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Training to develop soft skills for engineering students

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The emergence of the Industry 4.0 has been driven by technological advances that brought the need for evolution in the educational sector. Education 4.0 proposes a restructuring of teaching methods to include the socio-emotional skills highly demanded within the current job market. Engineers traditionally have a technical-scientific-based training; they focus on the development of core competencies such as mathematics, physics, chemistry and logic, while the socio-emotional competencies are taken for granted. Among these skills, teamwork stands out, as it includes leadership, networking and multiculturalism, essential for the work performance of the 21st century engineer. The purpose of this research is to propose a training to expand and develop the teamwork soft skills. The research was developed through a systematic bibliographic review (SBR), resulting in 33 base articles. The application method used the studies of Chiavenato and Kirckpatrick as a reference. The study data were collected through a questionnaire that compared the level of this competence before and after the application of the training. The data collected were treated with Bardin's Content Analysis. The results suggest there has been an improvement in skills, and additional fourteen competencies were identified. The improvement in the development of these skills meets the desire of the engineers' job market, which needs professionals trained in soft skills to deal with the demands inherent to teamwork.

Key words: Emotional intelligence, team, engineer; Education 4.0.

INTRODUCTION

The current Industrial Engineering scenario has been leading to the so-called Industry 4.0, which brings challenges, such as the demand for the development of new skills by professionals as well as strategies to attract talents able to deal with increasingly complex problems and technologies (Kipper et al., 2020). The technical skills in engineering undergraduate course meet, to a certain extent, the demands of the market. However, new

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competencies defined as the main competencies of the 21st century also need to be included within the knowledge and experience of students to allow them to succeed (Khodeir and Nessim, 2020).

Acquiring the skills of the future for the 4.0 environment is essential. These competencies are related to the constant changes in the modern world, such as economic crises, reflecting the unfolding of the Fourth Industrial Revolution (Piwowar-Sulej, 2021). Teaching projects, such as extracurricular activities, play a very important role in the development of competences. These activities are an efficient complement to education, allowing the development of a range of skills, such as communication and teamwork (Bodolica et al., 2021).

The educational projects must meet the current challenges and its objectives must be aligned with the requirements and needs of the educational institutions and the job market. The elaboration of projects based on Education 4.0 revolves around competencies, learning methods, information and communication technologies, and infrastructure. This new form is based on Education 4.0 for higher education, which seeks to train a highly competitive generation of professionals able to manage resources correctly, providing innovative ideas while facing the various current and future challenges (Miranda et al., 2021).

The current scenario has enlightened that the knowledge of technical skills, mostly already implemented in the undergraduate courses is not sufficient and needs to include socio-emotional skills. The graduated engineers, currently active in Industry 3.0 were trained based on analytical, logic and systematic knowledge, focusing on the problems, and understating the human-interactions side. These professionals usually find it easier to work in familiar, long-term teams (Piwowar-Sulej, 2021). The Industry 4.0 professionals must be open and active, receptive to work in a diverse team and perform different tasks.

The gap between the skills that contribute to employability, and the skills acquired during the engineering education has caused difficulties for future workers and graduates to meet the competitive global standards. Employability skills are necessary not only for obtaining a job, but also for developing potential and allowing progression in a company, contributing to an overall success (Moldovan, 2020).

Social-emotional skills are related to effective performance at work. An analysis of studies that investigate the effect of socio-emotional skills in successful cases suggest leadership as one of the most impacting competencies (Rezende et al., 2021). In addition, leadership is always mentioned alongside other competencies, such as networking, multiculturalism, communication and decision-making. This supports the argument that the separation of competencies in different groups is a powerful research instrument, but in the real scenario of universities and organizations, competencies must be treated in an integrated manner (Rezende et al., 2021).

Business schools have been offering courses on leadership for years, but these are usually traditional, classroom-based courses, focused on an overview of Leadership, and lack deepness in developing the socio-emotional skills necessary to exercise team leadership in industries (Corriveau, 2020).

The aim of this project is to improve the academia perception about the importance of teamwork and soft skills in general, aiding to overcome the idea that engineering is purely based on technical fields.

The important socioemotional competencies for the engineer, according to Campos (2019), can be divided into six core groups: Critical thinking; communication; teamwork; ethical perspective; emotional intelligence and creative thinking. Among these groups, teamwork was chosen for the study because it has been constantly identified as a gap in engineering courses (Campos, 2019). This skill can be subdivided into leadership, multiculturalism and networking. Therefore, the objective of this work is to carry out a training for the expansion of soft skills (worldwide known term in English for socio-emotional skills) teamwork, leadership, networking and multiculturalism for the industrial engineering center - mechanical qualification of CEPLAN/UDESC.

METHODOLOGY

The present study has a practical character, according to Lakatos and Marconi (2021)'s classification of research aimed at obtaining practical application results. Still according to the authors' classification, the approach to the problem is predominantly qualitative, as it is based on subjective and linguistic responses, which, for the purpose of this research, were treated with Bardin's Content Analysis (2015).

The practical application corresponds to the implementation of the proposed socio-emotional skills training within an engineering course. Regarding the technical procedures, it is a case study, as the participating actors belong to a specific and delimited group: Industrial engineering students with mechanical specialization from UDESC Planalto Norte (São Bento do Sul/SC).

Systematic bibliographic review (SBR)

This study was carried out based on data collected by a systematic bibliographic review (SBR), from May to July 2021. The scientific databases used were Scopus and Science Direct. The SBR was used to support the literature review through well-rated scientific articles from internationally recognized quality scientific bases. The objective was to survey the different forms of training and development of the soft skill teamwork and its subdivisions in Engineering: Leadership, Multiculturality and Networking, according to Campos et al. (2020).

