

# FOSTERING THE REDUCTION OF ASSORTATIVE MIXING OR HOMOPHILY INTO THE CLASS

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## Abstract.

Human societies from the outset have been associated according to race, beliefs, religion, social level, and the like. These behaviors continue even today in the classroom at primary, middle, and superior levels. However, the growth of ICT offers educational researchers new ways to explore methods of team formation that have been proven to be efficient in the field of serious games through the use of computer networks. The selection process of team members in serious games with the use of computer networks is carried out according to their performance in the area of the game without distinction of social variables.

The use of serious games in education has been discussed in multiple research studies, which state that its application in teaching and learning processes are changing the way of teaching. This article presents an exploratory analysis of the team formation process based on collaboration with ICT tools of collective intelligence labelled The best team (TBT). The process and its ICT tool combine the paradigms of creativity in swarming, collective intelligence, serious games, and social computing in order to capture the participants' emotions and evaluate contributions.

Based on the results, we consider that the use of new forms of teaching and learning based on the emerging paradigms is necessary. Therefore, TBT is a tool that could become an effective way to encourage the formation of work groups by evaluating objective variable of performance of its members in collaborative works.

Keywords: collective intelligence, ICT, education, group formation.

## 1 INTRODUCTION

We live in families, we participate and work in teams, committees, and we develop a lot of our daily tasks in groups. From eating or exercising, sharing with friends, or collaborating, all of these scenarios include dynamic group behavior. In addition, businesses are conducted in groups, with two or more people, who have the expectation of some future negotiation [11]. McGrath emphasizes that groups are the social aggregates that imply the knowledge and potential of mutual interaction, so when talking about groups, complex systems must be kept in mind. Groups are complex systems, since they need many characteristics in order to define their behavior. [2] sustain that the process and activity cycle, reproduce and adjust the dynamic links and coordinate networks among others, these behaviors have motivated a century of research dedicated to the study of these phenomena, which have yielded abundant results on specific characteristics and processes in groups. [11] also emphasizes that the treatment of groups is not a simple but rather highly complex conformation, since it has many characteristics taken from the general theory of complex systems, the handling of complexity and the theory of chaos.

The first investigations into the conformation of the groups refer us back to the 1920s and highlight the relationship between certain social groups and their own social environment, stimulated undoubtedly by the methodological orientations of the time. A large proportion of psychological studies on social groups are provided by behavioral theory and learning theory. The processes of team formation mainly emphasize four aspects: Motivational basis, organizational structure, emergence of value systems, and production of differential effects on individuals. In relation to the motivation that pushes individuals to group together, their personal qualities, goals or attitudes are considered.

We have to emphasize that the interaction of individuals through a certain period of time gives rise to the appearance of habitual behaviors that generate patterns of groups behavior. The same ones that

are influenced in the execution of collective tasks, that determines the characteristics of the leadership in a group with certain ways of doing and behaving that become norms, breaking the initial subjectivism in which each one faces the others from their individual characteristics and abilities.

The Artificial Intelligence emerge how a computational field with the aims of support the making decision processes. Several researchers have presented the team formation proposals using artificial intelligence paradigms. [14] presented a framework based on agreement technologies and multi-agent systems, their concluded that the framework could be used by special educational and distance education. [9] proposed a model for group formation using collective trust, their model select the "best" fitted group for a task, moreover also presents one heuristic to find the best possible group since in practice considering all the possibilities is hardly an option. [9] also point out that that this notion of collective trust is much more accurate in capturing the complexity of interactions between users than any individual based method. [1] developed computer-aided policy that facilitates the automatic generation of near optimal teams based on collective intelligence, coalition structure generation, and Bayesian learning. The proposal was tested using simulations in hypothetic classroom scenarios that show that the policy is capable of converging towards the optimal solution as long as students do not have great difficulties evaluating others. They conclude that the simulations have shown that, as long as students do not have great difficulties classifying others, the policy is capable of improving the quality of team structures in a few iterations and gradually converging towards the optimal solution.

