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Clown Group - Engineers without Borders (Knowledge Connections): Building a Humanistic Training in Engineering Courses

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Abstract

The Clown Group – Engineers without Borders (Knowledge Connections) is a group of clowns formed by Engineers and Engineering students. The theoretical basis of the Clown Group goes back to the origins of Jerzy Grotowski's "poor theater" (1933–1999). Concerning the use of music, theater and dance to present and promote the pleasure of art, the Group values the interaction with the public and does not worry about the structural elements commonly characterized by the theater as stage and lighting. In this way, the Clown Group promotes a Humanistic Formation of its members by providing a development in the capacity of communication, contact with the external community and also the satisfaction, by allowing the art to be spread in a simple and effective way. The objective of this work is to analyze the importance of Humanistic Training in the professional and personal development of Engineers and Engineering students, treating as a special case the Humanistic Training linked to the actions of the Clown Group – Engineers without Borders (Knowledge Connections). As a hypothesis, it is expected that the experience of members and ex-members of the Clown Group can be proven through their training and presentations over the years. In order to evaluate the personal and professional development of members and ex-members of the Clown Group during the training process, a qualitative research was carried out, via an applied questionnaire, in addition to a documentary research by observation, in which data were collected through analysis and observation of photos and documents of the Clown Group. In addition, Artificial Neural Networks were used to correlate the members and ex-members based on the two applied researches. The members and ex-members of the Clown Group have experienced a major break in introspection, significantly improving their way of communicating with society. The members and ex-members presented an improvement in the way they relate to each other in a team, a fundamental aspect of an Engineer's professional life. The Clown Group presents itself as a very important action for Humanistic Training and the professional and personal development of Engineers and Engineering students. The diffusion of art in the academic and external community promoted by the Clown Group also allows the deconstruction of the stereotype that the areas of Engineering and the Arts cannot coexist.

Keywords: Art, Communication, Humanistic Training, Clown, Tutorial Education Program.

1. Introduction

The learners of Engineering Courses opted for this area of knowledge because they have affinities with Math and Science, besides having a high capacity to elaborate solutions to everyday problems. The University usually offers the theoretical and practical bases inherent to the process of training Engineers. However, questions arise as to how the Engineering courses could enable future Engineers to train beyond the strictly technical training. In view of the competences that the society demands from the Engineer, the School of Electrical, Mechanical and Computer Engineering (EMC) of the Universidade Federal de Goiás (UFG) included in the curricular matrices of its Engineering Courses Disciplines of Ethics, Law and

Citizenship and Environmental Sciences, aiming at a training based on theories of Human Sciences, Social Sciences and Environmental Sciences, promoting the discussion of a reflexive nature with a view to Humanistic Formation¹⁻³.

The EMC's initiative is necessary; however, it is not enough for the training of professionals whose worldviews are capable of establishing comprehensive and critical social ties^{4,5}. In fact, Humanistic Formation is understood as the capacity of the individual to deal with the various social aspects with which he interacts directly or indirectly, and according to Cenci and Fávero⁶:

“The Humanistic Formation must necessarily be effectively committed to a formation for life in society, pursuing certain fundamental dimensions of it, such as personal dignity, recognition of the worth of the person and the value of others. The development of personal autonomy and a coercion and successful project for self, respect for the similar and the environment, construction of a coherent and critical world view, the ability to establish social bonds and assign meaning to actions and things, a temporally situated understanding of itself Society in which he lives, guidance through universal values, etc”.

It is very common in the Engineering Courses, the presence of learners with difficulties of communication in public, relationship, interpretation of the environment and manifestation of opinion. In this way, many professionals in the area of engineering end up inserted in the labor market with a low level of connection with the Society, being that often this absence of connection and dialogue ends up harming the full professional development of the Engineer. It is noteworthy that it is established that the professional Engineer, in many cases, is introspective and disconnected on social issues. In this context, the Clown Group – Engineers without Borders (Knowledge Connections) was created in 2010, which is necessary for the training of future EMC/UFG Engineers. According to Rojas⁷:

“Somehow, the playful is present and adds an indispensable ingredient in the relationship between people, enabling creativity to pray”.

Since its creation, the Tutorial Education Program (Knowledge Connections) (PET) of the EMC/UFG has the Clown Group – Engineers without Borders (Knowledge Connections), in which the students and technical staff of EMC/UFG participate. The Clown Group shares with the academic and non-academic community its appreciation for art through theater and music. Thus, the Clown Group made its first presentation in 2011 under the direction of the Tutor^{8,9} and of an Electrical Engineering student producer and actuator⁹.

The Clown Group began with the proposal to perform clown-themed theatrical performances in academic and/or scientific events (conventional spaces) and unconventional spaces, such as shelters, fairs, popular communities, public places, among others^{8, 9}. It is the responsibility of Clown Group members to develop verbal and non-verbal communication techniques in a creative and spontaneous manner, with no regard to scenarios, stage and lighting, which favors an improvement in the interaction capacity in the various social media. The theoretical basis of the Clown Group goes back to the “poor theater” by Jerzy Grotowski (1933–1999)¹⁰. The focus during rehearsals and workshops is attributed to the actors, considering both their physical training and their ability to interact with the audience. However, there is concern and care with the development of the costumes of each member of the Clown Group, appropriate choice of musical instruments and development of the presentation script. In this way, the technical theatrical sides of the members of the Clown Group are developed through practical courses and workshops^{11,12}. In order to do theater it is necessary to give life to universes, it requires the transformation of literature into Performing Art and its direct transformation with the audience requires innovation and production. The structure of the script takes place in the transformation of the actor into character. The actor seeks to enrich the role with his abilities of improvisation and creativity

aiming to substitute an action without grace, for a more expressive action. During a performance, an actor is free to promote a change in the script based on their perception of the audience's reaction. In addition, there is the "artistic risk"¹³, an expression that originated in France in the late 1980s, where those responsible for cultural institutions dared to take advantage of audacity, where there are basically two risks. The first risk is the economic, linked to the success or failure of an event and the second one is the physical, related to the danger of audacity of the submitted body of the actor in the execution of his art. Bolognesi presents an iconographic documentation of some Brazilian circuses and their clowns¹⁴.