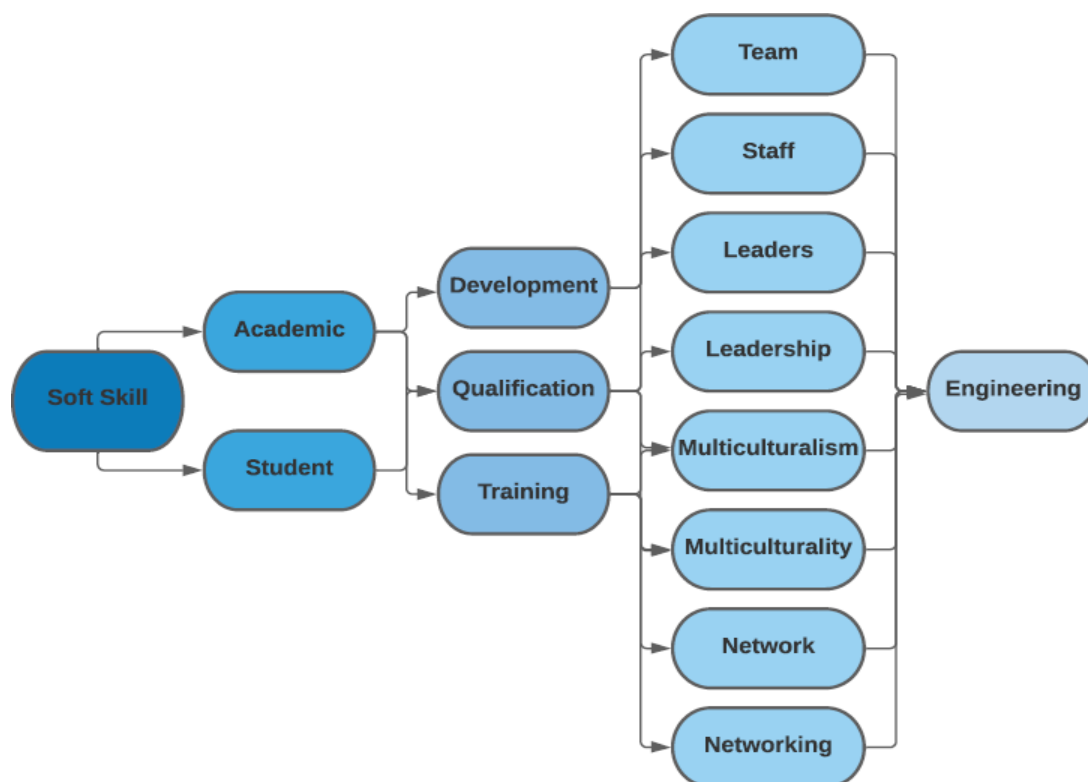The selected keywords and their derivatives were: Socio-

Figure 1. Diagram of keywords combination.
Source: Own authorship (2022)

emotional competences (soft skills); academic (academic, student); training (development, qualification); team (team, staff); leadership (leaders); networking (network); multiculturalism (multiculturality) and engineering. Through the defined words and their derivations, terms were combined, obtaining 24 different expressions, as illustrated in Figure 1.

The bibliographic survey was carried out using the Mendeley® software to collect and order the scientific articles. For visualization purposes, all the files obtained were input into Microsoft Excel®. Table 1 presents the results obtained from the systematic literature review for this study.

Following the SBR guidelines, after the first 14038 international articles were obtained, a second screening and refining stage was carried out. Conference documents and/or books, among other forms of publication other than scientific articles from journals, were excluded, as well as duplicates of each document. The grouping of the articles by the main soft skill 'Teamwork' and the subdivisions resulted in 1368 articles, from which 79 were related to teamwork, 489 to leadership, 17 to multiculturalism and 1069 to networking.

The final step was conducted reading all the titles and abstracts to select only the relevant articles, fully aligned with the research scope. In total, 33 articles were selected. These articles were grouped according to the topics listed in Table 2, which were used as basis to define the topics of the training meetings.

This step contributed to the entire application of the research, including the proposal development, the methodology and the elaboration of the questionnaires. The material used in the training was also based on the results obtained with the SBR and its references.

Research development stages

The core of the study was developed using four main items (Chiavenato, 2020): (1) Diagnosis, survey of the gap related to teamwork skills; (2) Design: elaboration of training to develop competencies and rectify identified deficits; (3) Implementation: application of the developed program;. (4) Evaluation: Analysis of the results obtained with the training.

The data for the diagnosis and evaluation stage were collected through an online questionnaire, in the pre- and post-completion stages of the activity, only from the students participating in the extracurricular activity developed. These data were treated qualitatively by content analysis, as proposed by Bardin (2015). The questionnaires were applied for diagnosis and for the final evaluation intended to evaluate the perception of improvement by the participants.

As data collection instruments, investigative questionnaires were used in the pre and post stages to evaluate qualitatively the participants' perception of their deficiencies in competence and if the proposed solution was effective. The questionnaires are found in Appendices A and B.

The levels for diagnosing and evaluating training questionnaires were inspired by Donald Kirkpatrick (Kanaane and Ortigoso, 2018), a pioneer in the development of training evaluation formats, focused on the training result. The levels are divided into: (1) Reaction; (2) Learning; (3) Behavior; and (4) Results, elucidated in Figure 2.

For the design stage, training and development (T&D) was done using the microlearning method, which provides better and more

Table 1. The systematic bibliographic review.

Keywords / key expressions	Systematic bibliographic review (SBR)		
	Database		Number of results
	Science direct	Scopus	
Development soft skill team academic engineering	910	5	915
Development soft skill team student engineering	1865	51	1916
Soft skill staff qualification engineering	162	0	162
Soft skill staff training engineering	1585	1	1586
Soft skill team qualification engineering	286	0	286
Soft skill team training engineering	2484	12	2496
Development soft skill leadership student engineering	736	5	741
Development soft skill leadership academic engineering	243	31	274
Soft skill leaders qualification engineering	136	6	142
Soft skill leaders training engineering	282	0	282
Soft skill leadership qualification engineering	123	0	123
Soft skill leadership training engineering	304	7	311
Development soft skill multiculturalism academic engineering	14	0	14
Development soft skill multiculturalism student engineering	43	0	43
Soft skill multiculturality qualification engineering	1	0	1
Soft skill multiculturality training engineering	37	0	37
Soft skill multiculturalism qualification engineering	10	0	10
Soft skill multiculturalism training engineering	37	0	37
Development soft skill networking academic engineering	2116	0	2116
Development soft skill networking student engineering	406	0	406
Soft skill network qualification engineering	85	0	85
Soft skill network training engineering	856	9	865
Soft skill networking qualification engineering	333	0	333
Soft skill networking training engineering	856	1	857
Total	**13910**	**128**	**14038**

Source: Own authorship (2022)

effective learning by dividing the content into smaller parts, easier to understand and which also uses technological resource to increase access to learning (Filatro and Cavalcanti, 2018). This teaching format is well suited to informal learning, as it focuses on avoiding the cognitive overload of students, proposing that the content previously divided into smaller units, is applied in a short period of time. The purpose of microlearning is information retention (Filatro and Cavalcanti, 2018). This method fulfills the requirements for Education 4.0 in higher education, for being innovative, more didactic and complemented by new technologies (Miranda et al., 2021).