Some others researcher has studied the useful of Collective Intelligence in the team formation process. [3] address the team formation problem for generalized tasks where a set of experts is to be discovered from an expertise social network that can collaborate effectively to accomplish a given task. In the other hand [8] presented a reflexive paper where they analyze the decision-making process developed by the 'wisdom of crowds'. They conclude it is very difficult to achieve the wisdom of crowds in environments where observational correlation is manifested. Instead, the group's decision often follows the high correlation information source, even when only a minority of the group uses this information.

The previous paragraphs have shown that exists a lot of methods have been developed by researchers from different knowledge currents, however, the mix of human collective intelligence and computation intelligence in the state of art are scarce, therefore in this study we propose a first approach of team formation groups using, the collective intelligence, psychological individual profiles and the ICT tool how media..

## 2 PROPOSAL MODEL

With the general idea of encourage the formation of work groups by evaluating objective variable of performance of its members focused on problem solving , a prototype of ICT tool and refining process has been designed, developed and formally presented in this section (Fig.1). The proposal model allows teachers, students and groups, actively participate in the process of team formation focus on the reduction of assortative mixing or homophily into the class.

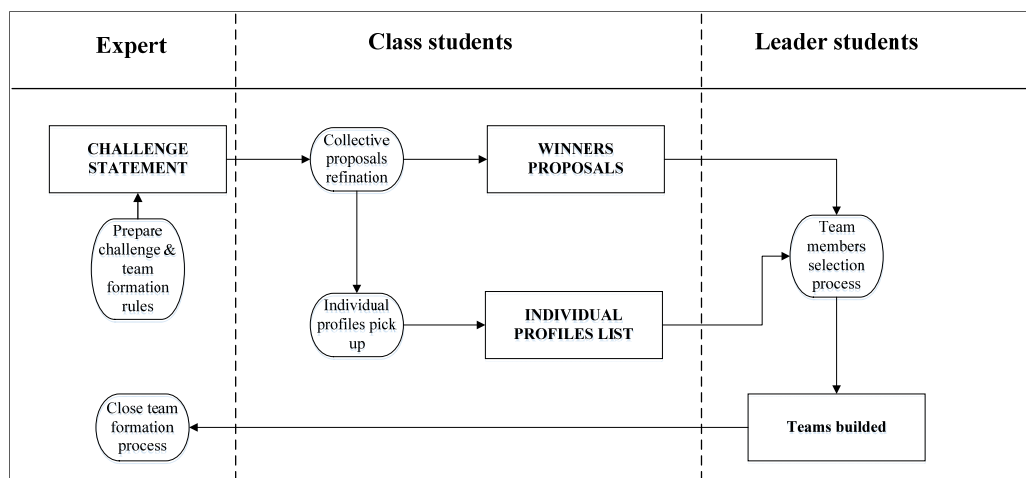


Figure 1. Team formation model

The proposed model tries to resolve two fundamental aspects in the teams formation, in first place the leader selection, and after that the team members selection. In the next paragraph, the process is brief summarized.

The model is split into four sub-processes (Section 2.1). It's combines both the individual profiles and performance. The individual profiles are measured through a set of psychological tests (Table 3) according to sub process presented in Fig 2a. This tries to reveal some individual patterns that will be analyzed by the leader's team in the member selection sub process (Fig. 2c). The individual performance and leader selection is developed according to results from ideas management and assessments process (Fig. 2b). The process presented in Fig. 2b, was adapted from the work presented by [13]. Finally, the "Team members selection process" allow to the author of proposal that gotten one position in the Top (n), become a leader. This leader should be selecting the members for develop his project according to Fig 2c.