Despite all the challenges of circus survival, Allouche et. al. concluded that the clown gained space from the twentieth century. Notice how this happened¹³:

"The strength of the circus in the life of the arts still has other aspects, because its wandering in the cities' corners reminds us of the solitude of artists at the margins of society, because their struggle against gravity suggests that all art challenges the problems and customs. During the nineteenth century the saltimbanco (acrobat, trapeze artist or juggler) was described and deduced as an effigy of artistic adventure, in which fate encompassed at the same time the precariousness and beauty of the creative adventure. A hero of a parallel struggle against gravity, the clown gained space during the twentieth century, from Farina (Jules Chevalier) to Buff (Howard Buten), as a singular representative of the artistic community, able to focus the irony of existence under his nose and to kick the haughtiness of the more affluent classes".

Nevertheless, how can we teach art? By attending a conference in 1861, Gustave Courbet responded as follows¹³:

"Art [...] would not know how to be for an artist, nothing more than a means of applying his personal skills to the ideas and things of the time in which he lives".

It is interesting to think the artist individually as his or her own instructor. Is there a great artist idealized by Courbet? Perhaps, if this myth has a very strong relationship in which the theatricality of the circus is inserted in the search for stronger and stronger individuals. However, can the "soul skills" (of the human being, of the individual) be taught as acting actor or circus athletic performance? Hardly, because at most, it can be cultivated¹³.

In this way, the inherent challenges of the comic formation of a clown are to innovate and the mere repetition or reconfiguration of known situations often does not satisfy the idealized goals. Therefore, it is necessary to surprise, to think "out of the box" and avoid the traditional. However, comedy requires skill in elaborating, creating, and developing to be free from decorated and fully ready actions. In this sense, "make believe", "pretending", "imagine being another person" and "create imaginary situations" are essentially dramatic positions in the creation of scripts of the presentations of the Clown Group – Engineers without Borders (Knowledge Connections). This allows a maturation of the members by promoting the Art, Culture and Knowledge Connections through clown, in addition to prioritizing social relations as an indispensable element for the personal contemplation of the future professional of Engineering and correspond a Humanistic Formation of the learner. Characteristics required in the Pedagogical Projects of Courses (PPC) of Engineering of the EMC/UFG¹⁻³.

In order to demonstrate the advantages of the differentiated training of the professional Engineer, obtained with the Clown Group, it is important to evaluate the personal and professional changes that this training process promoted in the members and ex-members of the Clown Group. Thus, in this work the results of a Marketing Research that presents the personal and professional profile developed by the team during their participation in the Group are presented. In addition to the Marketing Research, a documentary research was carried out by observation, using documentary archives of the Clown Group, which

presents the level of commitment of members and alumni in relation to the Clown Group. Thus, it is intended to use Artificial Neural Networks (ANN), more specifically the Non Parametric Self-Organizing Map (PSOM) network, to correlate members and ex-members through clusters that evidence research results.

2. Clown Group Training, Marketing Research, Documentary Research by Observation and PSOM Network

2.1. Clown Group Training

The art was chosen as a reference for the Clown Group – Engineers without Borders (Knowledge Connections) because it is a comprehensive language and can be translated into expressions of feelings, which characterizes it as a universal language. Accompanying the essence of universality, live music and scenic expression appear as guiding directives of the clowns that each movement interact with each other and with the public. This essentially distinguishes the artistic creation from the other modalities of human knowledge and the quality of communication between human beings that the work of art provides, through a particular use of the forms of language. Despite breaking the “Grotowskian” paradigms 10, music and costumes are included as elements characterizing the play. Each clown has a distinctive dress and performs a musical instrument throughout the performance, according to the specifics arranged in the script. The body, the voice and the creative imagination are basically available, which allows the performance of playful exercises that reveal and expand the capacity for communication, breaking the barriers of inhibition, looking and hearing oneself and the other.

Why make art? Art is made to achieve full realization and to get rid of existential voids and repressed expressions, common and individual. According to¹⁰:

“The theater [...] is capable of challenging itself and its viewers, violating the accepted stereotypes of vision, feeling and judgment – an even strident violation because it is reflected in the breath, the body, the inner impulses of the human organism. This challenge to the taboo, this transgression, causes the shock that pulls the mask, allowing us to offer ourselves undressed to something that is impossible to define”.

Thus, partially adhering to this concept, the Clown Group – Engineers without Borders (Knowledge Connections) shares with the public its appreciation for the fifth art: the theater. Art works as an educational model that aims to give a personal meaning to life, developing the particularity of each individual in creation, listening and concentration skills for the performance of works of interpretation. The dramatic process is considered one of the most vital to human beings, since this “can be observed in every civilized society, varying according to the development of civilization”¹⁵.