The implementation phase took place in meetings that lasted approximately 80 min each. The meetings were held at night via the microsoft teams platform; they were developed in two weeks, making a total of five meetings.

The presentation of content related to the topic of each meeting was divided into the first 20 min. Then, for the next 10 min they were asked to perform an activity unrelated to the topic to stimulate the mind, such as music, reading or physical exercise (Ferguson et al., 2017). The activities were available through provided links. The students returned to the content for another 20 min, in which the key information was reviewed, and the topic was discussed. Another 10-minute break was applied, and, in the last 20 min, the knowledge acquired was applied through activities and/or exercises (Ferguson et al., 2017). The format used in the training is illustrated in Figure 3.

The division of the topics of each meeting was carried out considering the predominant topics found in the Systematic Literature Review, as well as the objectives of this study: Training for the improvement of socio-emotional skills in Industrial Engineering students, as described in Section 3.1. After each meeting, a questionnaire was used to assess the improvement in learning about the meeting's topic. Table 3 shows the date, topic, developed content and the referenced authors.

For the evaluation phase, the results obtained with the diagnostic and training assessment questionnaires were approached using Bardin's (2015) content analysis method. This method is divided into three stages: Pre-analysis, investigation of the material and data processing (inference and interpretation). In the pre-analysis stage, the scopes of the diagnostic and final assessment questionnaires were defined, using the levels established by Donald Kirkpatrick (Kanaane et al., 2018) which are reaction, learning, behavior and results.

This stage related to the diagnostic and design phase of the

Table 2. Topics and respective authors.

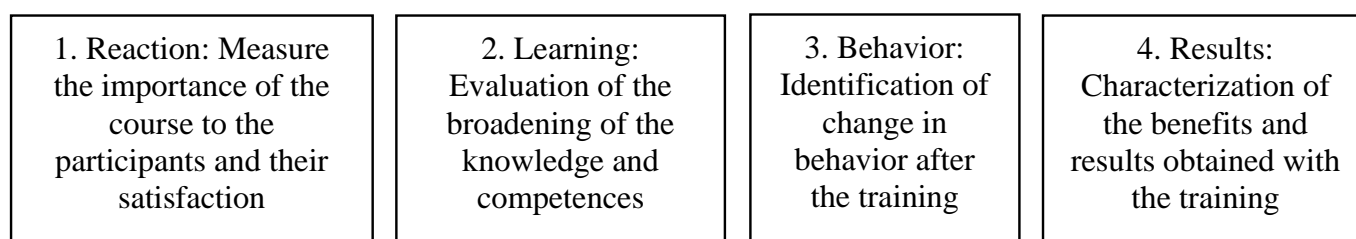| Topic	Author(s)
Teamwork	Bala and Singh, 2021; Bodolica et al., 2021; Devika, 2020; Giannakas et al., 2021; Haneberg and Aaboen, 2020; Moldovan, 2020; Piwowar-Sulej, 2021.
Leadership	Corriveau, 2020; Daley and Baruah, 2020; Liu et al., 2021; Rezende et al., 2021.
Multiculturalism	Fey et al., 2021; Fischer and Rode, 2020; Latha and Christophr, 2020; Mafico et al., 2021; Rezende et al., 2021; Utoft, 2020.
Networking	Fey et al., 2021; Fischer and Rode, 2020; Rezende et al., 2021; Utoft, 2020
Development of soft skills in higher education	Andreea and Bucur, 2020; Bala and Singh, 2021; Bodolica et al., 2021; Borah et al., 2021; Byrne et al., 2018; Corriveau, 2020; Daley and Baruah, 2020; Deep et al., 2020; Devika, 2020; Giannakas et al., 2021; Khodeir and Nessim, 2020; Latha et al., 2020; Lavi et al., 2021; Lenihan et al., 2020; Miranda et al., 2021; Moldovan, 2020; Piwowar-Sulej, 2021; Rezende et al., 2021; Rhee et al., 2020; Sokhanvar et al., 2021; Surekha et al., 2020.
The impact of soft skills in employability	Agostinho and Baldo, 2021; Borah et al., 2021; Deep et al., 2020; Flores et al., 2020; Haneberg and Aaboen, 2020; Khodeir and Nessim, 2020;Kipper et al., 2021; Lavi et al., 2021; Lenihan et al., 2020; Liu et. al, 2021; Moldovan, 2020; Piwowar-Sulej, 2021; Ribeiro et al., 2021.
Teaching methods	Andreea and Bucur, 2020; Ang et al., 2021; Corriveau, 2020; Deep et al., 2020; Devika, 2020; Lara-Pietro et al., 2021; Lavi et al., 2021; Lenihan et al., 2020; Miranda et al., 2021; Surekha et al., 2020.

Source: Own authorship (2022)

1. Reaction: Measure the importance of the course to the participants and their satisfaction	2. Learning: Evaluation of the broadening of the knowledge and competences	3. Behavior: Identification of change in behavior after the training	4. Results: Characterization of the benefits and results obtained with the training

Figure 2. Levels used for diagnosis and evaluation.
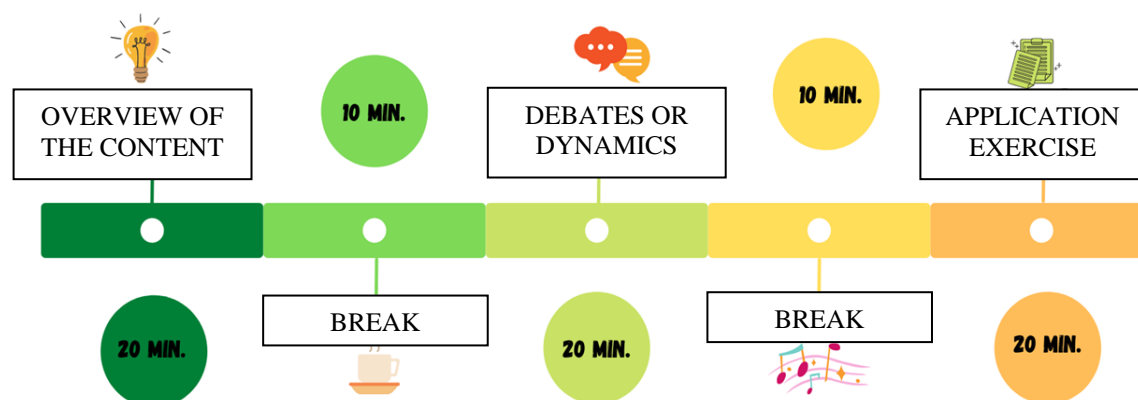Source: Own authorship (2022)

Figure 3. Content division, as per the micro learning method.
Source: Own authorship (2022)

training. For the investigation of the material, data are collected and examined, identifying the main keywords, acting in the implementation of the training. During the data processing and interpretation, all the information was organized, and the analysis and inferences were performed, considering the main objective – the development of the soft skills teamwork, leadership, networking

Table 3. Mettings content .

