A novel approach for the design of context-aware services for social inclusion and education

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Abstract.
BACKGROUND: The new generation networks (5G and beyond) will allow us to collect and process real-time information about a user and his context. Analyzing the adolescents’ behaviour and taking into account relations between their psychological frailty and socio-cultural context, it is possible to highlight situations of vulnerability.

OBJECTIVE: It is crucial to shed light on how the nature of social relationships and the similarity among individuals play a role in the collective dynamics.

METHODS: To understand these dynamics, Evolutionary Game Theory and the analysis of social networks, modeled as multiplex networks, are useful.

RESULTS: Thanks to a simulative approach we evaluate the emergence and maintenance of cooperation within a class, assessing the role of social network structure and of the homophily on the dynamics.

CONCLUSION: Exploiting these tools it is possible to design innovative ICT context-aware services based on collective cooperation and aimed at improving social inclusion, education and support for frail people.

Keywords: Frailty, context-awareness, social networks, evolutionary game theory, multiplex networks

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technological innovation.
In this context, vulnerability in terms of learning and academic performance emerges naturally as a cause but also as an effect of adolescent distress. Although before attending school they are not socially isolated, this place represents an environment of growth and development for the youngsters, where they can experience a more systematic form of autonomy and responsibility and the first autonomous and individual approach to society. This is the place where individuals experience their own strengths and weaknesses, first successes or failures and social skills.

In this scenario, new teaching techniques [48] highlight the importance of collective dynamics and the effectiveness of form of cooperation not only for educational purpose but also aimed at social inclusion, in support of frailty and heterogeneity. In this sense, on one hand, the gamification [5] exploits the form of the game and dynamics of cooperation or competition as a way to carry out activities generally considered boring and to encourage social skills within the class-group. On the other hand, methods based on Cooperative Learning (CL) [39, 48] which show that students’ academic performance improves when CL groups are activated. The improvements are particularly interesting in problem solving, social, leadership skills [19], decision-making processes, etc.

At the same time, the expansion of the Internet at its edge and the more and more intertwined interactions between human beings and their devices (e.g. smartphone) lead to an Internet paradigm where human users play an increasingly central role. Personal devices act as “proxy” between the physical world and the cyber ones and are useful to “sense” the world where users act and interact [17]. The massive amount of sensors and actuators, together with the pervasiveness of wireless technology and the big number of data about processes, behaviour, movements, social relationships, opinions, etc. make it possible the creation of a projection of the physical world, leading to the so-called Cyber-Physical Convergence [47]. All these factors lay the foundations for a radically new paradigm named Internet of People [17, 47], where people are not only passive users of applications but they are active elements of the Internet, becoming the main characters of a complex socio-technical ecosystem. In this perspective, people do not have to adapt themselves to technology but technology takes care of users, anticipating their needs [47].

Thanks to these technological improvements such as Internet of Things (IoT) [67], and Internet of People (IoP) [47] and the new scenarios in 5G networks it is possible to monitor and to collect a huge amount of data and real-time information, the so-called Big Data [45]. In addition, thanks to Multi-Access Edge Computing (MEC) [42] which provides IT capabilities, storage and processing capacity, it is possible to accumulate information and to process it in near proximity of end users. All these factors make it possible the development of innovative ICT applications and services built around the end user and aware of the context where he operates [54, 68].

Thanks to the knowledge about the users’ context, their frailty, relationships and influences derived
from the big amount of data extract through sensors it is possible the analysis of social networks; also the class-group could be seen as a social network [43, 57] where there are stronger elements, leaders, and more frail elements, who needs more concern, and where the application of a game-theoretic approach highlights competitive and cooperative dynamics among subjects. All these ingredients are the pillars for the designing of innovative ICT services, especially in an era when it is growing an interest for psychological and collective dynamics affecting users [9] in addition to the legal and economic issues, strictly linked to the satisfaction of specific details.

The reason to evaluate, at the same time, teaching methodologies’ and technological developments is that the ICT, considering the importance of the context, can become an innovative and powerful tool to improve the collective dynamics, evaluating and predicting the evolution of behaviour. Furthermore, the use of techniques and methodologies typical of games, with the aim of stimulating active and virtuous user behavior, is sometimes adopted in the development of ICT services. The typical elements of the games are used to involve users of a service and motivate its actions, in order to achieve a specific goal. For example, games can be used to improve students’ learning through e-learning platforms: students have learning objectives to achieve, accumulate points based on the results achieved, pass levels based on the accumulated score, receive rewards when they pass a level.