In the theater, the clown is not that classic clown model of the circus, but an actor in the form “exaggerated” or “sharp”. Thus, the clown is the main tool of the Clown Group, and this mode of acting is described as a clown with personality whose ability to make the audience smile should be similar with doing so reflect, it is possible to deeply explore the critical potential with comedy 13. The choice of this character style to make up the Clown Group is due in part to the skill the clown possesses to handle various situations, as well as a good professional Engineer. In the midst of juggling and pirouetting, the clown must be able to comply with the art of pulling smiles. Thinking about laughter and comedy is not an easy task, it is necessary to seek social interaction and the way in which the comic-making processes are performed to elucidate the social function that the phenomenon of laughter has

13. The clown as well as the Engineer, gets ready to get results, designing and executing, being the Engineer with arguments based on Physics and Mathematics, while the clown competes with the “ingenious” function of performing smiles in certain time. Importantly for Grotowski, Flaszen and Barba¹⁰, the good actor must be subject to any type of challenge that magnify his work and consider that his own condition of actor is his greater challenge of life. Willing to accept challenges in every class or challenge of the profession, members of the Clown Group immerse themselves in the clown universe and engage in the challenge of doing theater as Engineers. The execution of the project consists basically, among other developments, in three stages: (1) selection and study of the theoretical reference; (2) practical workshops; and (3) presentations based on art, music, mime and improvisation. The Clown Group uses a methodology that encourages self-knowledge and creativity, promoting personal growth through experimentation. Each clown has access to various types of activities during the stages of the presentation. Thus, Danilo Santos de Miranda (2010) states that¹⁰:

“[...] For the first observation that he states in “In Search of a Poor Theater” he says that the pace of life of modern civilization is characterized precisely by acts that are overly measured, by tensions, by a sense of predestination and death, by the Desire to conceal their real personal motives and assume instead a variety of roles and masks. That is, in everyday life we are already actors”.

Thus, theater is a dynamic tool for academic activity. The Clown Group – Engineers without Borders (Knowledge Connections) conducts studies with a view to understanding the basic aspects necessary for theatrical performance.

The Theatrical Initiation Workshop, based on “Open Dramatic Arts”, stimulates the pupil-actor, the creative spirit, the daring, the confrontation of risks and obstacles. This provides a great opportunity for the beginner to develop their artistic potential. These workshops are carried out with the expectation of awakening the participant to the development of the identity, autonomy, abilities, attitudes and interests for the discovery of novelties in all sectors of artistic knowledge, stimulating intellectual emancipation, providing each clown with an understanding of its expression and of the inquiries inherent in them, which should culminate in scenic creation.

The Society is a privileged space for the different manifestations of the expressiveness of the human being, in the search of the construction of new knowledge for its development and reduction of injustices. Thus, the spaces used by the Clown Group for presentations and workshops can be listed 8: events (congress, seminars, exhibitions, among others); unconventional popular spaces (public fairs; public places; among others); hospitals; shelters; and others.

Thus, since its first pilot presentation in 2011, the Clown Group – Engineers without Borders (Knowledge Connections) has already made sixteen presentations. Table 1 lists the presentations made by the team since its creation. These presentations contribute to the construction of a Humanistic Training in the Engineering Courses through Art, Culture and Knowledge Connections.

The first presentation of the Clown Group – Engineers without Borders (Knowledge Connections) took place on December 1, 2011, around 8:50 AM in the parking lot of EMC/UFG⁹. Initially, the clowns gathered and passed in the classrooms inviting students and teachers for their first pilot presentation organized by the Clown Group. The presentation broke the routine of the entire EMC/UFG, as it provided a very different environment than everyone expects from an “Engineering School”. The improvisation is a skill that greatly differentiates those who master it. Even in rehearsed presentations, improvisation disguises and fills the unforeseen, and was no different with the clowns. One could observe improvisation in the small details¹⁶. The proposal of the presentation was the laughter, caused by the

improvisation of the clowns. The silent theater and the joy of the clowns managed to make that day a different morning for everyone present. Even with the nervousness and shyness, the members of the Clown Group managed to surpass their expectations and evaluated the experience as something very different from all the experiences that they had until then in the Courses of Engineering¹⁶.

Table 1. Presentations made by the Clown Group – Engineers without Borders (Knowledge Connections) (2011-2016).

Year	Presentation	Place
2011	Opening of InterPET UFG 2012	Faculdade de Direito (FD-UFG) (Goiânia-GO)
2012	Opening of InterPET UFG 2012	Faculdade de Direito (FD-UFG) (Goiânia-GO)
	Opening of The Congress of Engineering and Technology (CET 2012)	Centro de Cultura e Eventos Prof. Ricardo Freua Bufaiçal (Goiânia-GO)
	Establishing Knowledge Connections	Condomínio Sol Nascente (Goiânia-GO)
2013	The Laughing Flower	Escola de Engenharia Elétrica, Mecânica e de Computação (EMC/UFG) (Goiânia-GO)
	Street Parade on The VII Family Cycle Tour	Câmpus Samambaia (Goiânia-GO)
	Street Parade at The Research, Teaching and Extension Congress of The UFG (CONPEEX 2013)	Câmpus Samambaia (Goiânia-GO)
	Stop at The Coffee at The Seminar of the Professional Masters in Collective Health	Escola pública de Ciências de Saúde do Estado de Goiás(Goiânia-GO)
	Behind The Scenes	Associação de Pais e Amigos dos Exepcionais (APAE) (Goiânia-GO)
2014	Stop at The Snack	Escola de Engenharia Elétrica, Mecânica e de Computação (EMC/UFG) (Goiânia-GO)
	Stop at The Coffee at The Brazilian Congress of Engineering Education (CO-BENGE 2014)	Centro de Convenções e Exibições Zona da Mata (Juiz de Fora-MG)
	InterPET UFG 2014	Centro de Aulas D (Goiânia-GO)
2015	Street Parade and Knowledge Connections	Setor Central (Goiânia-GO)
	Parade in The Auditorium (History of Inventions)	Escola de Engenharia Elétrica, Mecânica e de Computação (EMC/UFG) (Goiânia-GO)
2016	Dance of The Elderly	Associação de Idosos do Brasil Goiânia (AIBGyn) (Goiânia-GO)
	Street Parade	Escola de Engenharia Elétrica, Mecânica e de Computação (EMC/UFG) (Goiânia-GO)

