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Situated Psychological Agents: A Methodology for Educational Games

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Featured Application: The present paper introduces a methodology based on situated psychological agents that can be fruitfully applied to design and implement educational games, as it permits to represent the flows inside the game on the educational, psychological, and pedagogical level while detailing agents' features at a psychological level.

Abstract: In recent years, the ever-increasing need for valid and effective training to acquire competences in multiform contexts has led to a wide diffusion of educational games (EG). In spite of their diffusion, there is still a need to reflect on the design process that should embed the games' pedagogical potential and the instructional process in the entertainment scope. Moreover, as building EG, especially in digital environments, is an enterprise that involves specialists with different expertise, it can be useful to have a shared methodology that is easily understandable and usable by many users. In this paper, we propose to use situated psychological agents (SPA) as a methodology to design and build effective EG and show how to represent games in terms of SPA and their interactions by diagrams and describe different examples of how this approach has been applied.

Keywords: educational games; game design; situated psychological agents; education; competences

1. Introduction

Education is a key step and challenge in every society as successfully preparing future citizens in terms of knowledge, skills, and competences strongly affects the competitiveness at an individual and collective level. Not by chance, European Commission is tracing indications to strengthen human capital [1] so that everyone may have a key set of competencies that allow personal fulfillment and include transversal skills, such as digital competence and entrepreneurship competence.

Competences are more easily acquired through pedagogical models that favor the active involvement of the learner in the acquisition process [2–4] thus, opening the way to innovative educational strategies, including educational games (EG) [5–8]. Moreover, the introduction of information and communication technologies has led to a revolution in education concerning different aspects, for example, the tools that can be used for education, the places where education can happen, the possibility to interact with an incomparable higher amount of learning resources and educational figures. ICT has brought to the evolution of new approaches such as technology-enhanced learning and game-based learning [9,10].

It means, for example, that a learner, child or adult, can now access not only books, one of the most used learning sources for a very long time, but also additional multimedia contents, simulations,

and social media to obtain information. The world where education takes place is no more limited to the physical classroom but is expanded to cover potentially an unlimited world, in terms of space and time, that is totally or partially virtual. If we consider the tools that have been introduced in the educational context, it seems that, in spite of their wide diffusion, there is still a need to reflect on the methodology to design, implement, and use them in a learning scenario.

In more detail, it can be a useful reflection on the methodology to design and implement educational games, as an effective methodology should permit to have a shared formal representation of the main game elements, of their connections and their interactions.

In what follows, we will propose a methodology that meets this requirement, which is based on the situated psychological agents (SPA) approach, connecting it to the EG design process.

2. Educational and Serious Games: The Design Process

Serious games are games that educate, train, and inform, to use the title of the highly cited paper by Michael and Chen [5]. Since the first book by Abt [11], which referred to card and board games, serious games have become digital and have strongly affirmed their educational potentials [12,13]. This fact forces to critically reflect on this kind of games, as they intervene in the learning process in a way that has not been faced yet in traditional learning theory and typical game theory as well. Many remarkable theoretical frameworks have been proposed, also recently, to satisfy this need. Among these, it is useful to cite the learning mechanics-game mechanics model [14], which draws a set of pre-defined game mechanics and pedagogical elements abstracted from the literature and connects them to identify the main pedagogical and entertainment features of a game. This work highlights the fundamental game mechanics and how they are translated into learning mechanics. Also noteworthy is the activity theory-based model of serious games [15] that provides a useful representation of EG, with game elements, their connections and their contribution to pedagogical goals achievement. These works have the value of trying to answer the question of how the concrete components of the game should be structured to support learning and which elements are crucial to address the design process.

The design process, indeed, is extremely important in determining EG success.

The starting point of each designing enterprise is to clarify what is the goal to be reached. In the case of games, the questions are "What is the goal of the game? What the player can do?". In the case of entertainment games, some typical objectives are:

Erase: The player must "eliminate" the opponent, such as chess and checkers game;

Solve: The player must find a solution to a puzzle or answer a question: Examples are Cluedo or Trivial Pursuit;

Chase: The player runs towards or away from someone or something. One famous example is the video game Super Mario Bros;

Build: The player has to build something: A house, a city, an empire, as in The Sims, Civilization, and Age of Empires.

On the other hand, if our goal is to build EG, where the educational aspect is crucial, the designers have to specify also "What is the learning goal of the game? How it can be achieved by actively involving the player?" In this case, help can come from learning theory. For example, Bloom's updated taxonomy [16,17], which is commonly used to describe learning goals and includes remembering, understanding, applying, analyzing, evaluating, and creating, can help focalize what the EG aims at leading the player to. After the learning and game objectives are defined, the design must define three fundamental and interconnected levels: The shell level, the core level, and the educational level. It represents a multi-level approach for design, where there are two concentric levels, the shell, and core level and a ubiquitous one, the educational level, also named evaluation and tutoring level [2]. The level interconnections are represented in Figure 1.

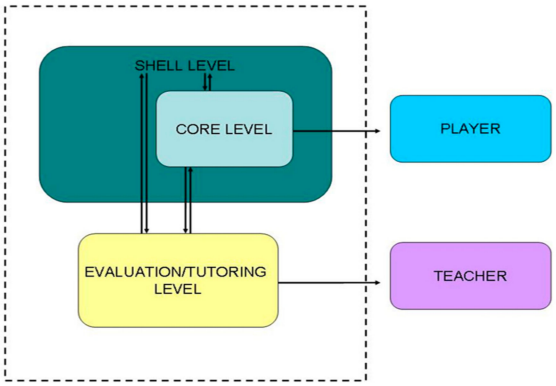

Figure 1. A multi-level approach for game design with shell, core, and educational level. Shell and core levels can be found in every kind of game, whereas the educational level characterizes educational games.

2.1. The Shell (Game Narrative) and Core (Game Mechanics) Levels

The shell and the core levels are present in every game, and in almost every cultural product as well. The shell level represents the visible content that is immediately accessible to the player. It frames the game dynamics within the core level. The educational level, even if it is present in many entertainment games, is explicitly characterized in educational and serious games, as it allows, on the teacher's side, to understand if and how the player/learner has acquired the concepts conveyed by the EG and, in some cases, directly intervenes in the learning process.

At the shell level, superficial and visible, we find the game narrative. EGs, like many other cultural products, are expressed through a narrative metaphor. It is, therefore, important to define who are the characters, what actions they can perform, what interactions are possible between characters, and the environment within which those actions take place. If we adopt a theatrical jargon, the plot, the scenario, the roles, the setting are aspects to be defined.

It is widely recognized that narration is a key aspect in human cognition [18], and it is, therefore, possible to find it in a wide variety of cultural products, such as fairy tales, movies, news, to cite some. Games, as cultural products, share this feature and then narration is present in games too [19]. As an example, the characters can be two armies in the chess game, the scenario can be a futuristic world in a videogame, the plot can be an interaction between relatives in a role-playing game. In the well-known game of Monopoly, for example, a pair of dice are rolled to move a player's piece around the board. Buying and trading properties mean to represent real estate trading that strongly helps to engage the player in the negotiation. The shell level, where narrative resides, keeps a hidden level with specific mechanisms and rules: This hidden level is called the core. Adopting a term that is commonly used in the context of videogame creation and development, this deep level is the game engine [20]. The game engine allows implementing core functionalities related to game dynamics, for example, related to physics, animation, artificial intelligence, etc.

These levels interact: One level can have strong effects on the other. The narrative provides a framework where the hidden content lives, as it was in a shell, as suggested by the name.

In the context of EG, the shell level is essential to provide a semantic context to the educational activities, whereas the core level is related to skills, abilities, competences to be transferred, and to the relevant learning objectives. It is interesting to note, as hinted at before, that the concepts of core and shell levels are present in every kind of game, not just in educational games.

2.2. The Educational Level

In EG, a relevant role is played by the educational level, which includes evaluation and tutoring activities, with the explicit educational goal to allow students to accomplish specific learning outcomes. It is, therefore, important to pay attention to the design process of such a key function. Together with this, all design decisions at all levels should be harmonized in order to provide a meaningful learning tool, as shown in Figure 1.