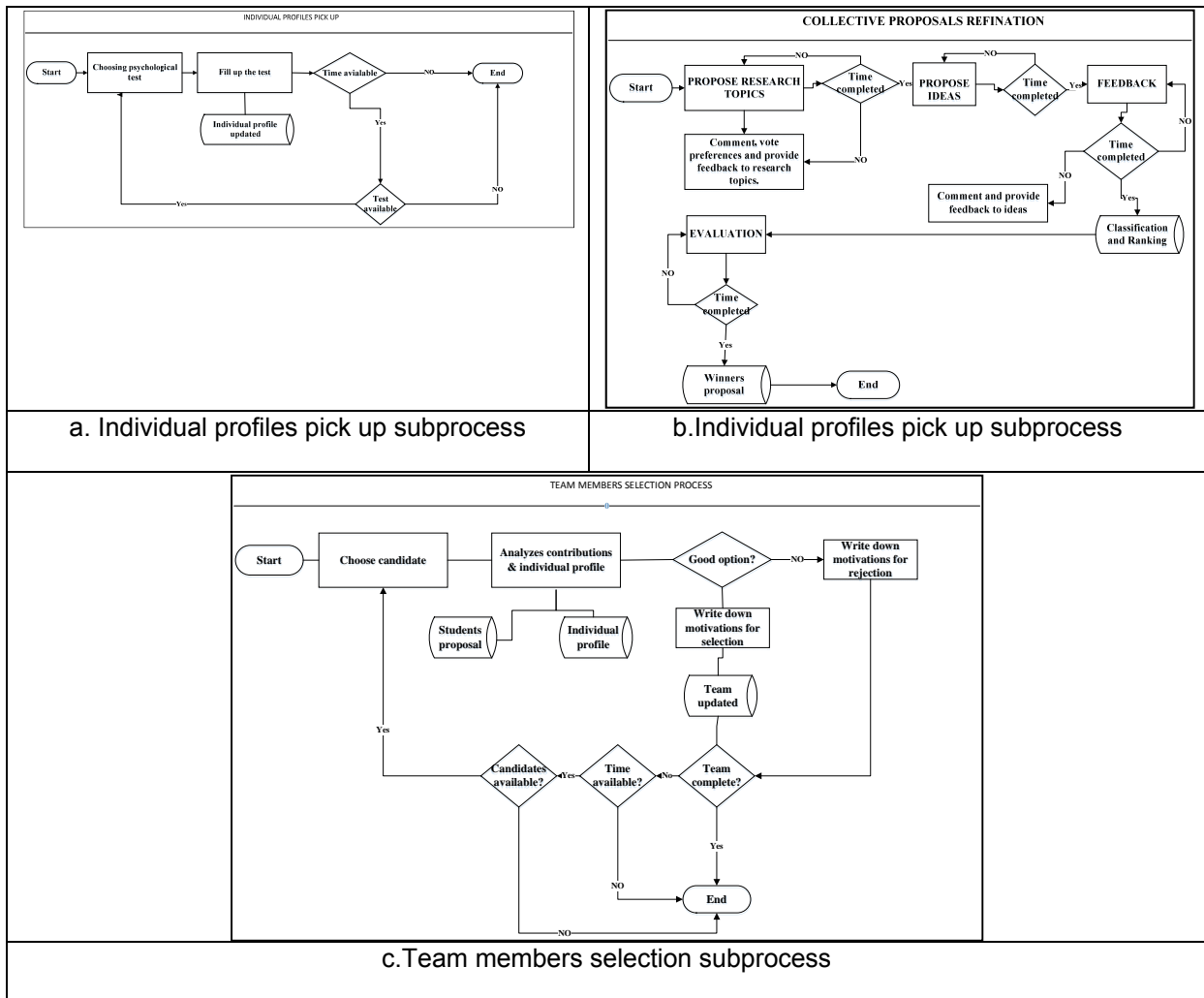


Figure 2. Sub-processes of team formation model

## 2.1 Model sub-processes

### 2.1.1 Prepare challenge & team formation rules

The expert (s) define an area of general interest (For instance : Educational Projects ) where it is required to seek for possible problem research areas as well as determine the allocated time for the fulfillment of each of the challenge stages. The area of general interest should be defined in a question mode, for instance: What is the future the higher education in Ecuador? Where are the best places for to play soccer in Ecuador? Whose are the main causes for low performance in the sports?. Furthermore, the expert must set up parameters about the number of member by team, time for each stage, rubrics (Table 3) & evaluations scales (Table 4) for each proposal, psychological tests for measure the individual profiles (Table 3), and the numbers of teams in the class.

Table 1. Recommended rubrics for evaluation

Rubric	Description
Novelty	The thing is new, it exists, it is known or used for a short time.
Added Value	The proposal generates added value or contributes to the solution of the problem like never before.
Innovation	The presented novelty can become a reality.
Inspirer	The proposed content inspires new ideas and it can extend the discussion topic.
Appropriate	It is suitable for the solution of the analyzed problem.
Complete	The content is complete and it can be easily understood.

Table 2. Recommended emotional evaluation scale

Emotion	Description	Value
Dissapointment	I feel a little bad. The proposal is disappointing.	3
Rage	It's terrible. It is the worst proposal I have ever listened about.	1
Anger	There is no effort. It is bad. I do not think it helps to anything.	2
Sadness	It might be better with a little more effort.	4
Joy	I really like it. It makes me happy and I think it could be put into practice.	5
Admiration	It's the best proposal I have ever read. It is excellent.	6

Table 3. Recommended psychological tests

Test	Description
Personality Questionnaire HSPQ	It measures fourteen first order and four second order personality traits. The fourteen scales point to dimensions whose functionally independent nature have been established through factorial inquiry, yet each is more than a factorial scale, represents a construct that has been shown to have general value as a psychologically significant structure within the personality, as well We must understand the strength of the superego (G-scale), dominance (E), emotional stability or strength of the self (C) or suggestion of temperament (F).