2.2. Marketing Research

In order to evaluate the personal and professional profile of the members and alumni of the Clown Group, a Marketing Research was carried out to answer some questions:

1. Was there a surprise reaction from members and ex-members when they saw the audience's reaction during the performances?
2. When visiting unconventional popular spaces, such as public places, hospitals and shelters, was the worldview of members and ex-members affected?
3. Did the humanistic and social learning of the Clown Group contribute to the training of members and ex-members in the same way as traditional engineering classes intrinsically immersed in these values?
4. When making a presentation in popular non-conventional spaces, such as public places, hospitals and shelters, was there an exchange of knowledge with the public?
5. When participating in a Clown Group activity, did the members and ex-members feel that the work has a great social and cultural impact on the communities visited, as well as on their human formation?
6. When participating in the Clown Group, were members and ex-members surprised to see how they were able to interact with a different area of technical engineering?
7. When participating in the Clown Group, did the members and ex-members develop their introspection, that is, have they learned to express their opinions in an uninhibited and coherent way and use the improvisational resource when the moment is right?
8. Has the development of the humanistic character of the Clown Group significantly impacted a change in the professional relations of members and ex-members?
9. Through clown art, have members and ex-members been able to verify a change in the way the public sees the stereotypes of the Engineer?

When participating in a job interview, did members and ex-members see a differential in their training compared to other candidates for joining the Clown Group? Thus, the Marketing Research was carried out in order to measure the gains obtained by both current and former members of the Clown Group, in order to present the importance of the arts in the formation of future Engineers and Engineers already graduated. The form applied to current and former members is presented in Table 2. This questionnaire is divided into two parts: Part A, evaluating the contributions of the Clown Group in the personal development of members and ex-members; And Part B, which assesses the contributions of the Clown Group in the professional development of members and ex-members. A total of twelve questions were asked, ten of them using an evaluation scale, but specifically using a Likert scale to measure the opinion of the members on what 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree Nor Disagree, 4 = Agree, and 5 = Strongly Agree. There are also two essay questions assessing more fully the personal and professional contributions made through clown art.

Table 2. Form applied in Marketing Research.

Part A: Clown Group's Contribution to Humanistic Training					
For questions 1–5, circle the response that best characterizes how you feel about the statement, where: A = Strongly Disagree, B = Disagree, C = Neither Agree Nor Disagree, D = Agree, and E = Strongly					
Q1 – I was very surprised to see the reaction of the audience during my presentations.	A	B	C	D	E
Q2 – When visiting unconventional popular spaces such as public places, hospitals and shelters my worldview was deeply affected.	A	B	C	D	E
Q3 – Humanistic and social learning acquired through the Clown Group contributed to my training the same way as traditional classes of Engineering intrinsically immersed in these values.	A	B	C	D	E
Q4 – When making a presentation in unconventional popular places such as public places, hospitals and shelters, I always established an exchange of knowledge with the public.	A	B	C	D	E
Q5 – By participating in an activity of the Clown Group, I felt that my work has great social and cultural impact in the communities visited as well as in my human formation.	A	B	C	D	E
Q6 – Describe in a few words what the Clown Group meant in your personal training process, highlighting points that marked your participation in the Group (as relations with the public, fun times...).					
Part B: Clown Group's Contribution to Professional Training					
For questions 7–11, circle the response that best characterizes how you feel about the statement, where: A = Strongly Disagree, B = Disagree, C = Neither Agree Nor Disagree, D = Agree, and E = Strongly Agree.					
Q7 – By participating in the Clown Group, I was surprised to realize how much I was able to interact with a different area than the technical Engineering.	A	B	C	D	E
Q8 – By participating in the Clown Group, I developed my introspection, in other words, I learned to strongly express my opinions uninhibited and consistently and I learned how to use improvisation resource when the time is propitious.	A	B	C	D	E
Q9 – The development of humanistic character of the Clown Group influenced expressively a change in my professional relationships.	A	B	C	D	E
Q10 – Through art “clown”, I cannot see a change in the way the public sees stereotypes Engineer.	A	B	C	D	E
Q11 – By participating in a job interview, I noticed a difference in my training over other candidates for having participated in the Clown Group.	A	B	C	D	E
Q12 – Describe in a few words what the Clown Group meant in your training process, highlighting points that marked your participation in the Group (as relations with the public, fun times...).					

2.3. Documentary Research by Observation

During the Clown Group's entire training process, all the actions and workshops produced were documented, using photos, media, articles, reports and videos. Thus, in order to evaluate the level of commitment and participation of the team, a Documentary Research by Observation was carried out to evaluate some points, namely:

1. The percentage of participation in the presentations;
2. The commitment to the clown costume in the presentations;
3. The commitment to make-up in the presentations;
4. The performance in the Humanistic Training Course in Connections of Knowledge;
5. The ability with musical instruments before entering the Clown Group;
6. Participation in the preparation and publication of articles in congresses and periodicals;
7. Strong interaction with the public; and
8. The realization of Knowledge Connections (or Knowledge Exchange) activities.

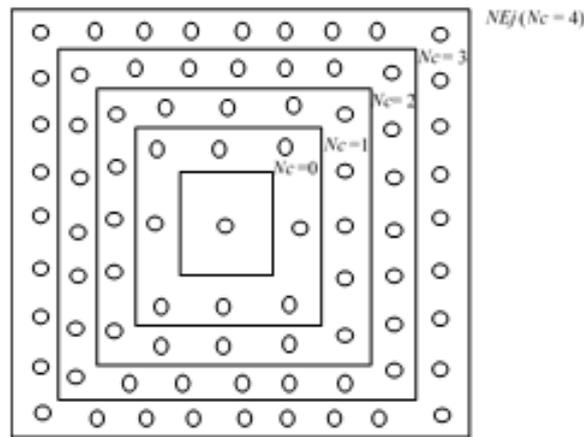
Table 3 presents the main points considered in the Documentary Research by Observation.