At the educational level, the evaluation function analyzes players' game performances relative to the specified training objectives and provides the players and the trainer with important information and data about the learning process. At this level, we find learning analytics, which is the measurement, collection, analysis, and reporting of data about learners, intending to improve the learning process as well as the environment in which it occurs. Despite some challenges that can derive from the effort of introducing learning analytics in EG, nonetheless, studies report that this effort can be useful to achieve greater effectiveness and measurements of progress in learning [21–23]. Paraphrasing Siemens's words [24], learning analytics is the use of intelligent, learner produced data, and analysis models to discover information and social connections for predicting and advising people's learning. From the teacher's perspective, this level is fundamental because it supplies specific tools and functions to support the training process.

3. Agents in EG and the SPA Approach

The ubiquitous presence of interacting artificial and real actors at each level, together with the importance of the narrative, recalls the theatrical metaphor already presented for the shell level. From the educational point of view, this metaphor is extremely powerful to represent interactions between the various actors of the educational process in EG. However, the theatrical metaphor effectively applies to all kinds of educational games only when agent's conception and design is based and inspired to psychological models, as they ultimately make choices, take decisions, and act within the environment they live in [2].

Indeed, the various actors populating the different stages of an EG, at the shell level (users, learners), core level (interactions between actors), and educational level (trainers, educators, tutors) can be represented as agents with different features and functions. If we think of EG, it is evident that the people involved in the learning process are a key element both on the educational and game side. Almost every educational situation is characterized by interactions between the learner, at the center, and the people involved in the whole educational processes, both in formal (teachers, educational designers, tutors etc.) [25] and informal contexts (parents, peers, etc.) [26–28]. Nevertheless, the kinds of interactions that specify the educational settings can be varied and show specific nuance that every methodology aiming at modeling the educational process should take into account.

By looking at Figures 2 and 3 we can see two different implementations of an educational process. The first one is usually observable in children who learn with a teacher through multisensory experience. It is characterized by well structured educational materials [29–31], e.g., a Montessori-inspired classroom [32] and a well-structured environment. In this case, the teacher can be modeled as an agent that we can call generically trainer and directly affects learners' activities. In this view, the environment within which the learner acts as the playground of the learning process. The trainer provides external guidance and support during the play, thus allowing a full understanding at the cognitive level.

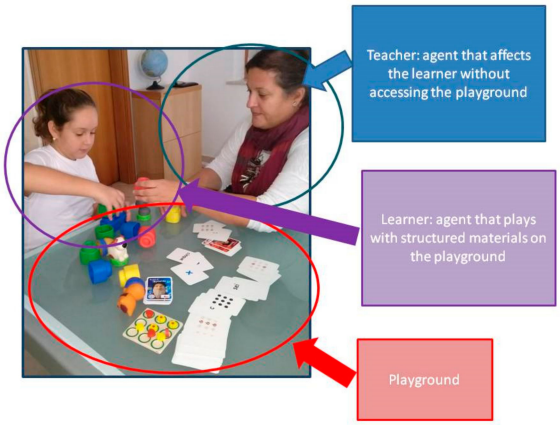

Figure 2. Learning interactions in a Montessori-type environment.

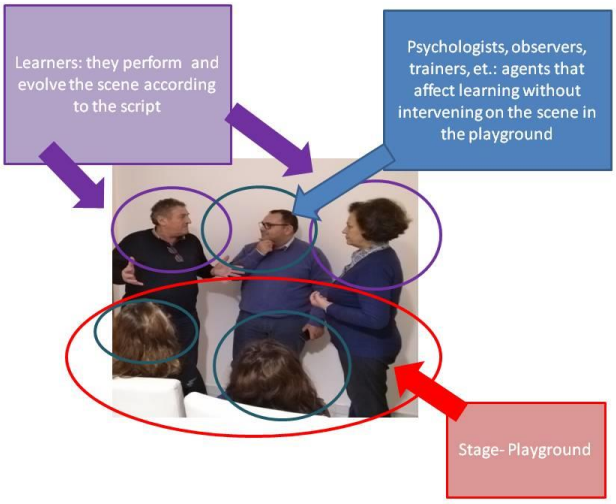

Figure 3. Moreno role-playing games.

The second situation comes from Moreno's role-playing games [33] where the learner acts exactly as an actor, by evolving the scene on the stage according to a given script.

Role-playing games simulate a social situation in which users are asked to cover and interpret specific roles to develop a certain competence, such as effective communication or negotiation [34–38]. Here, learners, as actors, according to a specific script, perform and develop their actions on a stage. In this way, the stage represents the playground where the learning takes place [29]. Behind the stage, the psychologist, the trainer, or the observers, which all can be seen as agents interacting with the learner, can provide guidance and support, affecting the learning environment, though not directly intervening on the playground.

These interactions always happen inside the game and can be partially or completely virtual if the agents are ruled by artificial intelligence [39–41].

However, the relevant elements of these learning situations are useful to define a more general methodology:

The playground: A space (physical and/or conceptual) that delimitates the actions of one or more learners. The playground is defined by the narrative structure. It can contain objects (physical and/or conceptual) that can be manipulated by the learner.

Learners: The learners can act in the playground, changing its state directly. They can be considered agents that are situated, immersed, in a scene of the play, and can select autonomously the actions that modify the playground in the function of their psychology, including cognition, emotion, etc.

Trainers: Teachers or people who have educational, training, or assessment functions affect directly or indirectly the learners but cannot modify the playground state.

In the design process of EG, it is, therefore, necessary to keep in mind the following elements:

(1) definition of the narrative structure with the necessary agents;
(2) definition of the actions and interactions modalities of the agents;
(3) definition of the agents' control system, whether human-controlled or guided by a set of rules or AI systems.

Learners and other characters present at the shell level, and therefore, belonging to the narrative of the game, can be called on-stage agents (OSA), as they directly interact and affect the core level according to their specific endowment. The BSA can interact with the game indirectly, by affecting OSA actions and are mainly present at the educational level. This distinction was firstly introduced by Dell'Aquila and colleagues [2] and Ponticorvo and colleagues [29]. Moreover, it can be also adopted at two different levels: 1) The first, related to the educational material (in EG interacting elements can be conceptualized in the form of agents), 2) and the second, to the learning scenario, where learners are conceived as agents interacting with other agents (real or artificial), thus defining the educational environment.

Taken together, the description of the design process and the focus on interacting agents and playground, are the main elements of the SPA approach for educational games, which allows addressing the EG design both at a high level of abstraction and at a high level of detail.

Therefore, the SPA are agents with different characteristics: OSA can directly act on the playground or BSA if they externally interact with the OSAs within a well-defined educational process. They are situated, as they are present and somehow "immersed" in the educational process, being in the playground or in the overall narrative structure. They are psychological, as they are endowed with cognitive and emotional features: In the case of human agents, it is automatic that agents have a psychological characterization. In the case of AI-controlled agents, it is possible to take inspiration from psychological theories and models to define their psychological characteristic and behaviors. It is useful to underline that the agents share the same context. Thus, there is a shared meaning between the actors involved in the learning situation.

The SPA approach, at the shell level, identifies the game characters, their characteristics, and interactions. At the core level, each agent is accurately defined as to its sensory and action endowments, i.e., what the agent perceives and what action it can perform. These actions must follow the game rules that are defined both by setting constraints and by the agent actions defined in the core level itself.

SPA can be useful for EG design because all the interacting entities within the game can be represented as agents, some immersed in the playground, and some not. Both the players and the roles that guide the learning process from backstage (psychologists, teachers, or trainers) can be conceived as agents. Players become OSA, and contour figures become agents with specific functions, from supervision or score recording to observation, tutoring, advising or mentoring. Considering the different levels described in Section 2, we can say that, at the shell level, an EG is a mise-en-scene of a plot by one or more agents interacting in a well and formally defined setting. On the core level, actions performed by OSA directly modify the game state, whereas BSA supports OSA at the educational level. It is possible to identify a clear separation between the shell level and the core one: The visible dimension can be conceived through traditional narrative techniques, and the core level, expressed in terms of SPA, implies the formal definition of the various game components that we have introduced.