Several works in literature highlight the role of social relationships and ICT on learning techniques and students’ beliefs, behaviour and their achievements. In [58] authors have made overviews about the impact of ICT, digital tools and cloud computing on students social and educational dynamics. In [33] it is showed the importance of Big Data as a way to have a knowledge about students and the context where they act. This knowledge can be useful in guiding frail students, identifying special learning needs for different groups of students, identifying student behavior and learning patterns, increasing their achievements. To this purpose, the role of social networks, real (within the class) or virtual (such as virtual communities [57]) on students’ attitude is evaluated in [57] and [48]. In [48] it is, also, presented a framework for the evaluation of the impact of mobile games, technological innovation and collaborative learning on students. In this scenario, investigating the dynamics and roles within a collaborative group is crucial, for instance the weight of the leader and its influence inside the group, as it is shown in [19] and in [43].

Starting from these premises, the aim of this paper is to analyse complex structures and dynamics, which allow us to understand how behaviour evolve within a community, identifying those factors which have a role in the emergence of cooperation and how it is able to lead the whole community to the so-called “social goods” [8, 22, 62]. These behaviour, adopted within the class, can also be propagated outside of the school, in all day activities, in family dynamics becoming a lifestyle which benefit the whole community.

This analysis is conducted exploiting a model of cooperation based on multiplex networks [6, 7, 51] and Evolutionary Game Theory (EGT) [22, 50, 63].

The remainder of this paper is organized as follows. Section II introduces the concept of frailty and the methodologies based on cooperation such as cooperative learning and gamification; in the section III there is our methodology based on multiplex networks and EGT; Section IV shows the results of simulations in relation to the impact that relationships within a social network and the similarity between nodes have in collective dynamics; Section V concludes the work.

2. Scenario

2.1. Frailty

Although the frailty is an issue central in the academic literature there is no single definition for this theme or particular standards to identify it [40]. In the origin the concept of frailty was associated by Federal Council of the Aging (FCA) to the poorest and neediest part of the population after the war. Then, it was associated to a condition of elderly people [15, 29] characterized by physical and/or emotional disability and placed in a socially unfavourable environment. The idea of a frailty [60] not only associated with physical disabilities but also with social, environmental and economic factors has been consolidated since the 2000s [21]. In other words, a frail subject is who experiences a vulnerable condition related to physical or emotional conditions. It is a dynamic status correlated to disabilities and social disorders and so it affects all ages. The evaluation of the frailty through social, relational, psychological and cognitive dimension, which are key elements for both young and old people, makes it possible to shed light on the emergence of frailty also among adolescents. In young
people there are several factors determining frailty [28] and the discomfort is easily manifested at school, because, here, it could affect the ability to learn or to socialise with peers. So the frailty of a student on his “personal” side could be translated into a form of frailty of the class made in attention deficit, hyperactivity or bullying, undermining the well-being of the whole group. Moreover, the frailty that teenagers live at school could be a symptom of a deeper discomfort. Working to motivate students is a way to improve performances in terms of learning but also to prevent the emergence, especially in adolescence, of problems with direct impact on health (such as drug-addiction, alcoholism, psychological or eating disorders, risks, etc.). The school class is the dimension where the “cognitive discomfort” of subjects occurs and so it is at the group-class level that the recovery strategies should be implemented. We must add that the notion of frailty at school it is not only referred to the psychological or social sphere but, more generally, to all categories of students with Special Educational Needs, expressed in functioning problematic which requires special individualized education programmes [31]. Learning disabilities (LD) are related to several disorders of school skills, such as dyslexia, dysorthography, disgraphia and dyscalculia. All these disorders have been categorized in the Consensus Conference together with their evolutionary aspects, symptoms and the association with other disorders (comorbidity). Even if in Italy these particular situations, requiring customized educational strategies, are protected by special laws such as the 104 of 1992 dedicated to disabled students and 170 of 2010 for students with LD; there are other categories with socio-economic, linguistic and cultural disadvantages who experiment difficulty in the learning process.