Table 3. Form applied in Documentary Research by Observation.

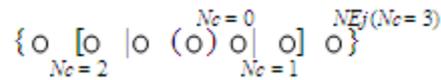
Main Skills Analyzed During the Participation of Members and Ex-Members of The Clown Group
<ol style="list-style-type: none"> 1. Percentage in the sixteen presentations 2. Commitment to costume in the presentations 3. Commitment to makeup in the presentations 4. Performance in the Humanistic Training Course in Knowledge Connections 5. Skills with musical instruments before joining the team 6. Participation in the publication of articles in congresses and periodicals 7. Strong close interaction with the public, from analysis of photographs and videos 8. Making Knowledge Connections

2.4. PSOM Network

The PSOM network is a network of non-parametric architecture that presents some changes in the training algorithm for the self-organizing maps (SOM), originally proposed by Kohonen¹⁷. The PSOM network is based on pruning processes (removal of pre-established classes at the output) and updating weights. In this way, the network can identify the presence of redundant patterns. The algorithm still allows the grouping of classes with the same characteristics and that have a strong correlation. Figure 1 presents a comparison of the typical architectures for SOM (two-dimensional structure) and PSOM (one-dimensional structure), with neighbors of node j , NE_j (Nc) published in¹⁸.



(a)



(b)

Figure 1. Typical architectures with neighbors of node j , $NE_j(N_c)^{18}$.

3. Data Collection and results of the PSOM network

3.1. Marketing Research Data Collection

The responses of the Marketing Research assertions were grouped in Table 4 (1-5 and 7-11 assertions), and all the members and former members of the Clown Group were presented with their feelings about the statements presented in Table 2.

For this study, answers were also collected for the two essay questions present in the questionnaire. It is possible to observe in a unique way the individual positioning of the team on the importance of this process of formation in the personal and professional life of each one.

Here are some comments from members and ex-members regarding personal progress developed with the Clown Group (Q6):

“It helped me a lot to improve my ability to speak in public...” – Clown 4, 2016.

“The Clown Group has given me the opportunity to pass on my artistic experiences to colleagues who would become Engineers friends, making me realize that all people who are proactive are able to learn from areas of knowledge unrelated to those they have chosen for their lives. For example, Engineers learning to value Society and personal relationships through the art of being a clown”. – Clown 8, 2016.

“The public reaction was what really caught my eye. It is a great way to break paradigms and narrow the gap between the academy and the average citizen. There is fun, interpersonal relationships, knowledge production and personal growth”. – Clown 9, 2016.

Here are some comments from the team regarding the professional development acquired with the Clown Group (Q12):

“In the dynamics of selective processes, several companies use the fact that they can improvise as a selection criterion”. – Clown 3, 2016.

“Through the Clown Group I realized that creativity, joy and the ability to express myself well must be in everything we do, whether in a friendly conversation, in a theoretical class or even in a work in the Engineering area”. – Clown 8, 2016.

“By participating in the Clown Group I won a bit of my shyness and had no difficulties in facing internship interviews. Another important point was the humanistic side I learned in the Group. While doing internship I had to work in groups and I was able to handle people better, respecting the differences and needs of each person”. – Clown 12, 2016.

Table 4. Data collection for all clowns of 10 assertions.

Clown n	Question									
	Q1	Q2	Q3	Q4	Q5	Q7	Q8	Q9	Q10	Q11
#1	4	4	3	4	4	4	4	2	2	3
#2	4	4	4	4	5	4	4	4	2	3
#3	5	5	4	5	5	5	4	4	2	3
#4	4	5	4	4	5	4	4	3	2	3
#5	4	4	4	4	5	5	4	4	1	4
#6	4	4	3	4	4	5	4	4	3	4
#7	4	4	3	5	4	4	5	3	1	3
#8	5	5	5	5	5	3	5	5	1	5
#9	5	4	4	4	5	5	5	4	2	3
#10	5	5	5	4	5	4	4	5	2	4
#11	4	5	4	3	5	4	5	4	3	4
#12	5	5	5	5	5	5	5	4	2	4
#13	4	3	2	4	3	4	4	4	3	2
#14	3	4	4	5	5	4	5	3	4	3

3.2. Data Collection of the Documentary Research by Observation

To illustrate the use of Documentary Research, one photograph of Clown Group presentations are presented. Photograph 1 shows in detail information about the costumes, clown makeup, and interaction with the audience⁵. In this way, photograph such as these presented were essential for the accomplishment of Documentary Research by Observation. Table 5 presents the datasheet of one presentation shown in Figure 2. In addition to all images, all videos and the papers published by the Clown Group^{8, 9, 16, 19-25} served as a parameter to analyze the participation of clowns in group production. Table 6 shows the collection of data obtained through Documentary Search by Observation, presented in Table 3.



Photograph 1. Interaction with the public on the streets during the presentation “Street Parade and Connections of Knowledge”²⁴.

Table 5. Technical file: Presentation “Street Parade and Knowledge Connections”²².

What	Presentation “Street Parade and Knowledge Connections”
Acting	Analice Silva Gomes, Antônio Marcelino da Silva Filho, Cleidson César da Silva Júnior, Gilberto Lopes Filho, Jonas Augusto Kunzler and Thaís Borges de Melo
Conception	PET Group - Engineering (Knowledge Connections)
Direction	Prof. Dr. Getúlio Antero de Deus Júnior
Production	Analice Silva Gomes
Executive Producer	Prof. Dr. Getúlio Antero de Deus Júnior
Target Audience	Community of Goiânia
When	12 June 2015
At Where	Setor Central (Goiânia-GO)
Who Promotes	PET Group - Engineering (Knowledge Connections)
Keyword	Extension and Culture, Poor Theater, Street Theater and Clown Group
Schedule	2:30 p.m.
Documentation	Laboratório de Engenharia Multimeios (Engemulti) and Prof. Dr. Getúlio Antero de Deus Júnior

Table 6. Data collection for all clowns of skills analyzed in Documentary Research by Observation (perceptual values).