The Educational Level in the SPA Approach

In this section, we will focus on the educational level in the SPA approach. BSA are the main characters at the educational level: They may have the function to support the learners involved in EG, mainly as OSA. BSA does not intervene directly in the playground but provides what is required

to enhance the learning process. These agents cover specific roles, functional to the achievement of educational goals. Educational or learning goals are inspired by a specific learning theory, such as the already cited work by Bloom or Kolb [42] who emphasized concrete experience, active experimentation, reflective observation, and abstract conceptualization. A meaningful learning process is characterized by the presence of feedback, as giving (and receiving) feedback is essential to understand how close learners are to the defined learning goals. Feedback, together with debriefing are regarded as the most important element for maximizing the learning process [43], as they guide learners through a reflective process about their learning [44], offer a space for giving personal meaning to the learning experience [45], and help to relate this learning experience to real-life contexts. In the SPA approach, feedback is provided by BSA, and in the case of digital games, it can come both from real or artificial tutors. In digital games, their role is essential to provide learners with short feedback cycles through which they can get continuous and immediate information regarding the effect of their actions on the game interactions. Conversely, in traditional educational approaches where teachers generally have to mark students' work using conventional means (i.e., manually), there is a significant delay until students can receive the appropriate information regarding some aspects of their task. Digital EG can help to reduce such delays almost to zero. Moreover, feedback is offered throughout the full game session. A very important moment for delivering feedback is at the end of the game, during the debriefing phase, when the learners receive feedback about the overall performance. It is also a process which gives the opportunity to analyze what dynamics occurred during the game, what went wrong, and was achieved, and share experiences with other people, making it possible to compare different perspectives from other players or from other people involved in the learning process, such as tutors.

The SPA approach to developing EG opens a way to adopt software based on artificial intelligence systems to model the interactions between OSA and BSA and allows to conceive these complex interactions between agents as finalized to a meaningful learning process through feedback and debriefing activities. The tutor can be a human being, but also a virtual entity, thanks to artificial intelligence. In both cases, it is crucial that the tutor observes and traces behaviors, actions, reactions of learners during the game, similarly to what happens when a student performs a task or takes a test in face to face situations to create a learner's profile. To create such a profile, educational games can rely on a wide amount of data available, even more than in real life-oriented tasks. Digital games offer a system able to record every single action performed by the players, the time required by each action, as well as not effective choices made. Thanks to all this information, both real and virtual tutors can operate various analyses, to understand the cognitive state of the learner, thus implementing learning analytics. It is reasonable to hypothesize that real and virtual tutors can be even more effective when they jointly operate, as the virtual tutor can record a significant amount of data and provide immediate feedback, which is impossible to achieve from a human tutor, and the human tutor can supervise and actively guide the learning process in such a way that is, at the moment, very difficult, if not impossible, to achieve by a virtual agent.

The tutoring agents, both human or artificial, carry out various roles in different moments and at a different level. At the beginning they can select and decide which roles of the game will be played by each actor, also according to learning objectives and to previous results achieved. During the game, the OSA interacts with the narrative at the shell level and the game space level, while a BSA can help to maintain a high interaction level. At the end of the game, the tutor can build an individualized report regarding the overall interactions that occurred, record achievements and failures together with a preferred way to act, react and interact to build a detailed user profile. This report can also be useful to further customize the game/player interaction.

In the next section, we will introduce some examples of EG and present the design process that led to them by means of diagrams with formal notation.

4. SPA Applications to EG

In this section, we will report three relevant examples of how the SPA approach can be applied to EG design with particular attention to the formal representation of game elements. To this end we will use the following notation: The playground is represented as an empty rectangle, the circle represents OSA, and the square represents BSA. If the boundary is a full line, the agent is real, and if it is represented by a dashed line, the agent is artificial. The interactions are represented as lines: A continuous line represents a direct interaction, whereas the dashed line represents an indirect one, arcs represent feedback.

4.1. Block Magic

Block Magic [46,47] is an educational platform that exploits augmented reality based on RFID/NFC technology that allows building custom educational games with both physical and digital components. It consists of a set of magic blocks, a magic board/tablet device, and specific software (Figure 4). Magic blocks are an augmented version of traditional logic blocks, widespread structured materials, classically used in education. The technologies employed to augment are RFID/NFC sensors that allow to unite the manipulative approach, stimulated by logic blocks, and touch-screen technologies. An RFID system consists of an antenna and a transceiver, which can read the radio frequency and transfer the information to a device, and a small and low-cost tag, which is an integrated circuit containing the RF circuitry and information to be transmitted.

Figure 4. The Block Magic kit.

This configuration permits to a PC or a table, with BM software installed on, to connect with BM Magic Table, another relevant BM material. The Magic Table has a hidden antenna that recognizes each block, sends a signal to the PC/tablets, and produces feedback coherently with pupils learning path.

Each augmented magic block had an integrated/attached passive RFID sensor for wireless identification of every single block. A specially designed wireless RFID reader device, an active board, is used, which can read the RFID of a block and transmit the result to the BM software engine.

On the software side, the BM augmented blocks together with the Magic Table are complemented with software that includes a series of already-developed exercises and an authoring tool to build new ones.

The BM software engine is mainly formed by two parts: The first one is devoted to receiving input from the active board and generating an "action" (aural and visual). These actions implement the direct feedback the user can receive interacting with the system. This feedback is regulated by an embedded intelligent tutoring system [48,49] that ensures autonomous interaction between the user and the system, receiving active support, corrective indications, feedback, and positive reinforcement from the digital assistant on the outcome of the actions performed.

The second software component is devoted to customization, and it is dedicated to teachers, educators, etc., allowing them to build their exercises to be proposed to the child, focusing the attention on the skills the child needs to train more.

In BM, the narrative comprises the plot, the scenario, the characters, the setting and has the task of attracting the player and filling the game experience with meaning. The appropriate narrative allows to attract the child, so to immerse him/her in a completely different environment, that is relevant in every educational context. The narrative level exercises a framing effect on the core level.

The core is configured as an interaction between the player, the human OSA (or the players in a collective scenario), the teacher, another human OSA, and the artificial BSA. The interactions are mediated by physical materials: The Magic blocks.

Block Magic Representation in SPA Terms

From BM general description, we can move to BM description in terms of the SPA approach. As represented in Figure 5, in this case, we have two human OSA interacting: A learner and a teacher. Many important functions are played by the BSA, which is artificial. It provides feedback to the player (arc on the left) during the game, it affects the human OSA teacher proposing existing exercises and recording learner's interaction, it has an indirect effect on the learner OSA through the trainer OSA. The BSA is built according to adaptive tutoring systems theories [46,47].

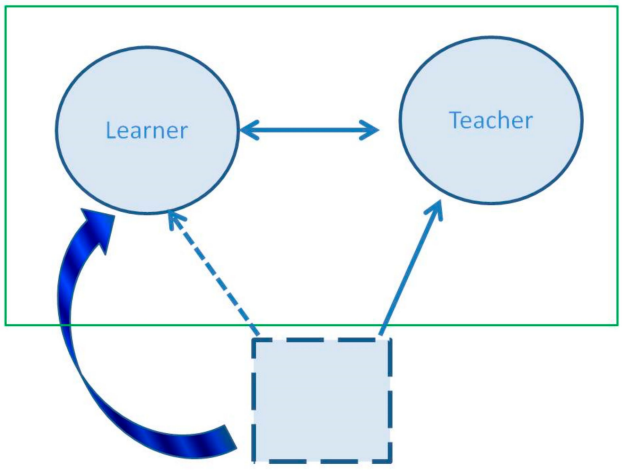

Figure 5. Block Magic represented in the SPA notation (the playground is represented as an empty rectangle, circles represent on-stage agents (OSA), and the square represents the BSA. Full-lined boundary indicates a real agent, dashed line indicates an artificial agent. A continuous line represents a direct interaction, a dashed line represents an indirect one, arcs represent feedback).

