recommendations for the content of masters' degree in Ergonomics, work on the 'ergonomics professions sheet' and its variations as well as reflections on ergonomics certifications. In addition, it proposed a picture of training programs in Ergonomics to whom the members of the CE2 contribute (see Figure 1).

Depending on the universities or institutions, these trainings are associated to Human and social sciences (in purple in the figure 1), to Sciences, Technologies, Health (in orange) or to Law, Economics, Management (in blue). In addition, some of the trainings in Ergonomics are directly dependent on a Mention in Ergonomics whereas other trainings are defined as 'parcours-type' in Ergonomics and associated to another Mention, such as Psychology for instance.

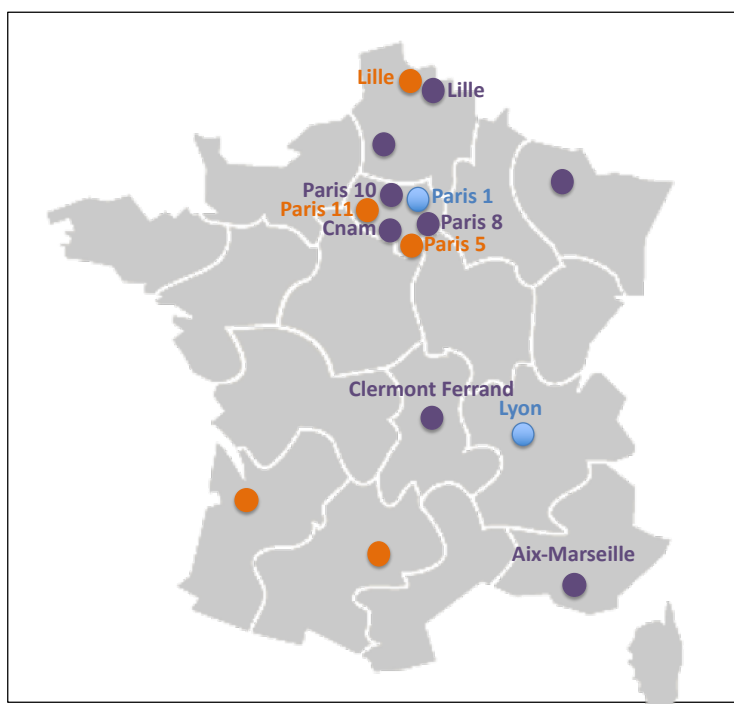


Figure 1: Overview of training programs in Ergonomics in France, to whom the members of the CE2 contribute.

The actions of the CE2 also lead to the production of recommendations for Masters' degree trainings in Ergonomics in relationship with other reference texts, such as IEA recommendations, CREE criteria and ergonomics professions sheet.

Finally, the objectives of CE2 are to address more global issues, such as the following:

- how to maintain a common guideline in an evolving and on-going accreditation process?
- where and how to intervene at a more global level (national, European, etc.) ?
- what are the ergonomics practitioners' difficulties and what are their needs (in partnership with different ergonomics associations)?

All these actions are thus fully useful for professors and assistant professors in Ergonomics.

3 Master degree in Ergonomics: Human factors and information system engineering (Aix-Marseille University, Aix-en-Provence)

After this global presentation of actions related to training in Ergonomics in France, we are going to focus on the professional and research Master specialized in Ergonomics: human factors and information

system engineering, which is proposed at Aix-Marseille University (in Aix-en-Provence, France) and directed by Prof. Nathalie Bonnardel.

3.1 History of the program

In 1983, the Université de Provence (Aix-Marseille I, Aix-en-Provence) offered its first graduate program in ergonomics in the form of a specialized diploma, first called a DESS (*Diplôme d'études supérieures spécialisées*) in ergonomic psychology, and it was then renamed DESS in cognitive ergonomics.

This training was created by Pr. Claude Bastien and it was mainly based on cognitive psychology and ergonomics, with a specific focus on expertise, and studies and interventions in the workplace. Another specificity was progressively developed in this program, which consisted in providing students with a training in computer science and programming, in order to allow them to better interact with other stakeholders in their future profession. In 1994, I joined the pedagogical team of the DESS, which comprised mainly Claude Bastien (full professor), Jean-Paul Caverni (full professor), Jean-Luc Péris (associate professor) and Annie Piolat (full professor) as well as numerous professionals. I progressively became co-responsible and responsible of the DESS in Cognitive ergonomics. Thus, I introduced new orientations in the content of the program, in order to prioritize the processes of work activity analysis, to train students to use a variety of methods and techniques in ergonomics, to allow them to access to information elements related to the history of ergonomics, and to lead them to develop competencies in the design and evaluation of user interfaces as well as assistance to human activities.

These orientations were based on my own background, comprising:
1) a Ph.D. thesis in Cognitive ergonomics performed both at the University of Provence (Aix-Marseille I) and at the 'Institut National de Recherche en Informatique et en Automatique' (INRIA, Rocquencourt, France), in the laboratory (or 'project') in 'Ergonomics psychology', which was created and first directed by André Bisseret. Then, at this period of time, this laboratory or project became co-directed by Pierre Falzon and Dominique Scapin.

2) classes in Ergonomics at Conservatoire des Arts et Métiers (CNAM, Paris, France).

3) professional practice as ergonomist in a SSII.

4) a two years of post-doc at the University of Colorado at Boulder and Institute of Cognitive Science (USA).

In addition, it was very important for me to develop closer relationships with ergonomics associations and societies, such as the SELF (Société d'Ergonomie de Langue Française), EACE (European Association for Cognitive Ergonomics, in which I became a member of the executive committee), CE2 (Collège des Enseignants-Chercheurs en Ergonomie), ARPEGE (Association pour la Recherche en Psychologie Ergonomique et en Ergonomie, in which I am currently a member of the Administration committee), and IEA (International Ergonomics Association).

Due to national changes in France and the introduction of the LMD (Licence, Master, Doctorat) system, in 2004-2005, the DESS in Cognitive ergonomics became a professional Master specialized in 'Ergonomics: Human factors and information system engineering' (in French: 'Ergonomie: facteurs humains et ingénierie des systèmes d'information'), and it was associated to a general mention of Master in Psychology. In 2008-2009, another change was introduced since this professional Master became both a professional and research Master, which allowed graduates to either work into companies or to pursue their studies with a Ph.D. This program being associated to a Master's mention in Psychology, the graduates stemming from this training can exert as Ergonomists and/or as Psychologists-Ergonomists, depending on their previous background.

This program includes traditional classes in cognitive, organizational and physical ergonomics as well specific trainings on risks prevention, work conditions, information system engineering, user interface and UX design, etc. Therefore, graduates from this training can access to a large variety of positions in Ergonomics. Most of the graduates directly work into companies just after obtaining their diploma but about one-third of them pursue their studies with a Ph.D. thesis in ergonomics psychology or in ergonomics.

Finally, a fusion among the three universities in our area (Aix-Marseille I, Aix-Marseille II, and Aix-Marseille III) intervened and this Master's program in 'Ergonomics: Human factors and information system engineering' is now proposed at Aix-Marseille University. It is also to note that, in France, a new process of accreditation of training programs has been applied (instead of habilitation, which was previously settled).

Thus, although the pedagogical objectives and the content of this

program globally remain the same, some changes recently occurred in the content and structuration of this Master's program, which will be effective from 2018-2019.

3.2 Description of the training and program in Ergonomics

The content of the education and training in the professional and research Master specialized in 'Ergonomics: Human factors and information system engineering' aims to allow students to develop the competencies targeted by associations evoked above, such as the CE2, and in accordance with the standards that are required by the ARTEE (Association pour la Reconnaissance du Titre d'Ergonome Européen en Exercice) to obtain, after a professional experience, the title of 'European ergonomist'. In addition, in accordance with this objective, some members of the pedagogical team have this title. Therefore, this program was developed in line with the European and international requirements for professional ergonomists.

This Master's program allows to train professionals who are capable of carrying out ergonomic interventions, aiming at optimizing workers' safety and well-being as well as the efficiency of production systems, through the combination of cognitive ergonomics, organizational ergonomics and physical ergonomics. It also allows to train ergonomists who have competencies in work activity analysis, in the design and evaluation of workstations and user interfaces (comprising programming and design of mock-ups). In addition, new contents were recently introduced in order to train students to UX design and design thinking as well as to develop ergonomics approaches related to new technologies of information and communication (e.g., virtual reality, with the use of Oculus-rifts, and robotics).

The Master program extends along two years, each comprising 60 credits (ECTS) that are associated to courses delivered by professors in ergonomics, in cognitive and social psychology, in computer science as well as by a large number of professionals in ergonomics.

During the **1st year** (about 400 hours of class), the students follow courses that give them both theoretical and practical knowledge related to human work and activities, comprising classes in cognitive and organizational ergonomics, in cognitive and social psychology, in programming and user interface design and evaluation, and they have to

realize both a 1st internship in a company and a research work on a topic related to Ergonomics.

During the **2nd year** (about 400 hours of class), the students follow courses that give them more theoretical and practical knowledge in physical ergonomics, cognitive ergonomics, and organizational ergonomics. They acquire a variety of methods and techniques related to work analysis/activity analysis, work environment analysis, adaptation to workers/operators, safety and risks management, user interface design and evaluation, UX design, prospective ergonomics and design thinking. They are also trained to use a variety of methods and techniques, including the classical ergonomics methods as well as specific techniques, for instance based on the use of eye-tracking.

The students in this Master program have also to follow classes on English in ergonomics as well as classes on labor law and rights (e.g., related to Internet and digital data). They are also trained to develop ergonomics approaches related to new technologies of information and communication, such as virtual reality. This last objective is favoured by the fact that students can access to the research laboratory PSYCLE (director: N. Bonnardel) and to the UserLab of the technical platform H2C2 proposed at the ‘Maison de la Recherche’ (Aix-en-Provence). The Userlab comprises numerous equipments of high technology that can be used for analyzing human activity as well as human-computer interactions.

In addition, the students have to participate in tutored projects and to carry out an ergonomic intervention in response to a real or simulated request from a company or based on establishments defined by the professors, which lead the students to progressively adopt a ‘professional posture’. Finally, during this second year of Master, the students also have to realize another research work in Ergonomics (usually in line with the one developed in the 1st year of Master) and to perform a long internship (about 6 months) in companies. These works are supported by groups of regulation to engage the students in reflective practice, and they result in written reports and oral presentations, with a committee composed of both professors and professionals.

Therefore, this 2 years’ Master program specialized in ‘Ergonomics: Human factors and information system engineering’ allows students to understand and perform different kinds of interventions, to analyze work situations and activities in both professional and extra-

professional contexts, to acquire a variety of methods and techniques, to develop competencies in complementary fields, and to promote new projects in ergonomics.

More information about this program and the content of the training in the 1st and the 2nd year of Master in Ergonomics: humans factors and information system engineering can be found on the following site:

<https://centrepsyche-amu.fr/master-ergonomie/>

3.3 Review of difficulties and positive aspects of the development of the program

In order to introduce a reflection on the development of this Master's program, difficulties encountered when creating this program are evoked as well as its positive aspects.

Difficulties encountered when creating the program

It has been difficult to obtain the department's recognition of the importance of having professors who are specialized in ergonomics psychology and ergonomics as well as the formal recognition of Ergonomics as a disciplinary.

We observe a major work overload for the main professors who give classes in this program: Nathalie Bonnardel (full professor), Brice Isableu (full professor), Ladislav Motàk (associate professor), Patrice Petitjean (PAST – associate professor who also exerts as ergonomist in his own consulting company) and Jean-Luc Péris (associate professor). They also ensure regular supervision of the students for practical works, internships in companies and research works in ergonomics. We also note difficulties in obtaining the support needed to create new positions for professors specialized in ergonomics.

Positive aspects of the development of the program

Since its creation, this program has been improved to correspond to European and international standards for training programs in Ergonomics.

A large number of professionals, specialized in complementary methods and fields (e.g., work and activity analysis, risks prevention, work conditions, nuclear plants, medicine, information system architecture,

user interface design and evaluation, UX design) are fully involved in the training of the students in ergonomics. They regularly intervene in this program and also contribute to tutored and applied projects in Ergonomics.

Professors and researchers specialized in cognitive, organizational and physical ergonomics as well as in cognitive and social psychology are fully involved in the training of the students. Their classes are complemented by other interventions proposed by colleagues from other departments and laboratories of Aix-Marseille University, such as Computer Science and Management Science.

This Master's program is associated to the laboratory PSYCLE (research center in the Psychology of Cognition, Language and Emotion, EA 3273) and it benefits from the use of numerous equipments that are available in the UserLab (laboratory of analysis of usability and usages) of the technological platform H2C2, such as eye-tracking (Tobii), systems of movement and facial/emotion analyses (FaceReader), and data capture and analyses (The Observer, etc.), systems of virtual reality (oculus-rifts, etc.).

Most of the students who get their diploma are directly hired by companies at the end of their internships but about one-third of them pursue their studies with a Ph.D. thesis in ergonomics psychology or in ergonomics.

The Master degree in Ergonomics: humans factors and information system engineering (or previously DESS in cognitive ergonomics) has, for years, successfully trained a large number of ergonomists and psychologists-ergonomists capable of carrying out interventions in workplaces, who exert as ergonomists in a large variety of professional areas and are fully recognized by companies.

To conclude, this Master's degree specialized in Ergonomics provides students with rich and stimulating contents in a friendly pedagogical context, which lead them to become Ergonomists who are able of working in a large variety of professional fields.

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