Kolb Learning Styles Test	It measures the style of learning, is the result of the way people perceive and then process what they have perceived, that is, describing how they learn, how they incorporate knowledge, and how they use this information in problem solving, style Learning that each person uses depends on their inherited intellectual characteristics, their physical experience and social interaction, is based on a categorization of four learning styles: "convergent", "divergent", "assimilator" and "usher".
Lynn O'Brien Learning Channel Test	It allows individuals to identify a preference for "channel" to assimilate knowledge and the one that scores the most is the one that predominates.
Reading the Mind in the Eyes test	Test develop by [5], for to measure of adult mentalising. This test has been applied in several experience related with collective intelligence measure applied for getting the level of social sensitivity [6][16][4][16]. In this test, a participant is presented with a series of 35 photographs of the eye-region of the face of different actors and actresses, and is asked to choose which of four words best describes what the person in the photograph is thinking or feeling.
Team Equilibrium (TE)	TE is a model that can be used as a basis to develop tools that helps teams for self-analysis. Its proposed framework is based on six thinking hats proposed by (de Bono, 1985) with aim to face a situation and solve a problem. Each hat should be applied during the solving problem process because it represent a different way to think and thus can be considered as a thinking direction[7].

### 2.1.2 Collective proposals refination

*Propose research topic.*- Each one of the participants are enlisted in the suggested challenge and during the assigned time to the challenge, they propose possible topics that present potential problems within the context of the challenge. Each participant in this process can propose as well as to make comments and vote for their preferences on the proposals submitted by other participants, encouraging a constant feedback.

*Ideas.*- In one or more topics of interest, even in those proposed by the same participant, solution ideas are proposed to the selected topics. The design of the proposal includes: a title of the solution, a short explanation on how to do it, besides, if required, a short essay of ideas, as well as videos and annexes that support the proposal could be included.