To validate the SPA approach, some data were collected with BM users. During the BM project (www.blockmagic.eu), trials were run in four schools in European Countries and involved about 250 students and 10 teachers of primary school and kindergarten. The teachers used pre-defined exercises but could also build their ones using the BM authoring tool, which is based on the SPA approach. After this process, researchers administered to teachers a structured questionnaire with 10 questions on a five-point Likert scale (5 indicating the most positive attitude) about the design process with SPA.

Results indicate that the design was facilitated by the SPA: In particular, it was appreciated for the possibility to quickly define interactions in the exercise (average = 4.30, st. dev. = 0,48; the point 5 in the scale corresponds to the most positive evaluation), to define the functions, especially the educational one, in the game in terms of agents (average = 4.10, st. dev. = 0,74) and to share in an easy and manageable way the idea with other professionals involved in the process (average = 4.40, st. dev. = 0.52). More details are reported in [46].

4.2. Enact: An EG to teach negotiation

Another example of SPA used to develop EGs is represented by Enact, implemented on a platform, based on recent psychological modeling through the application of current ICT research such as e-learning, mobility, internet, artificial intelligence [50,51].

The platform facilitates "learning by doing" experiences as the training scenarios that can be developed through EG can simulate real-life situations, and due to their verisimilitude, can enable the transfer of what has been learned to similar real-life contexts [52,53], developing the specific negotiation competence.

It is a single-player game designed to train users on effective communication and negotiation skills. A training scenario is populated by two 3D avatars, one controlled by the user and the other by the computer (the BOT), both able to express a range of communication aspects and elements by using verbal cues (e.g., vocal tone, shape of the speech bubble, and structure of the sentence), and non-verbal indicators (e.g., body posture, facial expression, eye contact, and gestures). These patterns of behavioral indicators have been identified in the communication model of assertiveness, passivity, and aggression [54].

On-stage agents within Enact are both the learner and the artificial agent with which the user interacts with during the game (see Section 4.2.1). OSAs perform their roles and interact with each other according to the theoretical principles of the five styles of handling interpersonal conflict proposed by Rahim and Bonoma [55] and Rahim [56] the psychological model adopted and underpinning the Enact game.

In other words, the main principles of the two theoretical psychological models of negotiation by Rahim and communication by Dryden and Constantinou underpinning the game, represent the rules defined in the core level that determine the OSAs' psychological and physical features. Rahim model differentiated five different styles of handling conflict on two basic dimensions: Concern for self and concern for others. The first dimension explains the degree (high or low) to which a person attempts to satisfy his or her own concern, while the second explains the degree (high or low) to which a person attempts to satisfy the concern of others. The combination of the two dimensions results in five styles of handling interpersonal conflict: Integrating, obliging, compromising, avoiding, dominating.

The five styles of handling interpersonal conflicts are described, as follows:

Avoiding (low concern for self and others) has been associated with withdrawal, buck-passing, or sidestepping situations.

Obliging (low concern for self and high concern for others) is associated with attempting to play down the differences and emphasize commonalities to satisfy the concern of the other party.

Dominating (high concern for self and low concern for others) has been identified with a win-lose orientation or with forcing behavior to win one's position.

Compromising (intermediate in concern for self and others) involves give-and-take where both parties give up something to make a mutually acceptable decision.

Integrating (high concern for self and others) involves openness, exchange of information and examination of differences to reach an effective solution acceptable to both parties.

Moreover the conflicting scenarios have been designed according to a series of variables which combination resulted in 25 different conflicting scenarios animated by 24 different characters, such as type of conflict (if based on divergence or convergence), gender (if player and agent have the same or opposite gender, so that the interactions can result as male-male (or female-female) and male-female (or female-male), and ethnic variables (to allow a user-avatar interaction covering different ethnic groups).

The user is introduced to the game with a scene explaining the conflicting situation, the role assigned to the user and her goal within the given scenario (shell level). Each exchange between the user and BOT is organized in a five-state scene (one for each of Rahim's styles of handling conflicts), which includes one turn of speech for each party. Each exchange is related to a gesture and/or facial expression that shows the way the sentence will be communicated to the BOT (core level).

After the user's answer, the BOT computes it according to the embedded psychological models, that is, for example, a dominating BOT will show predominantly aggressive and authoritative behaviors. Conversely, an obliging BOT will show an overall passive and submissive attitude towards the negotiation (Figure 6).

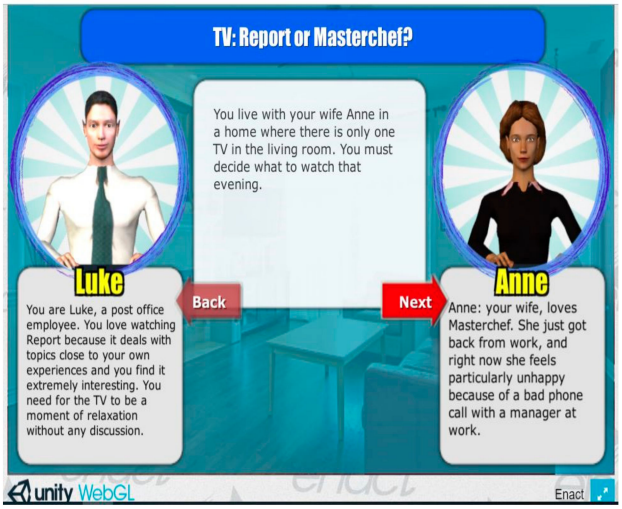

Figure 6. OSAs interacting at the shell level at the beginning of Enact. Introduction to the different OSAs.

The user starts the game by pressing the "play" button that brings the player on the game scene: The user's avatar is presented in a small window at the left upper corner of the screen, while the BOT represents the main character focused on by the camera.

The user's five possible choices are shown below the small avatar window, while the responses of the BOT are shown in the text bubble appearing over its head.

When the mouse is over one of the five user sentences (on the left-hand side of the screen), the animation (non-verbal behavior) related to that sentence is shown in the top-left window.

The innovative aspect of the Enact game is represented by its assessment feature that complements the training aspect. It implements soft skills measurements with an innovative rigorous psychometric approach, that offers the users the opportunity to assess her/his handling conflict styles, along with her negotiation and communication skills.

The assessment within Enact corresponds to the core of what we have defined as evaluation/tutoring level and represents the playful way through which the user can be assessed in a standardized manner according to the abovementioned Rahim's model.

The assessment of the player is based on the preferred negotiation styles used during a series of negotiation scenarios, given the description of the five styles provided by Rahim, and "pen and pencil" ROCI II instrument developed by the author. ROCI II is designed to measure the five independent dimensions of the styles of handling interpersonal conflict (integrating, obliging, dominating, avoiding, and compromising). The instrument contains three Forms A, B, and C to measure how a person handles her (his) conflict with her (his) supervisor, subordinates, and peers, respectively.

The Enact assessment is also fundamental for the automatic elaboration of a training strategy tailored to the specific development areas of the player, to create an effective learner-centered environment, where the user activity is focused on the areas of behavior that mostly require improvements.

Enact profiles resulted from user's game experiences are correlated with those obtained by the users through the administration of the ROCI ROCI-II (Rahim organizational conflict inventory-II). For this reason, the Enact tool has been designed to return a score directly comparable with the ROCI-II to produce scores for each of the five styles of handling conflict contemplated in Rahim's model: Collaborating, accommodating, dominating, avoiding, and compromising. In addition to the ROCI-II

form C, the other four psychological tests have been administered: (a) A short version of BIG five personality inventory, (b) assertive efficacy test, (c) self-efficacy test, and (d) coping test. The aim was also to investigate possible relationships between high scores of self-efficacy and relevant personality traits with the styles adopted by the Enact users and related positive effects on negotiation processes observed within the game sessions.

All the test takers had to play Enact and fill in the electronic form containing the five psychological tools in a row, in random order so to avoid bias related to the order of presentation. The users were asked to negotiate with an avatar in 10 different scenarios. The assessment took about one hour.