Clown n	Question							
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
#1	31.3	100.0	100.0	88.0	0.0	100.0	44.4	66.7
#2	68.8	90.0	100.0	93.0	0.0	83.3	100.0	100.0
#3	100.0	100.0	100.0	0.0	100.0	83.3	33.3	33.3
#4	25.0	25.0	100.0	0.0	100.0	16.7	0.0	0.0
#5	43.8	100.0	100.0	0.0	0.0	66.7	44.4	66.7
#6	18.8	33.3	100.0	87.0	0.0	50.0	11.1	0.0
#7	37.5	66.7	100.0	0.0	100.0	50.0	33.3	33.3
#8	31.3	20.0	100.0	0.0	0.0	33.3	44.4	66.7
#9	43.8	66.7	100.0	0.0	0.0	33.3	33.3	33.3
#10	31.3	60.0	100.0	0.0	0.0	33.3	33.3	33.3
#11	25.0	100.0	100.0	0.0	0.0	33.3	22.2	33.3
#12	43.8	100.0	100.0	91.0	100.0	50.0	22.2	33.3
#13	31.3	50.0	100.0	0.0	100.0	16.7	11.1	0.0
#14	18.8	0.0	100.0	0.0	0.0	0.0	22.2	0.0

3.3. Results of the PSOM Network

The initial settings for the PSOM network training are an initial number of clusters equal to 15, an initial learning rate equal to 0.1, a maximum number of epochs equal to 1,000 and a minimum number of clusters at the end of simulation equal to 2, 3, 4, 5, 6 and 7 (pruning processes). A grouping of the team based on the similarities between them was made using a PSOM network, which had as input the data of the two surveys. As output from the PSOM network, groups of 2, 3, 4, 5, 6 and 7 groups of members and former members of the Clown Group were obtained, which showed similarities of development and behavior according to the parameters of the Marketing Research and Documentary Research by Observation. In this way, for each survey the inputs were specified as being the collected data, and the desired outputs, that is, the number of desired groupings was adjusted in order to search the clowns with the highest level of similarity, starting with an initial number of 2 groups and progressing to clustering with 7 groups. As can be seen in Figure 2(a) and 2(b), the current and former member of the Clown Group were grouped 12 times with the help of the PSOM network, with Figure 2(a) referring to the Marketing Research and Figure 2(b) related to the Documentary Research by Observation.

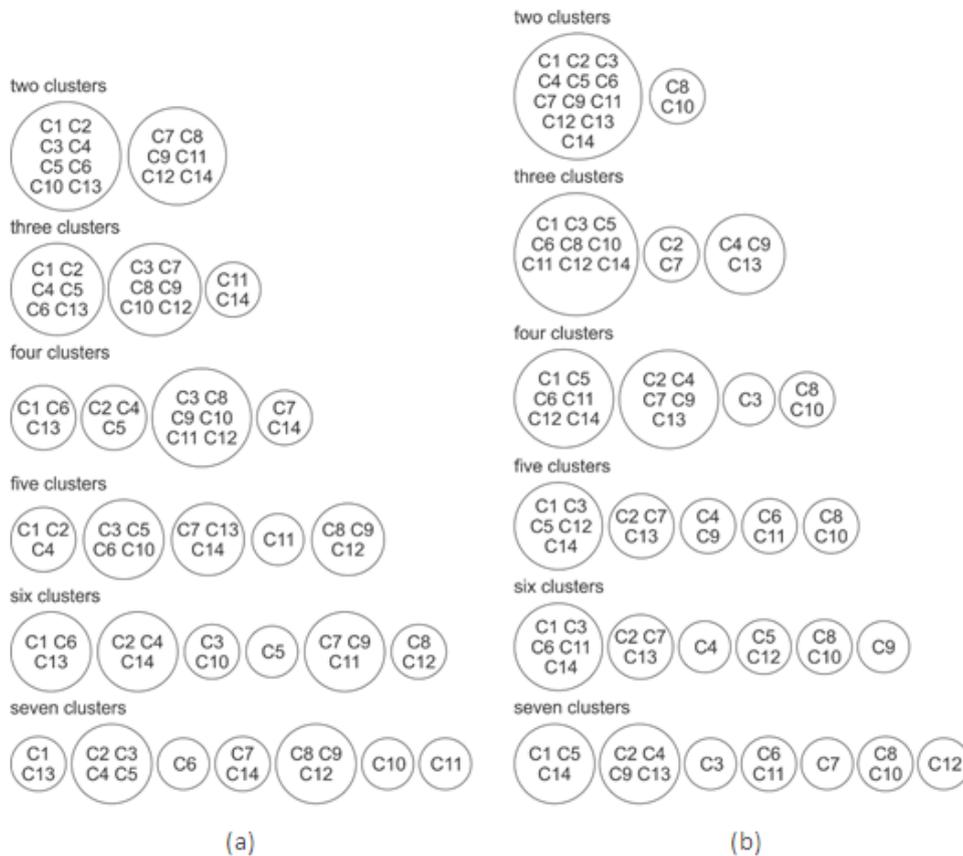


Figure 2. Grouping of members and ex-members of the Clown Group: (a) Marketing Research; (b) Documentary Research.