2.2. Cooperative learning

Cooperative Learning (CL) [39] is an educational approach which involves methods and strategies based on cooperation among students [48], each of whom share with the group his knowledge and his skills [39]. The most popular kind of CL is the so-called “Learning together” [34, 35, 38] in accordance to whom the class is divided in small work groups where each individual plays a particular role and works for the achievement of a common objective. In the CL each student, working together with the others, maximizes his learning capabilities and contributes to increasing the capabilities of the entire group [36]. CL is based on the theory of constructivism [44], in according to which, adopting a socio-cultural approach in the study of human evolution, languages, beliefs and reasoning are the result of a culture based on social interactions among human beings and so it represents a knowledge shared by the community. In particular, the growing process of children, in terms of development and learning, depends significantly on interactions with others (mainly parents and teachers) and with the environment (dialogues, games, actions, activities, approaches). The interplay and the cooperation are considered a crucial means to improve the society [1]. “Human beings should learn to live cooperatively, to experience the cooperation during the school period. The life within the school class represents a democratic process in such a microcosm and the main aspect of democratic life is cooperation. The class life should embody democracy, not only in the way students learn to make choices to carry out academic group projects, but also in the way they relate each other. Thanks to this approach, students learn the observation of rules, the respect to the other, and to solve problems together” [64]. Learning in a group is not only effective from the cognitive point, but also realises positive socio-relational processes: the increase of self-esteem, the sense of responsibility, social skills, the sense of collaboration with others to achieve a common goal, the sense of belonging and interdependence within the group. CL groups are usually heterogeneous for cultural backgrounds and personal characteristics and, in order to achieve effective cooperative work [16], it is recognised also the role of the status: it seems that students with a higher status have better participation, and this condition could facilitate the achievement of greater expectation of competences. To sum up, CL is based on five basic principles [35, 37–39]:

1. Positive interdependence: each member of the group has a role and the work of the individual cannot be separated from that of the others, so that individual success cannot exist without collective success; the failure of an individual is the failure of the whole group. Each student is indispensable for the group and for the collective success. This mutual interdependence is the leading force behind individual and collective actions.

2. Individual responsibility: all students have to contribute with their work, knowledge and skills to the success of the group.
3. Direct interaction: A continuous comparison between elements of the group is fundamental for having feedback about the quality of the work done by each one. Interactions become a way to grow thanks to mutual incentive. Cases of disagreement of conflicts become sources of conceptual or methodological learning.

4. Social, interpersonal and collaborative skills: students are encouraged and supported in the decision-making, communication and conflict management skills, but in the development of relational growth which promotes the achievement of common results.

5. Group evaluation: at the end of each activity it is necessary to program an evaluation to analyse the dynamics of the group and the results achieved.

In CL the group is also asked to make every effort autonomous and sufficient without requires the help from third parts such as the teacher. Members must cooperate and help each other by meeting those who come across difficulties. This approach triggers positive behaviour among all the members of the group who will spontaneously be brought to help and ask for help. CL improves and strengthens interpersonal relationships between frail and not frail students and the diversity becomes a starting point for cooperating and managing situations of frailty. “In a cooperative situation the objectives are defined in such a way that everyone sinks or swims together, while in the competitive case, if one swims, the other can also drown” [65]. CL compared to competitive or individualistic learning generally leads to:

1. Greater productivity and better results deriving from the experimentation which allows students to work with grater motivation, and from the possibility of experiencing different perspectives and point of views that promote the ability to reason and the problem solving.
2. Improvement of social and communicative skills. Students, working together, develop team spirit and confidence.

2.3. Game-based learning

Gamification is the process of using game-thinking and game-dynamics to engage audiences and solve problems [69]. It is an approach which involves the use of game mechanisms in non-playful context, with the aim of encouraging the performance of a specific activity or the acquisition of a specific behaviour. The use of some “game” techniques in the education leads students to more effective, wider and longer lasting learning, with better results also in terms of encouragement, motivation and attention [5]. Even if the term gamification is more current and evidently linked to the era of social networks and the technological evolution of the last decades, it is necessary to take a step back to highlight how, actually, the idea that underlie this phenomenon was not completely new. The birth of game-based, the use of games in the field of teaching and learning, was in the 70s in USA with the diffusion of Oregon Trail, a video game that was used in primary school [14]. The growing interest in game-based learning derives from the involvement that this approach could be with students, that are video-games users. In particular, the main characteristics of game-based learning are the follows:

1. The game represents a learning tool
2. Video games or non-digital games are both used
3. Ad hoc games aimed at education are envisaged
4. It promotes critical, creative and computational thinking
5. It facilitates and promotes cooperation
6. It makes learning more attractive, even if the topic is boring.