The system collects the data about the user's behavior and choices and creates a model of the player that will then be used for generating tailored information to be used in the training session. The score and profile of the player's negotiation skills are actually calculated by summing the independent concern for self and concern for other variables gathered during interactions, which are represented within every sentence that the user can choose.

In the assessment session, the artificial agent's behavior is static, not adaptive, and reflects a specific negotiation style for each of the scenarios.

The tutoring system is available only after the assessment has been completed. Thus, it will intervene during the training scenarios and at the end of the game session in order to provide useful information to the user about his or her performance related to the BOT he or she is currently interacting with and to his or her general behavior when managing conflicting situations.

The user is given a profile based on the Rahim model related to the specific situations he or she played, together with advice about how to improve the efficacy of his or her communication and the changes achieved since the assessment profiling.

The profile emerges mainly through a comparison of the behavior of the user and the style of the artificial agent she interacted with.

Furthermore, we have highlighted the importance of offering the user with immediate feedback about his/her performances. An example of immediate feedback is provided in the Enact game session by the on-stage agent (Figure 7).

Figure 7. Examples of verbal and nonverbal indicators expressed by OSAs during the conflicting interaction.

The BOT, which the user interacts with, displays immediateness of the interaction with an aggressive, assertive, obligingness facial expressions and body posture (non-verbal communication) and gives verbal feedback through the text (Figure 7).

4.2.1. Enact Representation in SPA Terms

In the Enact game, as shown in Figure 8, there are two on-stage agents: The learner who plays the game and the artificial agent with which the user interacts in the scenario. The human OSA performs

his/her role according to his/her negotiation style, whereas the artificial OSA acts according to the implementation of Rahim's principles. The OSAs interact directly with the other with questions and answers. In this case, there is a BSA, a tutor who is artificial and interacts directly with the artificial OSA and indirectly with the human OSA. It is outside the playground but affects directly the artificial OSA and indirectly the human OSA.

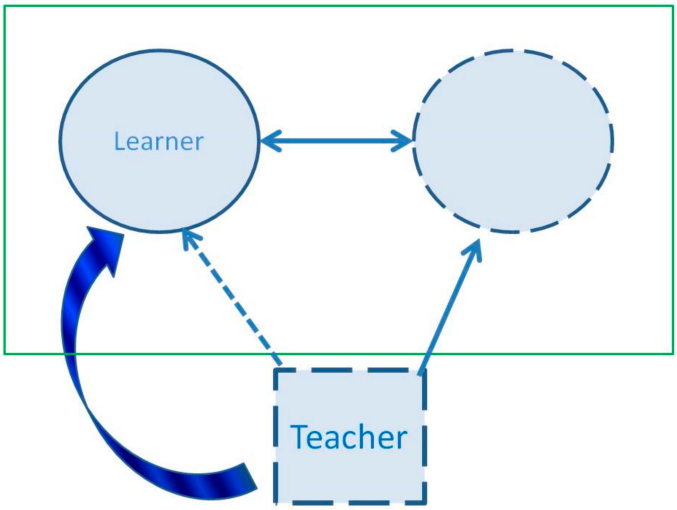

Figure 8. Enact game represented in the SPA approach (the playground is represented as an empty rectangle, circle represent OSA and square represent BSA. Full-lined boundary indicates a real agent, dashed line indicates an artificial agent. A continuous line represents a direct interaction, a dashed line represents an indirect one, arcs represent feedback).

At the end of the game, it also provides human OSA with relevant feedback.

During the Enact project, also the effectiveness of the SPA approach was investigated. Indeed, the Enact game was pre-validated in two iterations: The first one allowed to collect feedback by the means of a questionnaire on the quality of the interface and the BOT. The questionnaire was composed of eight questions on a five-point Likert scale. The complete results are reported in [2–53].

Data showed that the overall feedback was extremely positive. The second iteration involved the participants playing with different scenarios, and then a questionnaire of 13 questions on a Likert scale was administered. Additionally, in this case, the feedback provided by users was positive.

On the qualitative side, the people involved in the design and implementation of the Enact game, using the SPA was useful and allowed them to efficiently collaborate with other professionals involved in the game development.

4.3. Eutopia

4.3.1. Eutopia: EG to Train Soft Skills Based on Role-playing Mechanisms

Eutopia represents a specific application of SPA to develop EGs, as it is not just a game but rather a platform with which it is possible to create an unlimited number of role-playing games.

Eutopia platform can acknowledge many years of experience underpinning several European projects, such as Sisine, Sinapsi, Eutopia-Mt, Proactive, and S-cube project. Eutopia has been used and tested in different contexts and by different group targets (university, training institutions and agencies, MEs and SMEs, public administration, as well as non-governmental organizations and social enterprises) and for the development of various kinds of competencies (negotiation, international mediation, negotiation, communication, leadership, team building, time management, motivation, decision making, and problem solving).

Eutopia takes inspiration from the technology used in multiplayer games and embeds role-play methodology as a psycho-pedagogical approach.

The underpinning learning approach is based on open dynamics so that there is not an exclusive way to achieve the desired learning objectives.

The technological dimension allows a virtual extension of traditional face-to-face role-playing activity that is transposed it into a digital setting. This enhances the potential of the training experience in which learners are involved. Eutopia recreates a graphical word populated by virtual actors (avatar) controlled by real users.

While role-playing methodology that derives from psychodrama and sociodrama [33] has learning purposes, role-playing videogames are created for recreational purposes and take inspiration from pen-and-paper role-playing games. Indeed, role-play [30] has extensively been recognized as a powerful technique for enhancing the traditional training practice, boosting participants' learning experience, facilitating knowledge, and promoting skills, competencies, and group, as well as personal development, in face to face activities [57–60].

Since its origins, role-play technique has been variously adapted and applied to different settings and contexts, for different purposes and to many disciplines (e.g., psychology, organizational change, sociology, and pedagogy) for intensifying and accelerating learning and for developing new ways of understanding of concepts and knowledge.

Role-plays can be adopted to deal with personal (psychodrama) or collective (sociodrama) issues and used to exercise a variety of specific skills (learning simulations).

Moreover, role-play games can be considered as learning strategies that can be enhanced through technology by extending learning through added dimensions that may be impossible to conduct in face-to-face situations [61]. Among them, the so-called massive multiplayer online role-playing games (MMORPGs) and multi-user virtual environments (MUVEs) as, for example, Second Life (http://secondlife.com/education/) and Active Worlds (http://www.activeworlds.com/edu/).

MMORPGs derive from role-playing video games, which in turn take their origins from pen-and-paper role-playing games (e.g., Dungeons and Dragons) and use much of the same terminology, settings, and game mechanics.

Regarding the technological dimension, Eutopia, in addition to the functions normally provided in MMORPGs and MUVEs, offers specific features designed to facilitate its use in distance learning. In particular, it has been used to develop a variety of role-playing games for the development of different soft skills.

In summary, the platform is based on a client/server architecture, which comprises three different software pieces for users:

- Editor—for trainers, allowing the design of personalized storyboards and role-play learning scenarios
- Client—for both trainees and trainers, allowing them to interact with the 3D environments and with each other through text chat messages and non-verbal modalities
- Viewer—for visualizing recorded group interactions and sessions along with text-based exchanges.

Trainers through and within Eutopia assume potentially different roles. They can act as a playwright by writing storyboards, as a screenwriter by personalizing training scenarios, as a casting director by assigning roles to be played out, as a movie director by monitoring and guiding participants' actions and behaviors, a as director of photography by selecting relevant dynamics to be recorded, a as film critic by giving actors personalized feedback (debriefing phase).

Trainers by creating storyboards can define properties of training scenarios along with psychological and physical features of the different roles to be played by participants (Figure 9). They also act as a guide for using the learning platform features at their best to explore the learning potential of available tools.