Date	Topic	Developed Content
13/09/2021	Soft skills in industrial engineering	Comprehension of the soft skills and why they must be developed: their relevance in engineering and their impact in future employability
15/09/2021	Multiculturalism - The first subdivision of teamwork	Overview of multiculturalism, exploring the different cultures present among the students, identifying similarities, recognizing differences, and learning how to work respecting them. and accepting everyone
17/09/2021	Networking - The second subdivision of teamwork	How to develop communication and networking and their importance
20/09/2021	Leadership - The third subdivision of teamwork	What is leadership, types of leaders and the importance of having leader characteristics
22/09/2021	The teamwork	What is teamwork, how the subdivisions leadership, multiculturalism and networking influence teamwork, methods for more effective teamwork

Source: Own authorship (2022)

and multiculturalism for industrial engineering students, concluding the evaluation part (Chiavenato, 2020). All steps and the correlation between them are shown more schematically in Figure 4.

Population and sample

The study population was Industrial Engineering - Mechanics Qualification course students, from the Center of Planalto Norte (CEPLAN) of the State University of Santa Catarina (UDESC). The sample consisted of twelve volunteers who signed up to participate in all training dates and meetings. No restrictions were imposed regarding age, gender or stage in the course. The required resources were equipment with internet access (mandatory), camera and microphone (optional) and availability to participate in all meetings at the specified time. The training was developed in remote mode given the COVID-19 pandemic at the time of the study.

Research application

The first phase of the study was a diagnosis of the deficit related to teamwork skills (Chiavenato, 2020). The survey was carried out through a structured questionnaire based on Donald Kirkpatrick's levels of reaction learning, behavior and results (Kanaane and Ortigoso, 2018) and information on the pre-analysis results of the SBR. The Diagnostic Questionnaire in Appendix A consists of twelve questions, seven of which are essays, and considered the satisfaction and importance of the course for the participants, the change in participants' attitudes, the expansion of their knowledge and skills and identification of change in their behavior as a result of learning, as well as characterization of the benefits and results obtained with the training (Kanaane and Ortigoso, 2018). All the twelve academics initially enrolled in the training answered the questionnaire, henceforth they will be identified by AC1, AC2, AC3, AC4, AC5, AC6, AC7, AC8, AC9, AC10, AC11 and AC12, for identity and data protection purpose.

After the application of the diagnostic questionnaire, the results led to the design, or the preparation of the training to develop skills and rectify the identified gaps (Chiavenato, 2020). The material developed for the five meetings addressed soft skills in Industrial Engineering and addressed individually the three subdivisions of teamwork - multiculturalism, networking and leadership. The

implementation phase occurred between the third and fourth weeks of September 2021. The meetings started at 19:00 on each of the previously scheduled days and lasted 80 min, using the microlearning methodology (Filatro and Cavalcanti, 2018). At the end of each meeting, three to five questions were applied to assess whether the topic had been learned. During the implementation stage, only five of the twelve students initially enrolled participated in all the meetings.

After the training completion, the participating students responded to the final evaluation survey. The evaluation questionnaire in Appendix B is divided into eight questions, seven of which were essays. All information collected during the training through the questionnaires was addressed using Bardin's Content Analysis method (2015).

The data processing was followed by a statistical operations phase, in which two analysis formats were used: Selection and classification of keywords related to the main soft skills (leadership, multiculturalism, networking and teamwork), and other mentioned concepts with the frequency at which they had mentioned (Bardin, 2015). During the synthesis and selection of results phase, the best answers given in open questions were selected, evidencing the results found in the statistical operations. Table 2 was used as a basis to group the inferences from the theoretical framework that allowed the interpretation of the results (Bardin, 2015).