4. Analysis

The accounting for the answers to questions 1 to 5 of the Marketing Research (Part A: Clown Group’s Contribution to Humanistic Training) is presented in the Graphic 1, considering: (A) Strongly Disagree; (B) Disagree; (C) Neither Agree Nor Disagree; (D) Agree; (E) Strongly Agree. The answers to questions 1 to 5, shown in Graphic 1, demonstrate the perception of the personal development of the members and former members of the Clown Group. It can be noted that 13 of the 14 members of the group had their world view affected by visiting unconventional popular spaces (Q1), were surprised by the public reaction during the presentations (Q2), had impact in the communities visited (Q4), as well as in their human formation (Q5). On the other hand, 10 members affirmed that the humanistic and social learning of the Clown Group contributed to their formation in the same way as traditional classes of Engineering (Q3). The professional development of members and former members of the Clown Group can be observed in answers to questions 7 to 11. The results of the Marketing Research (Part B: Clown Group’s Contribution to Professional Training) are presented in Graphic 2. As can be seen, 13 of the 14 members were surprised to see how

they were able to interact with a different area of Engineering (Q7). All the members stated that they had learned to express their opinions in an uninhibited way, helping to overcome introspection (Q8). On the other hand, 10 of the 14 members stated that Clown Group's development of the humanistic character had a significant impact on the change in their professional relationships (Q9) and on the way the public sees the Engineer's stereotypes through clown art (Q10). Note that the numerical result found for question Q10 differs from the rest because this question was formulated as a negative assertion. Therefore, the disagreement of the members of the Clown Group in the Q10 question evidences a change in the way the public sees the stereotypes of the Engineer. Only six members saw participation in the Clown Group as a differential in their training compared to other job interview candidates (Q11).

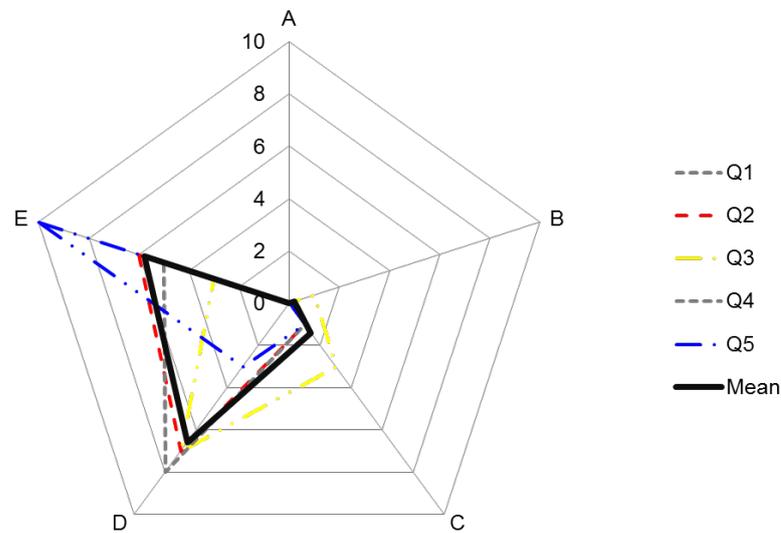
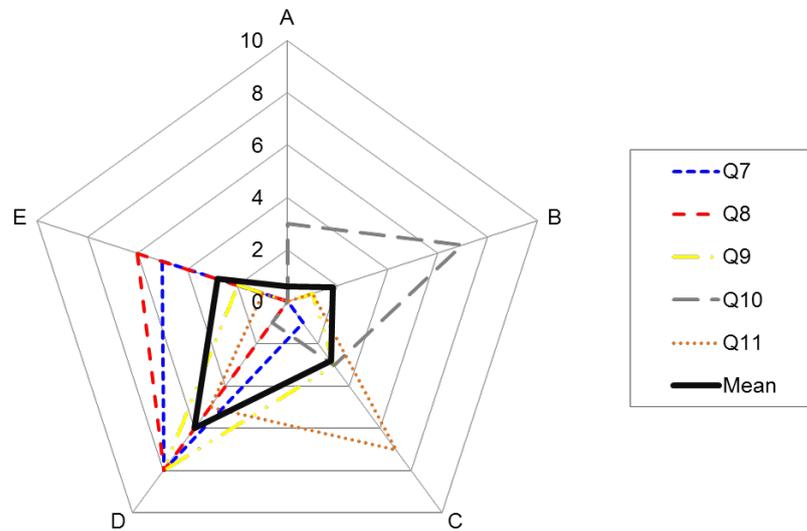


Gráfico 1. Graph with the accounting of the answers to questions 1 to 5 of the Marketing Research (Part A: Clown Group's Contribution to Humanistic Training), considering: (A) strongly disagree; (B) disagree; (C) neither agree nor disagree; (D) agree; (E) strongly agree.



Graphic 2. Graphic with the accounting of the answers to questions 7 to 11 of the Marketing Research (Part A: Clown Group's Contribution to Humanistic Training), considering: (A) strongly disagree; (B) disagree; (C) neither agree nor disagree; (D) agree; (E) strongly agree.

Through the answers to questions 6 and 12, presented in the Data Collection Section, it was possible to notice the great development of the current and former members of the Clown Group in relation to important characteristics strongly detected: communication development; break introspection; and improvement in teamwork. These characteristics are of essential importance for the training of future Engineers.

In general, the results of the Marketing Research reflect the limitations of human sensory organisms that process the information received in a very independent way from one individual to another. Human perceptions are activated through prior knowledge and life experiences that shape the worldview in such a way that, at the end of the data analysis, a strongly skewed result is obtained.

The results compiled from the Marketing Research show a strong tendency of the members and former members to present as positive the experiences and training acquired with the Clown Group, both at a personal and professional level. Figures 2(a) and 2(b) shows groupings of members and former members of the Clown Group conducted through the Marketing Research and through Documentary Research, presented in results of the PSOM network.