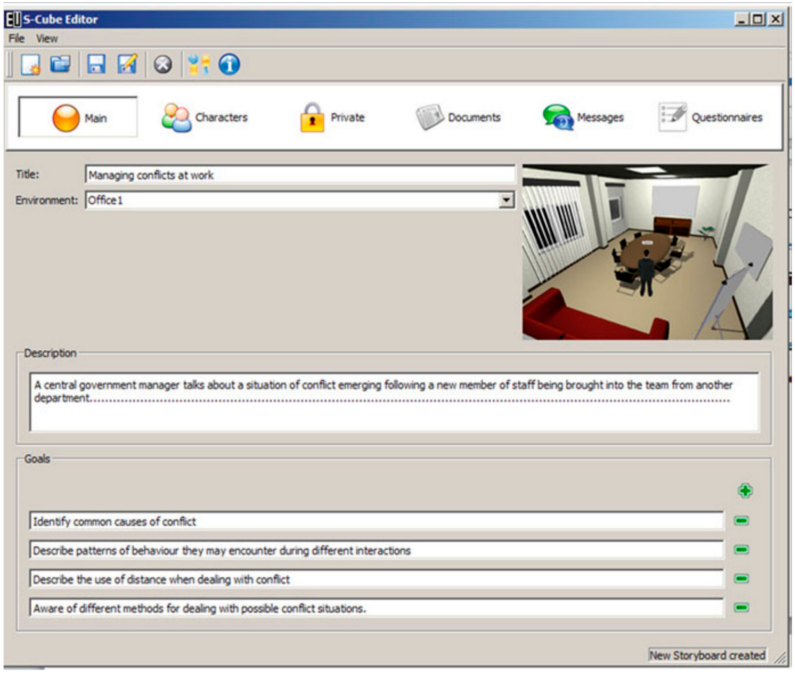

Figure 9. Script definition.

The use of feedback and debriefing systems allows the exploitation of all the potential of trainers' guide, facilitation, and support.

The Eutopia virtual environment provides an avatar-based system of communication, mediated by the artificial agents representing both human being trainer and the learners, respectively BSA and OSA.

By using the Eutopia Editor, trainers can write the storyboard for online multiplayer games. Its design requires an accurate definition of learning goals, narrative, and roles to be enacted and of the physical and psychological features of avatars (Figure 10).

Learners act out their roles interacting in a virtual, navigable environment provided by the system, through controlling virtual alter egos, the avatars.

These represent what we have defines as OSAs, as they directly act and interact in the virtual environment by influencing the dynamics of the game and impacting on its process.

Learners can communicate via short text messages, which appear in bubble cartoons over their avatars' heads.

They can also interact by using various forms of para- and non-verbal communication (expressed by emoticons and facial expressions that can be assumed by avatars).

For example, players can decide the loudness (shown by the font size of the text in the bubble) and emotional tone (shown by the shape and color of the bubble) of a message.

Players can control the gestures and body movements of avatars, for example, by making the avatar wave goodbye, point at someone, or hug someone.

They can "whisper" messages to each other, that is, send messages are that are visible only to players directly involved in the conversation and to the trainer.

Finally, they can communicate with the trainer and raise any questions to receive guidance or clarification. Trainers after scripting and starting the role-playing session can intervene during interaction among learners in two possible ways.

The first is to act as an invisible stage director that is to behave as a back-stage agent by using a variety of features to observe interactions among players. The second is by directly intervening in the game. For example, she can take the role of a character in the scenario and play the game like

other players. However, they can also activate events to change the dynamics of actual interactions. These represent cases in which the role of BSAs coincides with that of OSAs.

When the game is concluded, they can provide players with personalized feedback assessing whether the group and individual goals have been achieved and to what extent, encourage group discussion and examine the most significant aspects and dynamics emerged, as well as the main strategies adopted by players.

Indeed, an embedded tutoring tool enables to record training sessions, and replay role-play session interactions for tutors to provide feedback to significant interactions between participants to encourage the communication process, mutual sharing, self-reflection, and self-discovery and help in identifying potential areas of personal development. Feedback can be provided immediately after role play or in a later feedback session

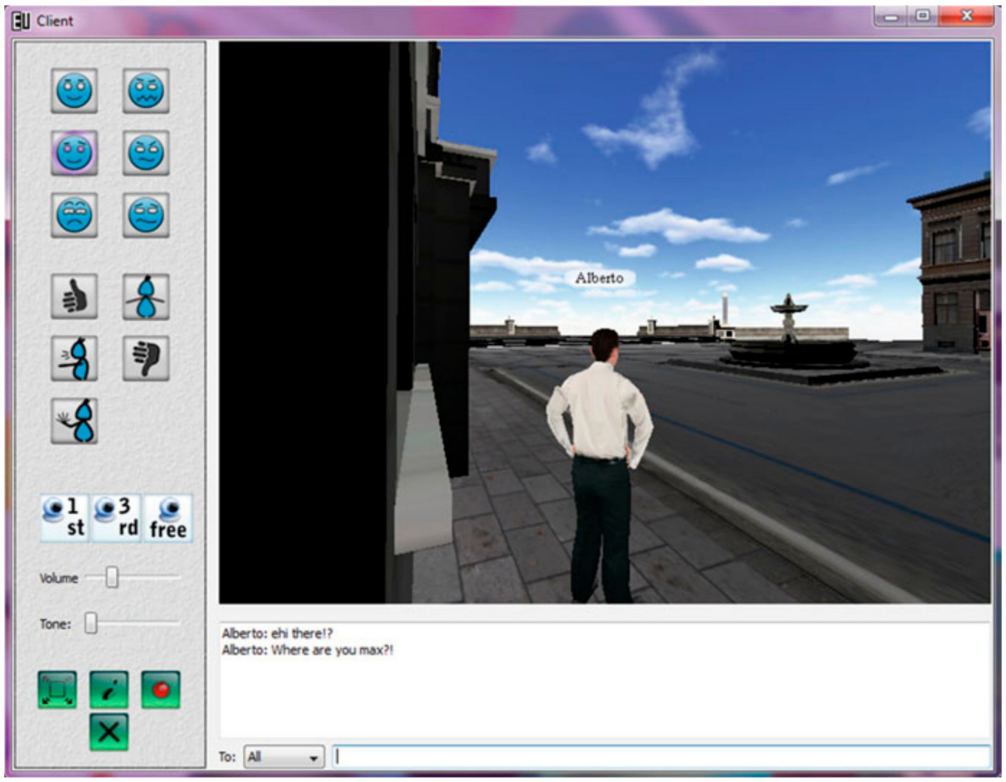

Figure 10. Avatar control as a way to explore an online session.

4.3.2. Eutopia Representation in SPA Terms

In the Eutopia platform, as shown in Figure 11, there are many on-stage agents that interact virtually: They are human OSA. They perform their role following the defined script and following the trainer (BSA indications). In this case, all the agents interact both directly and indirectly.

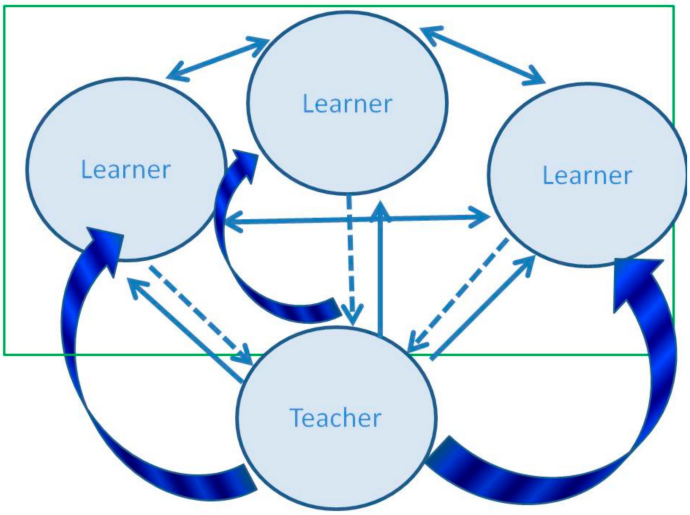

Figure 11. Eutopia platform represented with SPA notation (the playground is represented as an empty rectangle, circles represent OSA and squares represent BSA. Full-lined boundary indicates a real agent, dashed line represents an artificial agent. A continuous line represents a direct interaction, a dashed line represents an indirect one, arcs represent feedback).