*Feedback.*- When the phase of ideas is finished, participants come with the first iteration of quantitative refinement. Each participant makes a vote (I like it / I do not like it) on each one of the ideas proposed as a solution, except on the own ones. They can also comment and provide feedback on the proposals of solutions to improve them. Comments include a brief description and, if necessary, a report that includes videos, images, etc. As a result of this process, a ranking of preferences of ideas is generated. The ideas that go to the next stage are classified according to number of teams by the class. We have to point out that in the case that one student have more than one proposal in the list of ranking, the platform only select the first.

*Evaluation.*- The ideas that exceeded the preference ranking, come to be valued by the / the expert (s) as well as the participants as well as the proponent of the idea. The rating scale is done according to a set of rubrics. Each item is evaluated by the emotion caused on the evaluator (participant / expert) in accordance to the scale criteria defined.

*Winners proposal.*- Upon completion of the period of time assigned for the assessment, the final ranking of solution proposals is generated, for the team members selection and the subsequent application.

The main interfaces of collective proposals refinement subprocess are presented in Appendix I. Fig. 3.

### 2.1.3 Individual profiles pick up

*Choosing psychological test.*- The student have to selecting one by one the psychological tests available.

*Fill up the test.*- During the time assigned each student must to filling up the selected test. The test filled up will be show to team leader for the team member selection.

### 2.1.4 Team members selection process

*Choose candidate.*- Choose available candidate from the list, the list only present a code without any signal about the member identification (Appendix I. Fig 4a).

*Analyzes contributions & individual profile.*- Reading and analyzing: Proposal topic, ideas and vote criteria, additionally the individual profile. (Appendix I. Fig 4b).

*Write down motivations for selection/Rejection.*- Selecting or rejecting if the analyzed member is adequate or no adequate for your team. Only when you choose a member his/her personal information is presented.

## 3 EMPIRICAL EXPERIENCE & RESULTS

### 3.1 Empirical experience settings

In this section, the empirical evidence of TBT application through a web tool (Appendix I) is described. TBT was used by one group of student from the University of the Armed Forces of Ecuador ESPE in the academic year 2016-2017 in the months of November and December of 2016. The number of students were 24 (18 Masculine, 6 Feminine) the average of age was 20 years age. The students had to resolve the challenge addressed by the question "What is the best solution to improve some issues into the physical training field in Ecuador?". Therefore they had to execute the list of task presented in Table 4.

Table 4. List of task applied with the proposal model

Task	Content	Executer	Start	Finish
Prepare challenge & team formation rules	<i>Challenge.</i> - What is the best solution to improve some issues into the physical training field in Ecuador?" <i>Rubrics.</i> - According Table 1.	Expert	Nov-15	Nov-20

*Evaluations scales.- According Table 2*  
*Psychological tests.- According Table 3.*  
*Numbers of teams.- Six teams, therefore*  
*also the top list is six.*

Individual profiles pick up		Student of class	
Choosing psychological test	Selecting one by one the psychological tests available.	Nov-21	Nov-28
Fill up the test	Filling up the selected test	Nov-21	Nov-28
Collective proposals refination		Student of class	
Propose research topic	Have to search for possible topics of interest in the area of challenge that may require a solution (eg feeding in infants, sports development in early childhood, etc.). To execute this task each of you will propose at least one topic of interest (several of your interests are recommended) and will present your comments in several and vote according to your preferences (I like or dislike)	Nov-21	Nov-23
Ideas	A list of top topics has been generated according to the preferences of student's votes. In one or several topics of interest even in those proposed by the same participant, ideas are proposed for solving the topic selected or how to apply general topic to our local context. Ex: If you are talking about creative classrooms, propose possible options on how to apply it locally. The design of the proposal includes a title of the solution, a short explanation of how to do it, besides requiring a brief essay of the ideas, as well as videos that support the proposed solution to the problem identified in the topic of interest selected	Nov-24	Nov-25
Feedback	After the ideas, the participants proceed with the first iteration of quantitative and qualitative refinement (comments to improve the idea). Each participant makes a vote (I like / do not like) about each of the suggested solution ideas except yours; The result of this process generates a ranking of ideas preferences. The ideas that go to the next stage are classified according to a Top N (N is the number of teams for the class)	Nov-26	Nov-26
Evaluation	Ideas that surpassed the top N of preference, proceeds to be valued by the expert (s) as well as of the participants still the proponent of the idea. The rating scale is made according to a set of rubrics defined previously.	Nov-27	Nov-28
Winners proposal	The Top N of proposals will be presented. The team leader will be the owner of each proposal; therefore, they should be starting the team members selection in the assigned date.	Nov-29	Nov-29
Team members selection process		Team Leader	
Choose candidate	Choose available candidate from the list, the list only present a code without any signal about the member identification.	Dic-05	Dic-05