Let c , j , and k be the identification of a member of the Clown Group, where index i identifies two types of research used ($i = 1$: Marketing Research and $i = 2$: Documentary Research), index j identifies the number of clusters and the index k identifies the member (clown). For a case of two clusters, applying this notation, it is possible to write two matrices to represent the clusters:

$$C_{1,j,k} = [[1\ 1\ 1\ 1\ 1\ 1\ 1\ 0\ 0\ 0\ 1\ 0\ 0\ 1\ 0] [0\ 0\ 0\ 0\ 0\ 0\ 1\ 1\ 1\ 0\ 1\ 1\ 0\ 1]]$$

and

$$C_{2,j,k} = [[1\ 1\ 1\ 1\ 1\ 1\ 1\ 1\ 0\ 1\ 0\ 1\ 1\ 1\ 1] [0\ 0\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 1\ 0\ 0\ 0\ 0]]$$

Let the correlation index be between two different clusters, defined by:

$$cm_{j_1j_2} = \frac{(C_{1,j_1,k} \cdot C_{2,j_2,k}^T)}{\|C_{1,j_1,k}\| \cdot \|C_{2,j_2,k}\|}.$$

Thus, for a case of two clusters, the correlation matrix can be obtained:

$$CM_2 = \begin{bmatrix} 0,7144 & 0,2500 \\ 0,5893 & 0,2887 \end{bmatrix}.$$

Similarly, for a clustering of three clusters, the correlation matrix can be obtained and it is given by:

$$CM_3 = \begin{bmatrix} 0,4082 & 0,4714 & 0,2887 \\ 0,5443 & 0,2357 & 0,2887 \\ 0,4714 & 0 & 0 \end{bmatrix}$$

and for a cluster with seven clusters the correlation matrix is given by:

$$CM_7 = \begin{bmatrix} 0,4082 & 0,3536 & 0,0000 & 0,0000 & 0,0000 & 0,0000 & 0,0000 \\ 0,2887 & 0,5000 & 0,5000 & 0,0000 & 0,0000 & 0,0000 & 0,0000 \\ 0,0000 & 0,0000 & 0,0000 & 0,7071 & 0,0000 & 0,0000 & 0,0000 \\ 0,4082 & 0,0000 & 0,0000 & 0,0000 & 0,7071 & 0,0000 & 0,0000 \\ 0,0000 & 0,2887 & 0,0000 & 0,0000 & 0,0000 & 0,4082 & 0,5774 \\ 0,0000 & 0,0000 & 0,0000 & 0,7071 & 0,0000 & 0,0000 & 0,0000 \end{bmatrix}.$$

From the results found for the correlation matrices, it is possible to notice that Marketing Research and Documentary Research are relatively uncorrelated. In fact, they are different searches. However, it is possible to observe some relationships. For example, for clustering with two clusters, a correlation can be seen between Group 1 (C1, C2, C3, C4, C5, C6, C10 and C13) of the Marketing Research and Group 1 (C1, C2, C3, C4, C5, C6, C7, C9, C11, C12, C13 and C14) of Documentary Research, reflected by the strong correlation index equal to 0.7144 in CM2. In the case of three clusters, the highest correlation index equal to 0.5443 found in CM3, refers to the correlation between Group 2 (C3, C7, C8, C9, C10 and C12) of the Marketing Research and Group 1 (C1, C3, C5, C6, C8, C10, C11, C12 and C14) of the Documentary Research. Analyzing the case of 7 clusters, the highest correlation index equal to 0.7071 found in CM7 refer to the correlation between Group 3 (C6) of the Marketing Research and Group 4 (C6 and C1) of Documentary Research; Group 4 (C7 and C14) of the Marketing Research and Group 5 (C7) of Documentary Research; Group 6 (C10) of the Marketing Research and Group 6 (C8 and C10) of Documentary Research; and Group 7 (C11) of the Marketing Research and Group 4 (C6 and C11) of Documentary Research.

5. Conclusions

In view of the fact that humanistic formation consists, among other aspects, of an educational process in which teaching is not limited to mere transmission of information and capacity development through repetition, the Clown Group - Engineers Without Borders (Connections of Knowledge) functions as an instrument to make this change possible. In addition, the Clown Group seeks to play a social role in its artistic manifestations in order

to promote reflection, in addition to making theatrical act a cultural action. The theatrical proposals in society today, present diverse arguments about their contribution to human development and acquisition of cultural knowledge. On the other hand, aspects of development are highlighted especially with regard to the theatrical exercise, which allows a distance of the attitudes and a reflection on their own behavior, contributing to the accumulation of knowledge capable of adapting it in any environment through reason. The opportunity to learn methods of acting allows the Clown Group learners a new personal vision. In addition, some fundamental skills for the exercise of the Engineer's office are developed, such as speaking in public, acting spontaneously, being more creative, observing, reading and interpreting the space and the elements that configure it. Therefore, the experience gained by the team is beyond the training of the Engineering Courses and offers the participants, multiple tools that will allow the diversified professional performance, flexible and dynamic. The actions of connections of knowledge stimulate still the exchange of knowledge, besides allowing real reflections regarding social responsibility and a differentiated professional formation of the future Engineers. These reflections are discussed aiming at the creation of a theme for presentation that result in actions establishing an awareness of the role of the academic community in the paradigms of Society, resulting in a new perspective of social relations. The Clown Group becomes a very important action for its members, enlarging each presentation their experiences. In addition, it allows the art to be disseminated in the academic and external community by students of Engineering Courses, deconstructing the stereotype that the area of Engineering and Arts cannot coexist. Through the PSOM neural network it was possible to correlate the members and former members of the Clown Group, and it was possible to identify the similarities among all members regarding both the commitment to the group and the benefits obtained on a personal and professional level from all team.

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