At the end of the interaction, the BSA offers to OSA feedback and reflections on the different interactions.

Eutopia has been used and tested in different contexts and by different group targets (university, training institutions and agencies, MEs and SMEs, public administration, as well as non-governmental organizations) and for the development of various kinds of soft skills within different research projects, such as Sisine, Sinapsi, Eutopia-Mt, Proactive, S-cube (more information at www.nac.unina.it). In particular, to study the attitude towards the SPA approach, the perception of 18 experienced professionals (educators, trainers, psychologists, and educationalists adopting role-playing activities in traditional settings) on the use of role-playing games in educational and training contexts, with a specific focus on the Eutopia platform was investigated.

They completed a questionnaire on their perception of how online role play can encourage and foster meaningful learning experiences among participants. More details are reported in [2].

With regard to the methodological effectiveness of online role-play via SPA agents, we can affirm that it is generally considered as effective. A large consensus amongst the professionals was found on the role of the trainer, both virtual and real as conceived in the SPA approach.

5. Discussion and Conclusions

In this paper, we have introduced the SPA approach to developing EG. This approach presents various advantages. It opens the way to adopting automatic control systems and software based on artificial intelligence systems to model OSA and BSA behavior, as shown in the application section. By these means, it is possible to delegate both on-stage and backstage functionalities to intelligent and autonomous artificial agents, making it possible to run EG with mixed teams composed of human and artificial agents. It is, in fact, easier to build artificial agents to support the educational enterprise rather than model separately educational functions and features. Moreover, SPA allows to reproduce, model, and feed the dialogic interaction offering a formal representation of the people involved in the learning/teaching dynamic.

SPA offers an effective methodology to build up games moving on the shell and core level as well as the educational one. This means, that the same core level can be combined with different shell levels so as to be adapted to different contexts and allow to compare various populations (i.e., children and adolescents) and various areas of application (i.e., education, training or assessment).

Last but not least, it proposes a comprehensive framework that can be easily understood by specialists with different expertise. In EG design and development, education specialists, teachers, trainers are involved as well as computer scientists, software engineers, etc. These specialists can share their knowledge through this framework in a very effective way.

However, a possible shortcoming of this approach comes from the consideration that there are games, as well as educational software, for which there might be no need to define the rules of interaction in terms of psychological agents.

It is possible to summarize that the strongest point of the approach used within SPA to develop EGs is related mainly to the educational aspect allowing users to foster transversal skills through innovative approaches to teaching, learning, and assessment. The EGs proposed are based on two different educational approaches reflected in the implementation of the SPAs. Form a technological perspective is possible to distinguish EGs more cantered on allowing a virtual extension of traditional face-to-face psychodramatic mechanism and experiences (e.g., Eutopia), and those that instead reproduce "artificial" worlds based on computer-simulated, formal models about specific phenomena or theories to investigate (Enact and BM). From an educational and user-centered perspective, it is possible to identify two main categories. One category can represent the extent to which, while playing the game, the user has to express herself through behavioral acts that involve her body or other forms of interactions, such as an actor would do on stage. Those elements correspond to the traditional behavioral domain that plays a prominent role in psychodrama as we have highlighted for Eutopia and Enact, though with a different grade of involvement and immersion. Situations like BM in which the user is asked to perform abstract and strategic forms of decision-making are different from and yet complementary to these kinds of games. Here, the user's logical and reasoning aspects are prominently highlighted. The educational approach underpinning Eutopia is based on open dynamics. Therefore, there is no unique way to achieve the desired learning objectives. The technological dimension enhances the potential of the training experience because it makes a virtual extension of traditional face-to-face role-playing activity possible, transposing it into a digital setting. What emerges is that the figure of the trainer simultaneously represents a source of strength and weakness. On the one hand, it is undeniable that a real BSA trainer can enrich game performance by providing facilitation and adaptable performance feedback. On the other hand, the study presented shows that the need for fully skilled trainers may increase the cost and time of training.

Moreover, the dynamics resulting from the gameplay depend on learners, rather than on any form of artificial intelligence. This means that participants are offered a far richer, more open, learning experience than would have been possible if they had to interact with artificial OSAs and BSAs. However, the disadvantages of this method are represented by high cost and time consumption in organizing and managing the complexity of the virtual learning scenarios, as well as interactions among participants. Indeed, the critical element that emerged is related to the trainers/teachers' role in managing the online role-plays, and their need to be skilled in mastering different competencies at once.

Those limits have induced the authors to consider the advantages of introducing game technologies less dependent on the supervision of real BSAs, such as Enact.

In this case, although the system allows users to dramatize and enact role-plays, the complexity of the dynamics between OSAs is limited by the rule of the game to a certain number of actions, and the responsibility of the BSA is certainly reduced. Therefore, the assessment and observation of learning experience is less subjected to the influence and interpretation of many other potential interfering variables.

While Eutopia and Enact allow users to experience direct involvement with the learning objectives through a personal dramatization by acting out roles, BM points instead more on the logical and reasoning aspects involved in the gameplay. In this case, a set of formal rules and interactions embedded in the game needs to be followed for learners to achieve the relevant learning objectives.

This brings us to another aspect of our experience that is the appropriateness of the use of EGs. The decision on which game to use depend largely on the skills to be developed, as well as the resources and the time allocated for achieving the learning objectives. For instance, if a learning objective regards training from the cognitive domain, and the priority is making players learn and assess specific skills or behaviors (e.g., problem-solving requiring a quick response), the ideal methodology is more likely to be based on more structured games, as BM. Indeed, the educational resources and learning path that learners have to follow is easily accessible from learners at any time from anywhere. However, the set of formal rules and interactions to be followed to achieve the relevant learning objectives are embedded in the software and do not require a constant presence of experienced real external guidance as BSA. BM and Enact can drive the player to a stable training outcome more rapidly than in open dynamic situations, like Eutopia. Therefore, the advantage of this method lies in the fact that it is very low cost, as after an initial phase to familiarize users with the system, and it can be used without the guidance of a trainer, as the system is self-regulated and enables learners to achieve objectives rapidly. Conversely, if the competencies that are meant to develop are more related to aspects of emotional awareness, self-assessment, and self-confidence, we think that a situation methodologically such Eutopia, closer to the traditional role-play technique, might be the most appropriated. For all the EGs presented, we can acknowledge that the strength of providing the software with authoring systems has been a valued an extremely beneficial aspect as it allows trainers to rapidly develop their scenarios, personalizing their work for specific target populations with specific learning needs. In this light, there are many possible and potential areas of application.

The strongest points of the approach used within EGs are related mainly to the central role assigned to the player in the training or assessment processes developed within the software. The users can enhance their attitudes towards different skills, improve their capabilities, understanding, and practice with the support of the tutoring system provided, and following customized training sessions.

The experiences of the EU projects confirmed the value of using information technology as a tool placed in the hands of a trainer for the development of controlled ad hoc learning exercises, rather than being considered a simple replacement for trainers and learners.

The SPA approach presents a novel element of flexibility, both in delivery and practice of different skills and competencies training, where users can broaden the practice of different skills outside the traditional classroom approach by leveraging Internet technologies. However, what is even more interesting, professionals can be in total control of the model implemented, the training and the assessment processes. Furthermore, every skill or competence that requires the exploitations of people's interactions could benefit from such realization of an SPA to develop EGs.

The reason is that, whatever skills need to be transferred in the digital role-play, the educational technological level represented within the software enables modification both of the narratives and the educational models underlining the training requirements.