Analyzes contributions & individual profile	Reading and analyzing: Proposal topic, ideas and vote criteria, additionally the individual profile.	Dic-05	Dic-05
Write down motivations for selection/Rejection	Selecting or rejecting if the analyzed member is adequate or no adequate for your team.	Dic-05	Dic-05

### 3.2 Results

Table 5. Group selection results.

Id	Proposal	Gender		Team Profile Interpretation	Team members selection criteria
		M	W		
1	High performance improves overall development	2	2	The learning channel that predominates is visual, followed by the auditory, all belong to a Divergent - concrete learning style, the same ones that have the ability to separate a whole into parts but being precise and real. With varying personality types, while in second-order personality, they mostly belong to an introverted trait and few of the members are anxious traits.	The interests of the members in the proposals submitted and in their voting were related to the high-performance processes.
2	APP for physical training	3	1	The learning channel is diverse (Visual, Auditory, Kinesthetic), so that the leader must use the necessary tools to consolidate his team. Its main objective is innovation.	Selection according to the individual profiles, focused mainly in relation to creativity, optimism and management ability.
3	Disc- Recreational golf for hearing impaired	3	1	The group has a predominant learning channel such as the visual, accompanied by a divergent thought reflective, with the ability to use different senses. In most members Their personality varies, belong to a group of calm individuals, few of them are affected by their emotions and their environment.	Combined the individual profiles with emphasis on optimism and research capacity, as well as collaboration in the process of refining ideas.
4	Working small space	4	0	With 50% visual learning channel and 50% kinesthetic learning channel, mostly their type of thinking is divergent concrete, few of them are the same adapters that have the ability to change, modify or adjust things, in His personality there are variety, stable, little expressive, among others.	The interests of the members in the proposals presented and in their votes were related to the proposal.
5	Women's football with integrated method	2	2	Channels of different learning, they make their thoughts vary, with different personality traits.	Similar Interests in the proposals presented.
6	Women's Soccer with Men's Schedules	4	0	It has diverse learning channels, they make their thoughts vary, with a different personality trait	Similar Interests in the proposals presented.

## 4 CONCLUSIONS

The objective of the presented work is to share the progress on a research program, which purpose is to provide a process, tools and resources for fostering the reduction of assortative mixing or homophily

into the class in the teams formation process. The teams formation has a very broad and open conceptual framework and more theoretical and empirical research is necessary to generalize the application of the model.

The application of TBT has shown evidence on the usefulness of the model in the reduction of assortative mixing or homophily into the class. The usefulness of the model is considered because the evaluation according to the contributions, preferences and individual member's profiles, presents a new field for evaluation in the educational area, that combine the individual & collective human intelligence and the computational intelligence for making the best decision.

Although the students analyzed have personal interests and their main objective is to satisfy their own needs not the needs of their team, we have to remember the link between body, mind and spirit would help in the formation of a whole human being, using emotional intelligence strategies, collaborative work and ICT's, essential components for his or her formation. In this sense, future research should cover this fields, additionally combine the result of team with a collective intelligence measure, that allow analyzed in deep the affectivity of model with quantitative results.

The proposed model and the corresponding web tool are the result of a creative combination of theoretical and practical perspectives. From this point, with a consistent model, it will be possible to continue with the development of new features oriented to make recommendations on the continuous improvement to the state of art in the field of reduction of assortative mixing or homophily into the class, that combine the collective human intelligence and computational intelligence.

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## APPENDIX I. Web tool interfaces

The screenshot displays the CIR web tool interface, which is designed for collective proposal refinement. The interface is divided into several sections:

- Navigation Bar:** Located at the top, it includes a search bar, a 'Log in' button, and a 'Home' button. The navigation bar also contains icons for 'Work', 'Research', 'Associate', 'Contact', 'Profile', and 'Home'.
- Main Content Area:** This area features a 'Propose' button and a 'Comment' button. Below these buttons, there is a text input field for 'Item/Idea' with the prompt 'Write down what are you thinking'. A 'Propose' button is also present.
- Proposal Details:** The interface shows a proposal with a title 'Propose' and a description 'The list of task of the practice consists on proposing your own ideas and voting the ideas of your teammates. It is recommended to agree on the average number of ideas proposed for the tasks. Select the open to start:'. Below the description, there is a 'Propose' button and a 'Comment' button.
- Proposal Submission:** A 'Write down a brief report:' section is visible, followed by a 'Write down a brief report:' text input field. Below this, there is a 'Write down a brief report:' text input field.
- Proposal Evaluation:** A 'Performance' table is shown on the right side of the interface. The table has columns for 'Group', 'Performance', 'Group', 'Performance', 'Group', 'Performance', and 'Group'. The table contains data for various groups and their performance metrics.
- Additional Features:** The interface includes a 'Video' button and an 'Attachment' button. A 'Page: 1 (2)' indicator is also present.

Figure 3. Main interfaces of collective proposals refinement subprocess

**FABRICIUS**  
Group Name: Disc- Golf\_GRUPO

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**USERS AVAILABLE**

Analyze profile	User
729	729
709	709
718	718
711	711
724	724
714	714
713	713
728	728
725	725
704	704

Page: [1] 2      17 record(s) found 2 Pages.

**USERS ASIGMENT TO GROUP**

Name	Justification	Date
Erika.Durán	ok esta chevere	19/01/2017 1:28:28
1		

a. Choosing candidates for analyze

**FABRICIUS**  
Group name: Disc- Golf\_GRUPO

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**COMPETITOR :ST729**  
Justify your decision (Max 255 Characteres)

The profile presented was..|

0 Leader are interesting in this participant

**Individual Profile:**

1 of 1      Select a format      Export

**INDIVIDUAL PROFILE**

Black Hat	Blue Hat	Red Hat	Green Hat	Yellow Hat	White Hat
31 %	94 %	39 %	89 %	87 %	100 %

Black for judgement and devil's advocate  
Red for feelings and intuition  
Blue for managing and control mechanisms  
Green for creativty and production of ideas

**Contributions & Preferences:**

**SECTION : 1.-My proposal**

**STAGE Tópicos de Interés**

<p>Crecer y envejecer juntos...Un espacio compartido por niños menores de 5 años y adultos mayores a los 65 años, en donde se realicen actividades en conjuntos un tiempo determinado.</p> <p><b>Report</b> Mi idea proviene de un modelo (Present Perfect) en Estados Unidos de America, donde los niños y adultos mayores tienen la oportunidad de interactuar entre ellos, las capacidades que desarrolla los niños son las que se va perdiendo en el adulto mayor, el proyecto con direccionamiento en</p>	<p><b>Valuation:</b>9,0000000</p>	<p><b>Meaning:</b> Valuation is about number of likes received by the group</p>
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b. Analyzing, selecting or rejecting team members

Figure 4. Main interfaces of team members selection subprocess