Computing technology can serve education to support cooperation by providing students with the so-called points of shared reference, anchor points that coordinate action and attention to foster successful cooperation [18]. Computer-based games can be used as a mediating tool, it helps students to focus their attention to mutually shared objects, thus enhancing their CL experiences. A game can be seen as a system in which players engage in an abstract challenge –defined by rules, interactivity, and feedback –that results in a quantifiable outcome and often elicits an emotional reaction [26]. Moreover, the social connection enabled by CL experiences constitutes one of the key points that support the Game-based Learning, motivating action, promoting learning, and problem solving. There are several evidences of educational gaming applications, such as Minecraft. This game, allowing players to customize their world, gives rise to the creation of a community of players where crucial is the sharing of resources and, in this way, the gaming community
becomes an informal collaborative learning environment [52]. By the use of Minecraft it is also possible the creation of a collaborative game for learning mathematics in primary school [2]. Another important evidence of the benefits of game-based learning concerns the integration of gaming techniques with Students Response Systems (SRS) learning systems [5]. Classroom Response Systems (CRC) or SRS are key elements in innovative teaching techniques based on the constant presence of questions. These interactive teaching systems make it possible teacher-student feedback in real time. Numerous studies have shown the considerable benefits in terms of participation, attention, deriving from the use of SRS compared to traditional teaching systems [41]. The simulative dimension (role playing) of the game, thanks to appropriate IT tools, allows students to experiment and experience what has been learnt. The gamification triggers series of individual and relational reaction which help in the achievement of the expected goal and it could be used in several areas, it is effective with users very different for age, context, knowledge, particular condition of frailty such as Special Education Need or Autism. The active involvement together with the presence of missions, scores different levels of difficulty arouses interest and curiosity in the user and it increases the competition and the desire to challenge their own limits. For these reasons, the game is a valid tool not only within a class but in all those situations where a group of people have a common objective.

3. Methodology

To understand the hidden dynamics determining human behaviour and the emergence of cooperation it is useful the analysis of social networks. Social network analysis is a set of methods and techniques used to model social relationships [13]. The school class can be conceptualised as a social network and, moreover, the network structure of the school class could be associated with the individual’s short-term and long-term frailty, dependently on his or her own position within the structure [3, 61]. The major theoretical implication of applying a social network perspective is that it highlights patterns and structures between social actors rather than the characteristics of the actors themselves. One of the key assumptions within social network theory is that the structure of a network has consequences for both the individual members and for the network as a whole [62]. Social networks are then assumed to influence social and interpersonal behaviour through the provision of social support, social influence, social commitment and attachment. These psycho-social mechanisms subsequently impact health through a variety of behavioural, psychological and physiological pathways [3, 62].

Network analysis requires relational data, or information about who is connected to whom within a group (e.g., friendship connections within a classroom of students). Network analysis makes it possible to determine whether sociometric status, or one’s social position within a group, is associated with individual attributes (e.g., leadership qualities, extraversion). This evaluation can also be used to determine whether the specific attitudes, beliefs, and behaviors of one’s social ties (e.g., friends, coworkers) influence one’s own attitudes, beliefs, and behaviour.

The analysis of a social network is conducted by the graph theory where each person is represented as a node and each relationship as a link. The network structure, modelled as a graph, is crucial to reveal the role of social relationships on the emergence of collective behaviour, such as cooperation, revealing how mechanism of network reciprocity, group reciprocity or parochial altruism [53, 59]. The combined use of EGT and multiplex networks make it possible highlighting the interdependence between strategies adopted by individuals in the network: decisions of individuals depend on the choices of others with whom they interact [22].