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References

1. Bacigalupo, M.; Kampylis, P.; Punie, Y.; Van den Brande, G. *EntreComp: The Entrepreneurship Competence Framework*; Publication Office of the European Union: Luxembourg, 2016; p. 14.
2. Dell'Aquila, E.; Marocco, D.; Ponticorvo, M.; di Ferdinando, A.; Schembri, M.; Miglino, O. *Educational Games for Soft-Skills Training in Digital Environments: New Perspectives*; Springer: Berlin, Germany, 2016.
3. Johnson, R.T.; Johnson, D.W. Active learning: Cooperation in the classroom. *Ann. Rep. Educ. Psychol. Jpn.* **2008**, *47*, 29–30. [CrossRef]
4. Dewey, J. Experience and education. *Educ. Forum* **1986**, *50*, 241–252. [CrossRef]
5. Michael, D.R.; Chen, S.L. *Serious Games: Games That Educate, Train, and Inform*; Muska & Lipman/Premier-Trade: New York, NY, USA, 2005.
6. De Freitas, S. Are games effective learning tools? A review of educational games. *J. Educ. Technol. Soc.* **2018**, *21*, 74–84.
7. Xun, G.; Ifenthaler, D. Designing engaging educational games and assessing engagement in game-based learning. In *Gamification in Education: Breakthroughs in Research and Practice*; IGI Global: Hershey, PA, USA, 2018; pp. 1–19.
8. Shute, V.; Seyedahmad, R.; Xi, L. *Supporting Learning in Educational Games: Promises and Challenges. Learning in a Digital World*; Springer: Berlin, Germany, 2019; pp. 59–81.
9. Prensky, M. Digital game-based learning. *Comput. Entertain.* **2003**, *1*, 21. [CrossRef]
10. Kapp, K.M. *The gamification of learning and instruction*; Wiley: Hoboken, NJ, USA, 2012.
11. Abt, C.C. *Serious Games*; University Press of America: Lanham, MD, USA, 1987.
12. Connolly, T.M.; Boyle, E.A.; MacArthur, E.; Hainey, T.; Boyle, J.M. A systematic literature review of empirical evidence on computer games and serious games. *Comput. Educ.* **2012**, *59*, 661–686. [CrossRef]
13. Boyle, E.A.; Hainey, T.; Connolly, T.M.; Gray, G.; Earp, J.; Ott, M.; Lim, T.; Ninaus, M.; Ribeiro, C.; Pereira, J. An update to the systematic literature review of empirical evidence of the impacts and outcomes of computer games and serious games. *Comput. Educ.* **2016**, *94*, 178–192. [CrossRef]
14. Arnab, S.; Lim, T.; Carvalho, M.B.; Bellotti, F.; De Freitas, S.; Louchart, S.; Suttie, N.; Berta, R.; De Gloria, A. Mapping learning and game mechanics for serious games analysis. *Br. J. Educ. Technol.* **2015**, *46*, 391–411. [CrossRef]
15. Carvalho, M.B.; Bellotti, F.; Berta, R.; De Gloria, A.; Sedano, C.I.; Hauge, J.B.; Hu, J.; Rauterberg, M. An activity theory-based model for serious games analysis and conceptual design. *Comput. Educ.* **2015**, *87*, 166–181. [CrossRef]
16. Anderson, L.W.; Krathwohl, D.R. *A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy*; Longman Publishing: Harlow, UK, 2001.
17. Bloom, B.S. *Taxonomy of Educational Objectives. Vol. 1: Cognitive Domain*; Edwards Bros.: Ann Arbor, MI, USA, 1956; pp. 20–24.
18. Danto, A.C.; Goehr, L.; Ankersmit, F. *Narration and Knowledge*; Columbia University Press: New York, NY, USA, 2007.
19. Neitzel, B. *Narrativity in Computer Games. Handbook of Computer Game Studies*; MIT Press Cambridge: Cambridge, MA, USA, 2005; pp. 227–245.
20. Gregory, J. *Game Engine Architecture*; CRC Press: Boca Raton, FL, USA, 2017.
21. Freire, M.; Serrano-Laguna, Á.; Iglesias, B.M.; Martínez-Ortiz, I.; Moreno-Ger, P.; Fernández-Manjón, B. *Game Learning Analytics: Learning Analytics for Serious Games. Learning, Design, and Technology: An International Compendium of Theory, Research, Practice, and Policy*; Springer: Berlin, Germany, 2016; pp. 1–29.
22. Serrano-Laguna, Á.; Torrente, J.; Moreno-Ger, P.; Fernández-Manjón, B. Application of learning analytics in educational videogames. *Entertain. Comput.* **2014**, *5*, 313–322. [CrossRef]
23. Seaton, J.; Graf, S.; Chang, M.; Farhmand, A. Incorporating learning analytics in an educational game to provide players with information about how to improve their performance. In Proceedings of the 2018 IEEE 18th International Conference on Advanced Learning Technologies (ICALT), Mumbai, India, 9–13 July 2018.
24. Siemens, G.; Long, P. Penetrating the fog: Analytics in learning and education. *Educ. Rev.* **2011**, *46*, 30.
25. Hodkinson, P.; Biesta, G.; James, D. Understanding learning cultures. *Educ. Rev.* **2007**, *59*, 415–427. [CrossRef]
26. Griffin, J. Learning to learn in informal science settings. *Res. Sci. Educ.* **1994**, *24*, 121–128. [CrossRef]

27. Halverson, E.R.; Sheridan, K. The maker movement in education. *Harv. Educ. Rev.* **2014**, *84*, 495–504. [CrossRef]
28. Adomssent, M.; Godemann, J.; Michelsen, G.; Barth, M.; Rieckmann, M.; Stoltenberg, U. Developing key competencies for sustainable development in higher education. *Int. J. Sustain. High. Educ.* **2007**, *8*, 416–430.
29. Ponticorvo, M.; Di Fuccio, R.; Di Ferdinando, A.; Miglino, O. An agent-based modelling approach to build up educational digital games for kindergarten and primary schools. *Expert Syst.* **2017**, *34*, e12196. [CrossRef]
30. Ponticorvo, M.; Di Fuccio, R.; Ferrara, F.; Rega, A.; Miglino, O. Multisensory educational materials: Five senses to learn. In Proceedings of the International Conference in Methodologies and intelligent Systems for Techhnology Enhanced Learning, Toledo, Spain, 20–22 Jun 2018; pp. 45–52.
31. Ponticorvo, M.; Rega, A.; Di Ferdinando, A.; Marocco, D.; Miglino, O. Approaches to embed bio-inspired computational algorithms in educational and serious games. In Proceedings of the 1st International Workshop on Cognition and Artificial Intelligence for Human-Centred Design 2017, Melbourne, Australia, 19 August 20107; pp. 8–14.
32. Montessori, M. *The Montessori Method*; Transaction Publishers: Piscataway, NJ, USA, 2013.
33. Moreno, J.L. *Who Shall Survive?: A New Approach to the Problem of Human Interrelations*; Nervous and Mental Disease Publishing Co.: Washington, DC, USA, 1934; pp. 2–20.
34. Moizer, J.; Lean, J.; Dell'Aquila, E.; Walsh, P.; Keary, A. An approach to evaluating the user experience of Serious Games. *Comput. Educ.* **2019**, *136*, 141–151. [CrossRef]
35. Ponticorvo, M.; Miglino, O. Hyper activity books for children: How technology can open books to multisensory learning, narration and assessment. *QWERTY Open Interdiscip. J. Technol. Cult. Educ.* **2018**, *13*, 46–61.
36. Dell'Aquila, E.; Vallone, F.; Zurlo, M.C.; Marocco, D. Creating digital environments for interethnic conflict management. In *International Conference in Methodologies and Intelligent Systems for Techhnology Enhanced Learning*; Springer: Berlin, Germany, 2019.
37. Jeuring, J.; Grosfeld, F.; Heeren, B.; Hulsbergen, M.; IJntema, R.; Jonker, V.; Mastenbroek, N.; van der Smagt, M.; Wijmans, F.; Wolters, M.; et al. Communicate!—A serious game for communication skills. In *Design for Teaching and Learning in a Networked World*; Springer: Berlin, Germany, 2015; pp. 513–517.
38. Johnson, W.L. Using virtual role-play to prepare for cross-cultural communication. In Proceedings of the 5th International Conference on Applied Human Factors and Ergonomics AHFE 2014, Krakow, Poland, 19–23 July 2014.
39. Core, M.; Traum, D.; Lane, H.C.; Swartout, W.; