of rules which responds to four main questions about who is playing, what they are playing, when to play and how much win or lose with the selections from the game.

Serious games are being considered important in global education [2], according to Clarc C Abt. (1970) serious games have been designed for a lot of activities besides entertainment [20]. The serious games can be used in some areas, e.g. military, government, educational, corporate, healthcare [2], furthermore, some research has gotten to conclusion that the application of game strategies has proved to be useful in learning processes, however it is essential to develop a better understanding of the tasks, activities, skills and operations that different kinds of game can offer and examine how these might match desired learning outcomes [21]; on the other hand, games helped students to understand the idea of object-oriented paradigm and the basic principles of object-oriented programming and increased their interest in learning the discipline as a whole [22]. This conclusion is coherent with the finding of K. B., C. L. Phillips, and N. D. Geddes (2009) [23], where they maintain : Game environments allow the game players to have much better "situational awareness" of the modelled environment than they would without it, therefore, these findings let us consider useful the serious games application in learning processes.

## 2.3. Real time assessment

Assessment is a fundamental part of the educational processes; its main purpose is to provide information concerning to evaluate the objectives of the educational process have been attained.

Information obtained by means of assessment activities can be used to make decisions regarding to what degree the evaluated student has met the knowledge requirements established. When the student reaches the sufficiency level required or a higher level, it is considered that the student can proceed to learn new contents; otherwise, the student must continue on the same content until reaching the sufficiency level established or a higher level. This assessment is known as summative assessment.

Formative assessment is valid when it provides evaluated students with information which is useful in attaining the learning objectives.

Assessment process organization and the activities developed for assessment purposes use to be different depending on whether it is summative or formative assessment. In this sense, for example, summative assessment activities consist of exams which are developed at the end of a formative process, whereas formative assessment activities are developed throughout this process and in a continuous fashion, or, in any case, more frequently.

Several studies conducted on real-time interaction indicate that assessment allows feedback on the teaching-learning process. According to research: a real-time mobile web-based module promotes bidirectional feedback and improves evaluations of the surgery clerkship, Wagner et al., (2015) indicates that the development of system allows students positive reinforcement and provides a feedback between teachers and students[24].

According to Rodrigues and Oliveira (2014) assessment highlighted in the educational process as a way to assess students' knowledge according to the supplied content enabling achieve the learning objectives. In his research describes a system that aims to work as a formative assessment tool for students and teachers to help the creation and evaluation of tests, allowing monitor student progress. Also, the system can automatically create tests for students to practice based on questions from past exams and assists teachers in creating assessment tests with different types of information about students. The system provides automatic feedback to students. Students enjoy the interaction with the system and also the results indicate a good correlation between evaluation Teachers and evaluation performed by the system[25].

Han and Finkelstein (2013) have developed Clicker Assessment and Feedback (CAF) is a system that assesses knowledge and provides feedback using the technologies. The results of the application of the system indicate that most effective for student because it allows for student participation and learning[26].

Wang (2010) conducted research on an evaluation system based on the web and then used it in an e-Learning environment. It has two characteristics: One is that the dynamic evaluation can provide students the opportunity to learn and the other is that learning and feedback are built in the testing process. With this system, students can perform self-assessment and obtain feedback. Through education and feedback, students may have more opportunities to learn and find the correct answer[27].

# 3.Fostering collective intelligence

With the general idea of foresting collective intelligence in educational environment, a prototype of a learning model has been designed, developed and tested and it's formally presented in this section and synthetically drawn in Figure. 1. The model allows teacher, students and groups, gradually improve the outcomes obtained from learning activities. So the system facilitates the interaction and engagement of students and groups, along with cyclical improvement of activities design. Guess the Score (GS) is part of the model, as a facilitator of engagement of participants.

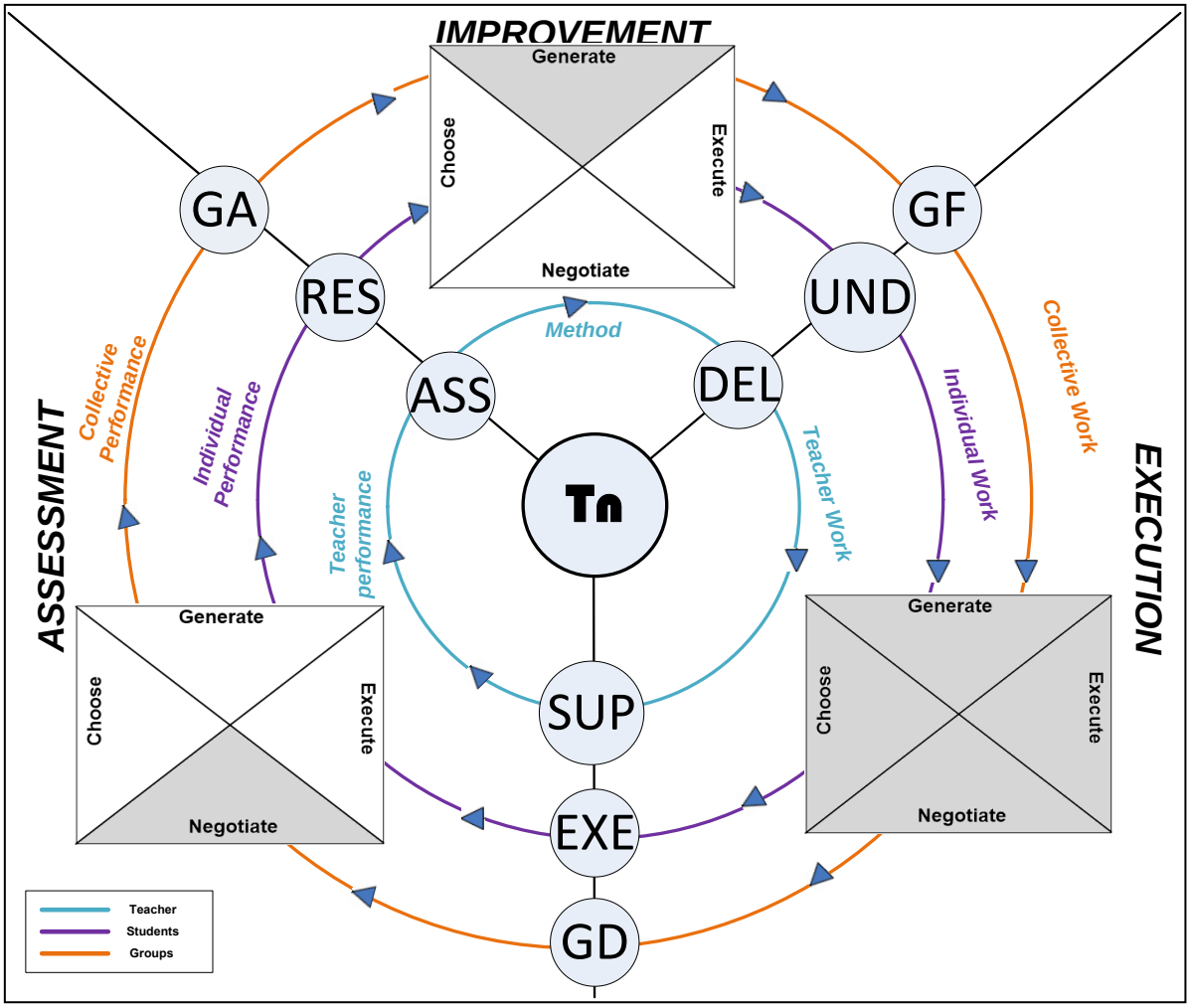


**Figure 1.** General view and components of a learning model to promote collective intelligence.

The central hypothesis of this model is that if a group of students learn in a collective intelligence environment, it increases both the outcomes of the groups and the learning level of individual students. Furthermore it increases also the social intelligence of individuals.

The model considers incremental and iterative design in order to improve the activities. This model is based in Deming circle and the Task Circumplex framework of McGrath(Figure 2). GS into the model responds to the objective of facilitating a way of measuring collective intelligence of the group, together with the assessment of individual students. The data obtained from interaction of students during the realization of activities will use to find patterns of behaviours of groups.

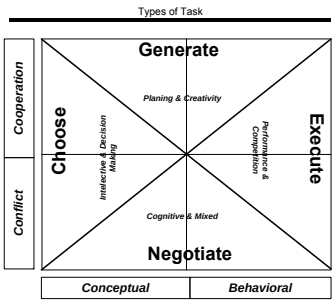


**Figure 2**. Task types for learning, adapting from McGrath (1984).

As shown in Figure. 1, the model follows three domains (sectors), circuits (circles) and matrixes which are: execution, assessment and improvement; teacher, students and groups and types for learning respectively. All circuits are concentric with the core task, it is supported by a serious gaming through a list of milestones summarized in Table 1.

Table 1. Components of model

| Milestone | Description |
|---|---|
| Delivery (DEL) | Definition of the list of task according to quadrants of Circumplex Model and the challenge of activity.<br>Serious game proposal according to the nature of challenge. |
| Support (SUP) | Support given to students during the development of individual and groups task. |
| Assessment (ASS) | Adjustment of the activity for the next application, using information from massive data. |
| Understanding (UND) | Understanding of contents and strategies for the development of the task. Evaluation of self-benefit of the activity. |
| Execution (EXE) | Interaction with the task development: choose, decision making, creativity, bargaining, and so on. |
| Result (RES) | Real time access to scores, self – assessment and new goals. |
| Formation (GF) | Formation of groups of work. The S.P.A.C.E formula , to determine the social profile for each student. |
| Dynamic (GD) | Visualization of group dynamics, considering individual social skill as well as group behaviours. |
| Assessment(GA) | Real time access to scores, self – assessment and new goals for the groups. |

With the focus in the learning conceptual model, the main processes in GS have been designed and shown in the Figure 3. The teacher by each practice have to register the valuation parameters (Example: Originality, Utility, Accuracy, Feasibility) and also the projects to valuing in the practice. In the date of the presentation the students have to defence their works through the oral presentation of group. The teacher give feedback to the group about some strong or weak factor in the presentation, after this task the teacher registers his score in the GS. The student have to guess the score of the expert valuation, the rubrics are: Exactly to the teacher plus 1 point, deviation in value of "n" points: Subtract "n-1", the time for that the students register their score is three minutes after that the teacher have registered his score and has started the close timer of valuation for one project, this process is repeated by each group of the class.

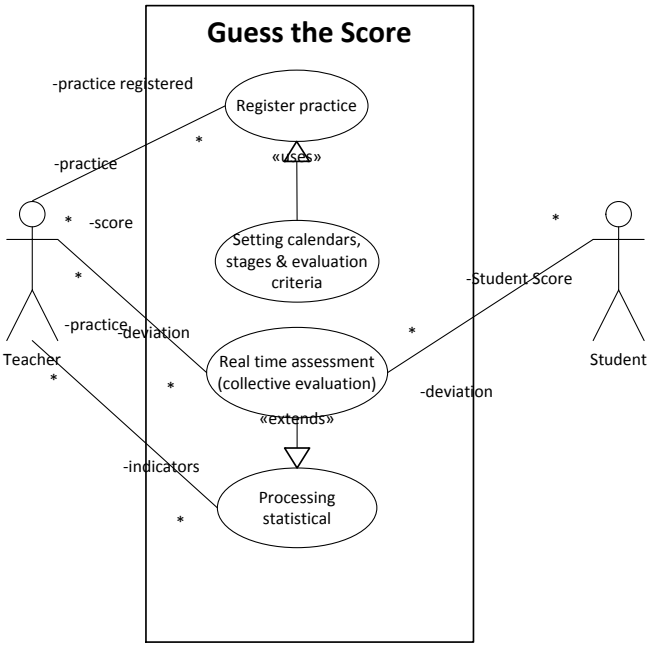


**Figure 3**.Guess the score, context's use case.

## 4.Generation and application of massive data in class

GS has been applied in two groups of students of pre and postgraduate (eighty students), in this section have been summarized its application by each milestone.

DL: The learning activity was Capital Innovation IC, and was aimed at facilitating the understanding of concepts and tools for the identification and protection of intellectual assets produced through innovation activities. The learning activities tasks involved: intellective, decision making, generation of ideas and executing performance task of the Circumplex Model. GS was specifically designed to foster participation of students in the assessment of all activities realized during the class. The gaming consisted on trying to guess the value that the teacher will score at works presented in class by students. The students had to valuing the groups that presenting their works, according to the parameters of the activity: Inventory of value protection, Threats and risk analysis, cost - benefit of protection and Intellectual capital SWOT. The criteria for the score were: (1) really poor, (2) Pretty lazy, (3) Normal, (4) Good, (5) Pretty good, (6) perfect. The rubrics for the score are: exactly to the teacher plus 1 point, deviation in value of "n" points: Subtract "n-1".

SUP: During the execution of activities the teacher explained to the class the content of the activity, and helped to specific groups to solve details of the different task. In the public presentation of works of groups the teacher discussed about the correctness and mistakes of the tasks. All students of the class where able to follow discussions and to participate.

ASS: The data generated by the participation of students in the “Guess the Score” gaming, during a two hour class were in a rank of between 10 and 20. This data correspond to the assessments made by each student about the level of performance of tasks, presented by any other students, and

expressed before the teacher made public his particular assessments (Figure 4). With all this data it was possible:
- At the individual level measure the deviation between the score of the teacher and each particular student. In each consecutive task assessed, the student was able to improve his or her capacity to apply the concepts related to intellectual capital(Figure 5).
- At the group level measure de deviation between the median of score of the group against the teacher and against the other groups. The groups were able to improve its dynamics analyzing their performance as a groups and individually(Figure 5).

*evaluate items of the project:* ***Heater.*** ***Closing in 35 sec.***

*apply a value between 1 (really poor) and 6 (perfect)*

| item | my score | class av. | Class deviation | N | min. | max. |
|---|---|---|---|---|---|---|
| Inventory of value protection | 4 | 3,4 | - 0,6 | 45 | 2 | 5 |
| Threats and risk analysis | 5 | 4,2 | - 0,8 | 45 | 3 | 6 |
| cost - benefit of protection | 3 | 2,4 | -0,6 | 45 | 1 | 4 |
| Intellectual capital SWOT | 6 | 5,2 | -0,8 | 45 | 3 | 6 |
| Average | 4,5 | 3,8 | 0,65 | | | |

confirm open *while voting is open the expert can change and reconfirm your score to the project currently evaluated .and see in real time the group behaviors*

**Figure 4.** Items to evaluate by expert(teacher) in "guess the score".

UND: Participants had to attend to the session to understand the activity and the tasks for each activity.
EXE: The students working in groups had to solve the list of task of activities.

RES: The students are able to visualize the scores and its ranking individually, as well as in group. Rankings presented included: individual position in relation to the class and group, the student behaviour along practices, and position of group in relation to the class (Figure 6).
GF: The groups were formed freely according to the preferences and affinity of the students, and applied the S.P.A.C.E. evaluation for knowing their social profile.
GD: The group according with the result obtained in each cycle established the goals for the next cycle.
GA: With the information of each practitioner, the groups analyzed their results and how they could improve it in future activities, the resources available are: the S.P.A.C.E formula of group, the average of deviation respect to the experimenter, rate from the minimal to maximal score of groups and so on.

*evaluate items of the project:* ***Heater.*** ***Closing in 35 sec.***

*apply a value between 1 (really poor) and 6 (perfect)*

| item | my score | expert | my diffr. | group diffr. | N | min. | max. |
|---|---|---|---|---|---|---|---|
| Inventory of value protection | 3 | 4 | 1 | 1,2 | 45 | 2 | 5 |
| Threats and risk analysis | 4 | 5 | 1 | 2,1 | 45 | 3 | 6 |
| Cost - benefit of protection | 4 | 3 | 1 | 0,5 | 45 | 1 | 4 |
| Intellectual capital SOWOT | 5 | 6 | 1 | 0,6 | 45 | 3 | 6 |
| Average | 4 | 4,25 | 1 | 1,1 | | | |

confirm *while voting is open you can change and reconfirm your score to the project currently evaluated . The columns after my score will be presented when the timer has finished*

**Figure 5.** Items to evaluate by students in "guess the score"

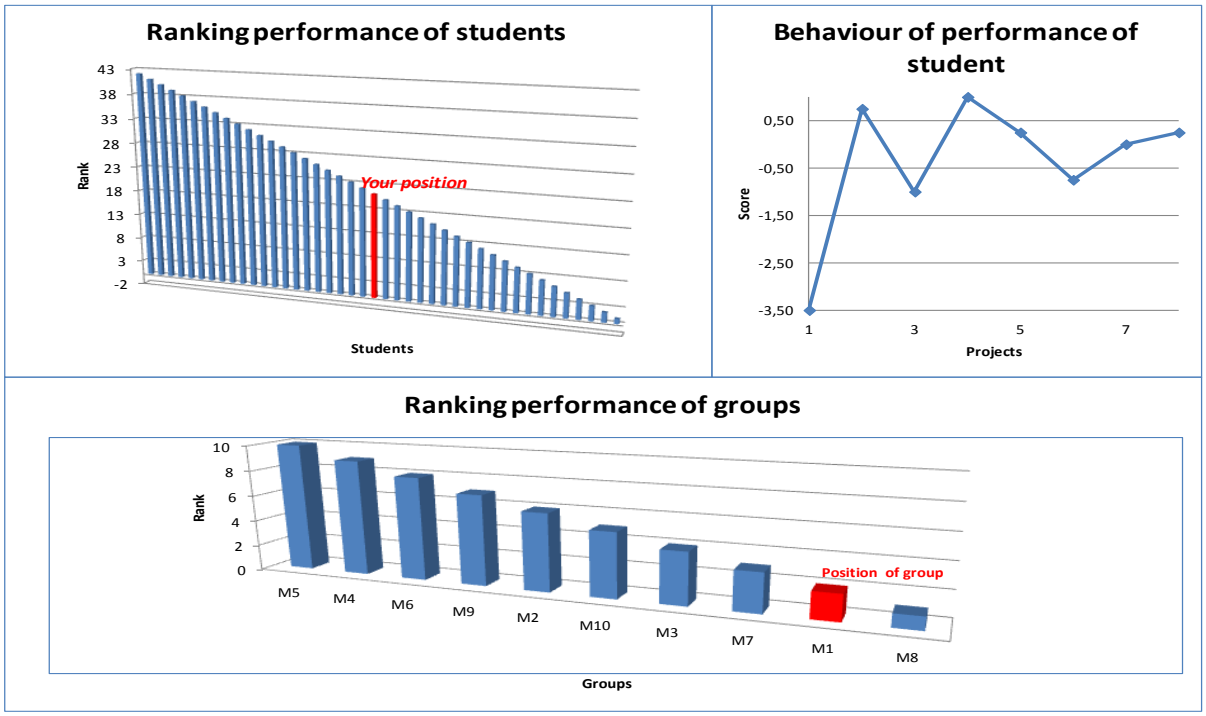


**Figure 6.** Rankings of: individual position in relation to the class and group, the student behaviour along practices and position of group in relation to the class

The findings of the test with the first GS prototype are useful to align the next step of research: Some of the results are: As shown in Figure. 7 the gaming strategy is a key element to succeed in student engagement; the process of collecting data from the participation of students has demonstrated efficient and works appropriately. Despite the S.P.A.C.E application was apply for measure the individual social skills with the GS application, the outcomes shown that there is no relation between the score and the social skill of students.

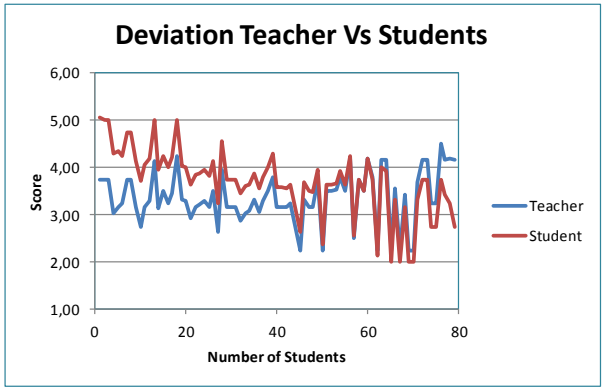


**Figure 7**. Deviation between of teacher and total of students in "guess the score".

## 5. Conclusions

The objective of the work presented here is to share the advances in a research program which intention is to provide a model, strategies, tools and resources to help improve the collective intelligence education. The GS and its theoretical framework is very wide and open and it's necessary much more research to find a consensus about which are the relevant theoretical elements.

The outcomes about S.P.A.C.E application carry out to think about the influence the ICT tools in the develop of social individual skills, however, the use of GS in the class has allowed obtaining some evidence about student's engagement, the increase of attention during the class and the increasing level of outcomes of exercises and practices.

The model proposed, and the corresponding tool, had been the result of a creative combination of theoretical, practical and applied perspectives. From this point, with a consistent model, it will be possible to continue with the development of new functionalities oriented to make recommendations in the improvement continue the knowledge of collective intelligence education.

## Appendix A. How does it work?

This appendix explains the list of task that the teacher and student have to do in Guess the Score during the class, and also the results after the application of gaming.

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