3.1. Multiple networks

A traditional graph representation is not suitable to show the complex nature of the relationships in which a subject is involved. For this reason, in this paper we represent the social network of students through a multilayer representation. In this kind of network, individuals are nodes with different layers of connections which incorporate multiple levels of interactions. Each layer describes several kind of connections among nodes (e.g. classmates, families, friends) [7, 10]. In each layer there is a different set of interconnections between nodes, called intralayer connections, instead the interconnection among layers are called interlayer interactions. Multiplex networks is a particular case of multilayer and it is the most used to describe social networks, it is composed of a set of nodes connected by links of different nature in different layers and the only pos-
possible type of interlayer interactions is that with its counterpart nodes in the rest of layers [6, 7, 10, 51]. “Multiplexity” [7] refers to the simultaneous analysis of multiple types of interactions between the same constituents of a complex system; allowing to understand the mechanisms underlying the hidden dynamics, through multiple channel of connectivity, providing the most fitting representation of systems where components have a different set of neighbours in each channel of connectivity [22]. This multidimensional description makes it possible to investigate structural properties and interdependence useful to explore emerging phenomena, to predict collective dynamics [22]. Within a class, a description of social context of students through multiplex network allows us to explore relations between social aspects and behavioral characteristics such as aggressivity, disruptiveness, popularity, studiousness, leadership [19], cooperativeness, athleticism, and shyness [25] and the link between the role of an individual in the network, the most central is also the most popular, and the evolution of prosocial or antisocial behaviour within the community [20, 30, 49]. In multiplex networks it is possible studying how the centrality of a node is distributed among the layers because a node central in a context (such as the leader within the class [19]) could be more isolated in other layer (e.g. in the soccer club) [6]. Having high centrality at the individual level reflects a kind of social dominance based on pro-social behaviour. On the contrary, low centrality suggests that the individual takes a lesser part in the social life of the network. In previous studies on school children and health, centrality has commonly been conceptualised in terms of ‘peer status’, referring to the degree to which the individual is an accepted, integrated and respected member of the group. Previous studies have additionally demonstrated that highly centralised school-class structures are typical for bullying and victimisation networks. Nevertheless, having friends contributes to the development of the self-system and pro-social skills.

3.2. Evolutionary game theory

Evolutionary Game Theory (EGT) is the mathematical framework for studying the interactions between two or more competing individuals, highlighting how and why, over time, some behaviour are able to persist within a population by providing prototypes of the most important interactions between the entities are involved, such as conflict or social dilemmas. The aim of this approach is using mathematical tools to describe and predict the outcomes of a game or of a real situation. It is applied in those situations where the outcome of an individual decision depends not only from individual choice but also from others people e it is used to analyse the emergence of cooperation [12]. EGT allows us to analyse and understand the evolution of behaviour [22], studying the strategic interactions between nodes. A game is a model of interactions among decision makers where both plan their actions at the same time [24]. A game is characterized by a set of N players which have a set of possible strategies; each strategy corresponds to the payoff that the player gets in function with his choice and that of the opponent. In particular, social dilemmas are game with two players and two strategies [32] and they provide a mathematical model of those situation where selfishness lead to less payoffs in comparison to mutual cooperation [12]. Each dilemma is defined thanks to a payoff matrix: the two possible strategies are cooperation or defection; cooperating means to give a contribution to the common good while defection means exploiting of others [22]. In the matrix in Table 1, R represents the reward achieved with the mutual cooperation; T is the temptation to defect; S is the sucker payoff obtained by a cooperator who plays the game against a defector and, finally, P is the penalty for the mutual defection. The application of these social dilemmas make it possible the classification of individuals in pro-social or pro-self, highlighting how cooperation is able to emerge in which situation where players interact repeatedly with each other, with the action of external controls but also in one-shot interaction without incentives from third parties. In accordance to the values assumed by the parameters of the matrix it is possible define different social dilemmas [56]. If \( R > S \) and \( R > T > P \) the game is the Harmony Game and the final state of a population that play this game is the total cooperation. The opposite situation is represented to the Prisoner’s Dilemma (PD) with \( T > R > P > S \). In the Snowdrift Game \( T > R > S > P \) and in the Stag-Hunt Game \( R > T > P > S \) [46]. In the context of learning techniques based on cooperation,
crucial is identify factors which are able to lead the whole group to the total cooperation, intended as the common goods in terms of social aspect and learning. In this paper we analyse the role of homophily [22] which is the principle that similar individuals are more likely to connect [63]. Adolescents are more likely to interact with subjects which have similar interests, hobbies, socio-economic status, performances, this aspect can lead to the creation of groups (called cooperative clusters) that are often very closed where social influence, the spreading of ideas passes through common knots. Homophily, therefore, limits the social context of an individual influencing their attitudes and experiences creating a social dependence (the most similar nodes are more likely to help each other) and social influence (the interacting nodes to emulate each other). Another incentive for cooperation within a social network is the critical mass [22], which is the minimum group of individuals capable of triggering new behaviour and collective action in a population, such that if actors organise themselves in a coalition of size \( n \), at least \( n \) people will prefer mutual cooperation over defection.

4. Simulations and discussion

Simulations have been conducted taking into account \( M=3 \) layers and \( N=30 \) nodes. The multiplex is populated, in a first time, choosing a Scale-Free network [46] (the most effective model to represent social-networks) as shown in Fig. 1(a). Each layer of the multiplex network represents a different kind of interaction among the element of the network, such as school, sport teams, friendship, etc. Each node of the network plays 300 rounds and in correspondence of that value the convergence to cooperation has already been reached. At each round nodes play PD game, defined by the payoff matrix in Table 2. Where \( b \) is the benefit and \( c \) the cost deriving from cooperation. Cooperating means working to achieve the common reward, in terms of learning while defecting do not contribute to the social good.

The PD is the best example for the problem of cooperation [23] because although individuals can benefit from mutual cooperation they can achieve better results by exploiting the cooperation of others. For these reasons, the PD provides a basis to explore mechanism which enabling the emergence of cooperation and its maintenance. Fig. 2(a),(b) shows the fraction of cooperators in a multiplex network pop-

![Fig. 1. Multiplex network of students with \( M = 3 \) populated with Scale-free network (a) and Erdös-Rényi (b).](image)

**Table 2**

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Fig. 2. Density Plots. The figures illustrate the density of cooperative nodes in PD game, against the steps of the game: we show the fraction of cooperators with $M = 3$ layers and CM fixed, ranging from lighter (lowest) to darker (highest) colour in the following configuration: (a) Scale-free network and high homophily, (b) Scale-free network and high homophily, (c) Erdős-Rényi with high homophily.

ulated as a scale-free network against the number of steps of the PD game. We take into account a fixed value of CM and different values of homophily randomly chosen following a normal distribution around a mean value, with standard deviation $\sigma$, where $\sigma = 8$ means a low homophily value Fig. 2(a), while $\sigma = 1$ means a higher homophily value Fig. 2(b). The fraction varies in the range $[0,1]$ where 0 corresponds to the global defection and 1 total cooperation. The colour indicates the population’s density, “the brightest color” means the lowest density while “the darkest colour” the highest. The plots demonstrate as the iteration of the game allows individuals to react to an opponent’s past behaviour, through a learning process. If two player interact repeatedly the expectation of low payoffs caused by the past defection makes cooperation more profitable as a result of reciprocal altruism. In Fig. 2(a)-(b) it is also showed the role of homophily as an incentive for emergence and maintenance of high levels of cooperation from the first steps of the game. It is demonstrated as the spatial structure may be a potent promoter of cooperation encouraging mechanisms of network reciprocity [53]. This macroscopic evolution shows how payoffs obtained from local interactions with neighbouring individuals are then used to determine the evolutionary process.

At the end of a round each player updates his own strategy in accordance to the Fermi’s rule as defined in [22]. So, the repletion of PD in a Scale-Free network triggers the mutual cooperation instead of in a random structure as shown in Fig. 2(c), which shows the fraction of co-operators in a population of a multiplex network populated as an Erdős-Rényi network [11], with random links. The network structure do not promote mechanism of network reciprocity and so, although high value of homophily and several iterations of the game, the global cooperation it is not reached.

In conclusion, from the results of these simulations the importance of social relationships within a network for the emergence of cooperation can be seen. Even if homophily represents an incentive to collaboration, interpersonal relationships play a major role to lead the community forward the “social-
goods”. Therefore, in a newly formed class where connections are weaker and the interactions are recent and limited, although case of similarity, cooperative behaviour does not emerge. The strengthening of ties and their iterations favour the emergence of cooperative phenomena with positive results in terms of inclusion, academic performances and psychological well-being.

From a theoretical point of view, this study provides the efficiency of a methodology based on EGT and multiplex networks to evaluate behavioural and social frailties in teenagers. This is a starting point to design and implement services and applications aimed at teaching, education, social inclusion or all aspects concerning the complex environment of the youngsters. The aim is leading to cooperative or collaborative behaviour for individual and collective social well-being, which is able to improve the quality of life, starting on a change in social relationships.

5. Conclusion

The aim of this paper was applying a model of cooperation among people to propose a possible approach for the designing of ICT applications aimed at improving the social inclusion and the education. Innovative teaching and learning techniques start from the assumption that the game is an effective tool because it makes it possible the creation of situations where the interlacement of commitment, activity, attention, competition and cooperation is useful to reveal the evolution of behaviour and relational dynamics. All these ingredients, the evolution in ICT, the analysis of gathered Big Data, together with artificial intelligence’s techniques could be useful, in the future, to recognise and characterize the social class structure and the emergence of symptoms of frailty. Thanks to EGT and multiplexity we focused on the factors which encourage the emergence and sustainability of cooperative behaviour within a population. For the future, it could be interesting analysing clustering methods to evaluate the dynamics within a group with heterogeneous nodes and community detection algorithms.

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