RESULTS AND DISCUSSION

Socio-emotional competences and training

The initial knowledge about socio-emotional skills was assessed by Questions 1 and 2 within the Diagnostic Questionnaire. Question 1 "Regarding socio-emotional skills in Engineering, during your undergraduate course, have you learned or heard about it? If so, at what time or in what way?" aims to identify whether the development of these skills is approached in undergraduate courses and in which manner. 50% of the students had never learned or heard about it. 16.7% had learned about or knew the content in an undergraduate research project; another 16.7% learned about it in the classroom under
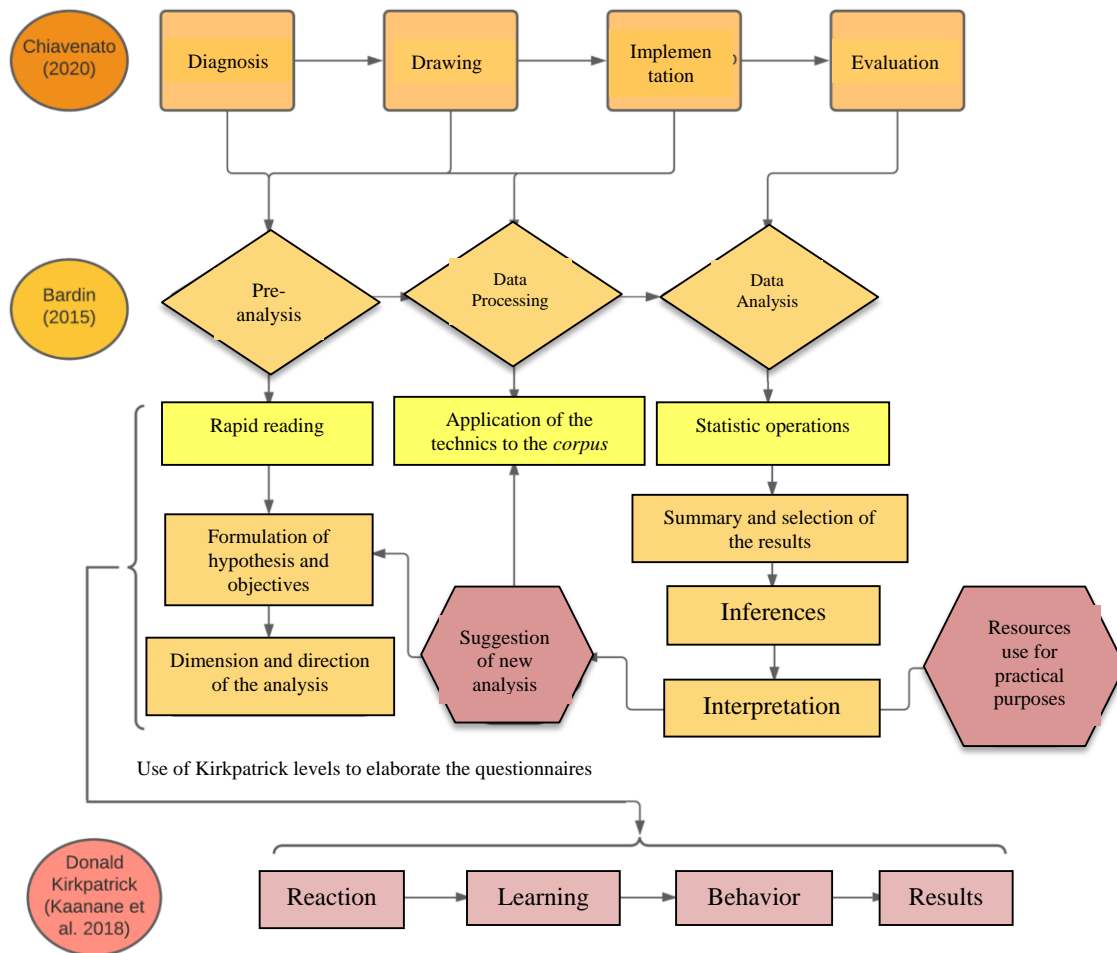
Figure 4. Schematic organization chart of the research development phases.
Source: Own authorship (2022)

the subject of Organizational Behavior, and still another 16.7% learned about it in lectures or courses outside the course. AC2 mentioned having great knowledge in the area through social networks but had never heard about it in their undergraduate course. "I never heard anything about it in college, but I had heard about it through profiles on Instagram". The results show that half of the participants had not even heard of socio-emotional skills, supporting the relevance of this research.

Question 2 "As an Industrial Engineering student, what is your view on socio-emotional skills in Engineering and how do they apply?" seeks to identify the students' perception of the topic and its applicability. Of the total responses, 41.7% responded that the topic has applicability in professional and personal development in general. About 25% of the responses identified that the topic applies to the areas of leadership and management, while 16.7% of the students identified that the applicability is greater in teamwork and communication

areas; 16.7% did not know how to answer. The response of AC12 expressed how technical knowledge is overestimated in relation to socio-emotional knowledge and the impact in the career and the work environment: "As a student, I had a view that they were not as important as my technical knowledge; it is the technical knowledge that would bring the solution of problems or new ideas. But now, working, I see that you will hardly have the ideas for the problems alone. And the time you spend dealing with people (or with yourself) is extremely longer than the time you deal with technical information. In my case it is roughly 90% people to 10% technical. So today I see that these skills are extremely important to achieve a good performance at work".

AC12's comments highlight the discussion of professional development for Industry 4.0. Commonly, those already in the job market feel more connected to the analytical, logical and systematic side. This reflection is in line with the studies of Piwowar-Sulej (2021), who

stated that the student who graduates to follow aligned procedures, performs activities as established, in the correct way, focuses a lot on the problems, and sometimes underestimates the interpersonal side. Students who seek success in their career within the Industry 4.0 context must be receptive to the diversity of teams and complex activities.

The proposed training was evaluated through Questions 11 and 12 from the diagnostic questionnaires and Questions 6 and 7 from the evaluation questionnaire.

In the diagnostic phase, Question 11 "attribute value to the relevance of a training in socio-emotional skills in higher education:" with a scale from irrelevant to extremely relevant, allowed the academics to give their opinion on the relevance of the training before having the experience. About 41.7% identified it as extremely relevant; the rest were divided between relevant and very relevant. The results suggest that even lacking experience, students already felt the need to learn soft skills. The aim of Question 12 "And finally, what are your expectations from enrolling in this training?" was to verify the students' expectation regarding the training. Around 66.7% mentioned learning and improvement, 16.7% mentioned objectives related to management and leadership and the other 16.7% had expectations related to their personal development. The answer of AC9: "Develop the socio-emotional skills that the disciplines in college did not allow - which I think are extremely important to develop and stand out in a work in engineering areas", highlights both the lack of this content during higher education, and its importance for career development, justifying the need for training focused on the development of socio-emotional skills.

In the final evaluation phase, Question 6 "As for the teaching method applied in the training, describe your experience" aimed to evaluate the teaching method from the participants' point of view. The responses were all positive, and 60% classified the training as "very good". AC2 and AC7 answered: "It was good, classes well explained, very efficient and not tiring" and "very good, the time was very well organized and used", highlighting that the microlearning method, which uses breaks, brings interest in the class, and makes it more effective and less exhausting. Question 7 identical to Question 12 mentioned earlier and aimed to understand if the students' point of view regarding the importance of learning soft skills changed after the training. 100% of the participants evaluated it as extremely important, which shows a clear impact of the training in the students' point of view.

Bardin content analysis - descriptive statistics

The completion of the questionnaires followed the data processing phase with Bardin's content analysis.

According to the method, the sentences were used in full. All responses collected were organized in a spreadsheet for visualization purposes, and, with the results properly sorted, the stage of reading and identification of the main predispositions and contributions was carried out. This step also identified the references given by each respondent connecting the explained ideas with the concepts listed by Campos (2019) as presented in Table 3.

As can be seen, the students listed competences beyond those that the study initially aimed to approach, although all the items are directly related to the four main proposals and to each other. This reinforces that learning and understanding these competences separately is not sufficient, as all of them are necessary both personally and professionally. The frequency analysis was developed based on a prevalence assessment, which evaluated the number of times each concept was mentioned by each respondent as shown in Table 1. The prevalence is shown in Table 4.

The global frequency allows understanding the most cited concepts, which were, consequently, developed more intensely in the applied method. The multicultural competence, mentioned 28 times, stands out. It is worth remembering that this competence brings the individual into a different cultural environment (Mafico et al., 2021). By learning how to work in a team, in a different method, with different people, the experience takes academics out of their everyday comfort zone.

The proposal of training in the EAD mode, using the microlearning learning method, including discussion, questioning and dynamics, caused greater interaction between students, creating a relationship in which each one shared and learned from others. Multiculturalism makes the team diverse, requiring collaboration and teamwork to deliver (Rezende et al., 2021).

The competencies of teamwork, leadership and networking were mentioned 19, 16 and 13 times, respectively. Some ideas proposed by the students include more than one competence. This shows there is a link between the competences.

The local prevalence analyzes the relationship between the ideas and the objective of the question. For this, Questions 1 to 5 from the diagnostic questionnaire were used. These questions evaluated the perception about how the training changed or affirmed their view on socio-emotional skills in engineering. Respondents also assessed the development or improvement in each of the core competencies of this study, in line with the research objectives.

These questions were used to validate the efficiency of the training. The analysis of Figure 5 suggests an effective learning process, as lifelong learning and the main competences were predominantly mentioned in the study. When the result is compared with the answers from the diagnostic questionnaire, in which students

Table 3. Socio-emotional competences and reformulation of the identified concepts (proposed ideas).

Socio-emotional competences	Formulation of the identified concepts
Communication	Solve problems through an effective team communication; develop communication; knowing how to listen and speak; being communicative; discuss ideas; position myself [sic]; communication
Active listening	Knowing how to listen and to speak; seeking to understand; knowing how to listen; trying to understand the team; understanding everyone's difficulty
Problem solving	Solve problems through team communication; solving problems; troubleshooting; managing conflicts and not harming the project; conflict mediator; understanding the problem and its solution; understanding all existing problems, open for suggestions; trying to find identification; knowing how to manage problems; understanding the others' problems within the environment
Open minded	Manage conflicts without harming the project
Critical thinking	Knowing one's limits; Being critic
Creativity	Creativity; New ideas; Giving ideas
Innovation	Innovation; New ideas; Giving ideas; Having work vision
Emotional intelligence	Self-control; emotional stability; connect oneself [sic] with the others' opinion, expression one's own opinion, but accepting the group decision, even when there is a disagreement
Life-long learning	Improvement; learning to adapt; knowing how to adapt; start develop this competence at work; human development; new knowledge to improve ability to deal; learn better; learn something new; evolve; add at work and college; develop and understand more about socio-emotional skills that the disciplines in college did not include
Motivation	Motivation
Self-direction	Focus; focus on the objective; autonomy; knowing how to handle future challenges.
Ethics	Culture does not prevent project success
Professionalism	Good results in the company and socializing with colleagues; good performance at work; socio-emotional skills are the basis for every professional to stand out in the market; create relationships that adds to the professional path; learning to use soft skills professional, academic and personally; organizational construction; better understanding of skills applying them professionally and privately
Teamwork	Solve problems through team communication; dealing with people; people management; working well in a team; collaborative with the team; team work; collaboration; there is no leader without a team; planning team goals; contribute positively to a team
Multiculturalism	Dealing with subordinates or group of people; knowing how to deal well with different personalities; several views on a single situation; improve rapport with other people; multiculturality clashes; persuasion; different scenarios and different people; multiculturalism; adapt to other cultures; competencies need to be developed regardless of customs; culture does not prevent the project from being a success; multiculturality; understand and accepting diversity; learn, respect and improve; helping all members of a team; no difficulties in dealing with people and processes; better relate to people on the most varied subjects; learning to better accept group choices; understanding others' problems within an environment; ability to rethink based on others' views on the subject; differences are part of any area of life; adapt to other cultures
Leadership	Being a leader and knowing how to manage; administration and management; assume leadership positions; leadership ability; leader; lead; distributing and delegating tasks; leadership; there is no leader without a team; participatory leadership; understanding the different types of leadership
Networking	Exchange experiences; exchange information with contacts, network of contacts; search for external contacts; aggregated and shared knowledge; create relationships that add in the professional path; networking; being involved with different people, with different backgrounds; bringing a baggage of knowledge; taking one's knowledge to others; engagement in networks of contacts; better relate to people on the most varied subjects; the view of other people on the subject makes us reformulate some subjects

Source: Own authorship (2022)

should classify their difficulty level in each competence, as shown in Figure 6, the difference is even more pronounced.

Figure 4 summarizes the students' self-assessment of

Table 4. Compilation of the results of the prevalence assessment.

Soft skills	Responder	Number of times the skill was identified	Total
Communication	AC2	1	6
	AC6	1	
	AC7	2	
	AC12	2	
Active listening	AC2	1	6
	AC4	2	
	AC9	1	
	AC10	1	
	AC12	1	
Problem solving	AC4	5	10
	AC6	2	
	AC7	1	
	AC9	1	
	AC10	1	
Open minded	AC4	1	1
Critical thinking	AC1	1	2
	AC4	1	
Creativity	AC1	1	4
	AC4	1	
	AC9	1	
	AC12	1	
Innovation	AC1	1	5
	AC4	1	
	AC5	1	
	AC6	1	
	AC9	1	
Emotional intelligence	AC1	1	3
	AC4	2	
Life-long learning	AC1	3	15
	AC2	2	
	AC4	1	
	AC5	1	
	AC7	1	
	AC8	1	
	AC9	2	
	AC10	2	
	AC11	1	
	AC12	1	
Motivation	AC4	1	1
Self-direction	AC1	1	4
	AC4	2	
	AC12	1	
Ethics	AC4	1	1
Professionalism	AC1	1	7
	AC2	2	
	AC4	1	
	AC9	2	
	AC12	1	

Table 4. Contd.

Teamwork	AC1	1	
	AC2	2	
	AC3	2	
	AC4	4	
	AC7	2	16
	AC9	2	
	AC10	1	
	AC11	1	
	AC12	1	
Multiculturalism	AC1	2	
	AC2	4	
	AC3	1	
	AC4	6	
	AC6	4	
	AC7	3	28
	AC9	2	
	AC10	1	
	AC11	2	
	AC12	3	
Leadership	AC1	2	
	AC2	3	
	AC3	1	
	AC4	2	
	AC6	2	
	AC7	3	19
	AC8	1	
	AC9	1	
	AC11	2	
	AC12	2	
Networking	AC2	1	
	AC4	3	
	AC6	3	
	AC7	2	13
	AC9	2	
	AC12	1	

Source: Own authorship (2022)

their perception about each competence approached in the study. Most of the students evaluated their competences as well developed. However, at the end of the study, the students identified that there was still room for development. When compared to Figure 3, in addition to the requested competencies, lifelong learning was mentioned.

Bardin content analysis: Results synthesis and selection, inferences and interpretation

The choice of a specific topic within all the socio-emotional competences was to facilitate the validation of the training, evaluating its objectives of developing teamwork, leadership, multiculturalism and networking
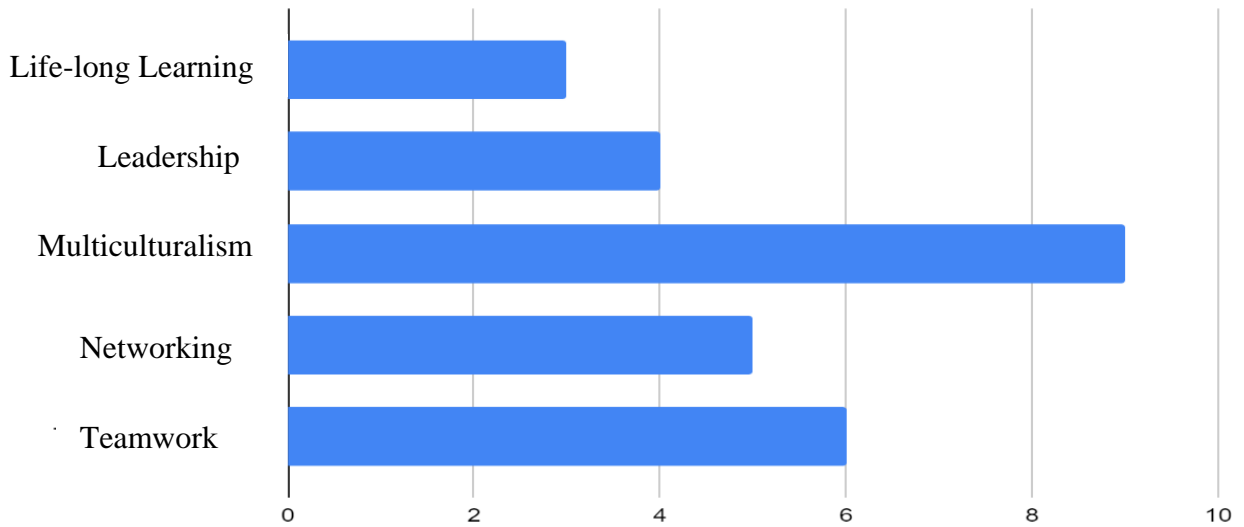
Figure 5. Comparison between the most mentioned competences.
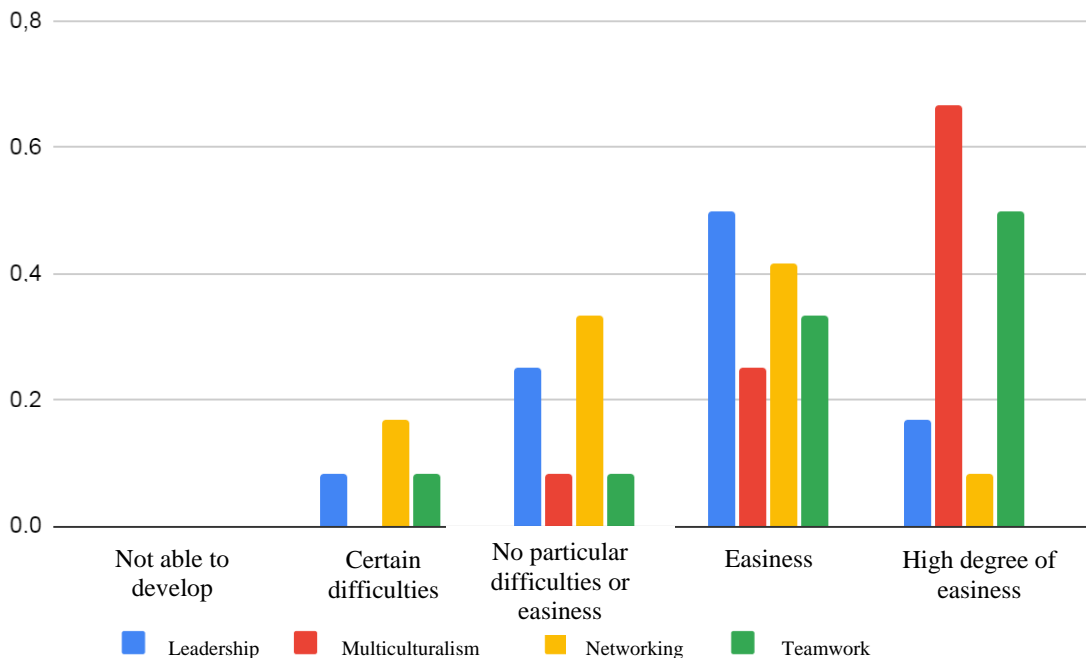Source: Own authorship.

Figure 6. Self-evaluation of the respondents regarding their soft skills.
Source: Own authorship.

skills. However, the students expressed 13 other types of competences other than the ones initially targeted in this study. For example, when asked whether the training changed or affirmed their view about soft skills in Engineering, and how they apply, AC4 said: "Yes! The training helped me to identify some skills in myself, as some that already existed, but which I did not know how to name; they apply in teamwork, in being able to understand other problems within an environment, in various situations". This answer indicates that the training met the students' expectations, fulfilling the research objective and providing a broader view of other skills.

This phenomenon can be explained by Campos (2019), who says that socio-emotional skills are interconnected, and when developing or working on one, the development of others, albeit on a smaller scale, invariably occurs.

Considering that the study aimed at developing a training to meet the current challenges within the contextof Education 4.0, the objectives remained aligned with the requirements and needs of the educational institution and the job market. The four pillars of this new educational format are competencies, learning methods, information and communication technologies, and infrastructure (MIRANDA et al., 2021). They were achieved with the content of competencies, learning method (Microlearning), a means of technological education (remote, via Microsoft Teams), with adequate infrastructure and accessible to students. The proposal of Education 4.0 in higher education is to apply new teaching methods, more didactic and innovative, linked to technology (MIRANDA et al., 2021). The following feedback about the training was obtained: "It was a very constructive meeting, different experiences with people, a dynamic meeting, the speaker was patient and very communicative, an incredible meeting and I really enjoyed the breaks so we could connect with other thoughts" (AC12); and "The methodology actually helps the context assimilation, the examples covered are easy to understand and the exercises help to visualize the Soft Skills in daily practice" (AC4). The training format provided the development of the skills necessary for the Industry 4.0 professional.

Conclusion

The main objective of this study-to develop and implement a training to expand socio-emotional, specifically Teamwork-related skills - was achieved, as demonstrated by the results and the participants' perception about the relevance and comprehension of these skills. In addition to these competencies, fourteen others were identified in the responses of students who voluntarily agreed to participate in this study.

The training structure developed considering three base authors, Bardin, Chiavenato and Donald Kirkpatrick and their respective methodologies, proved to be effective. The grouping of ideas from the three authors allowed a new format to be developed, enabling students to learn efficiently. The training and research format was based on the author Chiavenato, renowned in training and development techniques in administration. The questionnaires were structured considering the references of the diagnostic and evaluation levels of Donald Kirkpatrick, a pioneer in the development of training evaluation formats; they focused on the results and feedback. The data processing was carried out with Bardin's content analysis, which allowed to adequately qualify each result and response obtained throughout the research, avoiding a superficial validation. Furthermore, the application of the microlearning method, which divided the content into smaller, easier to understand parts, brought a new experience to the students.

The training also compared the challenges of remote teaching during the pandemic with face-to-face courses, based on the classroom system with live explanations. It can be challenging to keep the attention of the public used to the face-to-face method, which is the reason why the Microlearning method was chosen, breaking the content explanation into smaller periods of time with pauses.

This training format was, according to the students' informal reports, innovative and stimulating. Innovative teaching encourages not only students' participation in class, but also enables better understanding of the content. In the current information era, in which information is widely and immediately available, teaching methods need to be revised and should be capable of stimulating participation and attention.

The training also influenced the students' self-knowledge. At the beginning of the research, the vast majority identified themselves as having easiness with most of the competences, but as the course progressed, each student gained a broader view of each competence and how they could expand their knowledge. Many who had initially identified themselves as good leaders did not know how to identify different types of leadership in class, and those who claimed easiness with multiculturalism did not to know how to define the competence.

During the training application, there was a significant dropout rate, justified by the participants due to the COVID-19 pandemic and its influence in personal life. As future suggestion, it is interesting to carry out the same course in a face-to-face format to compare the integration between the participants and the exploration of the competences. According to the informal and formal indications of the students, it is relevant to study a possibility of integrating this content with technical subjects, for the professional development for Industry 4.0 to be more effective.

It is also worth mentioning that an academic training must be continuous, as it is not possible to learn all the technical content aligned with the socio-emotional skills during the 5 years of universities. Lifelong learning must be one of the goals of engineering professionals inserted in Industry 4.0.

Finally, the applied and structured method fulfilled the expansion of the teamwork skills for engineering students; it promoted the development of these skills, and provided a teaching method that stimulated the students and allowed an effective learning. Students responded to the entire survey with enthusiasm for learning, providing insights about their perceptions and highlighted the need for ongoing training that possibly connects the technical

skills with the socio-emotional development.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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APPENDIX A – DIAGNOSIS QUESTIONNAIRE

This questionnaire aims to diagnose the knowledge and application of the soft skill Teamwork and its subdivisions Leadership, Multiculturalism and Networking for the students of the Industrial Engineering course - Qualification in Mechanics. This questionnaire is a prerequisite for carrying out the Training "Socio-emotional Skills: Teamwork in Industrial Engineering". Your personal data will not be disclosed.

1.   Please write your full name:

Soft Skills

2.   Regarding the soft skills in Engineering, during your undergraduate course, have you ever heard about them? If yes, when and how?

3.   As an Industrial Engineer student, what is your point of view about social-emotional competences and how do they apply?

4.   Evaluate your Teamwork skills:
○   I am not able to work in a team.
○   I have difficulties working in team.
○   I do not have particular easiness or difficulties working in team.
○   I work well in team.
○   I work very well in team.

5.   Reflect about your self-perception about your Teamwork skills:

6.   Evaluate your Networking skills:
○   I have difficulties in Networking.
○   I have some difficulties in Networking.
○   I do not have particular easiness or difficulties in Networking.
○   I have easiness for Networking.
○   I have a high degree of easiness in Networking.

7.   Reflect about your self-perception about your Networking skills:

8.   Evaluate your Multiculturalism skills:
○   I cannot handle Multiculturalism.
○   I have certain difficulties with Multiculturalism.
○   I do not have particular easiness or difficulties with Multiculturalism.
○   I work well with Multiculturalism.
○   I work very well with Multiculturalism.

9.   Reflect about your self-perception about your Multiculturalism skills:

10.   Evaluate your Leadership skills:
○   I am not able to exercise Leadership.
○   I have some difficulties in Leadership.
○   I do not have particular easiness or difficult with Leadership.
○   I have easiness to leader.
○   I have high degree of easiness to leader.

11.   Reflect about your self-perception about your Leadership skills:

Content

12.   Assign a degree of relevance to socio-emotional skills training during graduation:

○   Irrelevant
○   Relatively relevante
○   Relevant
○   Very relevant
○   Extremely relevante

13.   What is your expectation with this training?

APENDIX B – EVALUATION QUESTIONNAIRE

Este questionário tem por finalidade avaliar os resultados obtidos com a Capacitação "Competências Socioemocionais: Trabalho em Equipe na Engenharia de Produção". Seus dados pessoais não serão divulgados.

1.   Please write your full name:

Soft Skills

2.   Did the training change or confirmed your perception about Socio-emotional skills in Engineering and their application? Justify.

3.   Re-evaluating your perception on your own Teamwork skills, was there a development or improvement? Justify.

4.   Re-evaluating your perception on your own Networking skills, was there a development or improvement? Justify.

5.   Re-evaluating your perception on your own Multiculturalism skills, was there a development or improvement? Justify.

6.   Re-evaluating your perception on your Leadership skills, was there development or improvement? Justify.

Content

7.   Describe your experience with the teaching method used in the training:

8.   How relevant was the socio-emotional skills training?
○   Irrelevant
○   Relatively relevant
○   Relevant
○   Very relevant
○   Extremely relevant

Did the training achieve your expectations? Suggest some points for improvement.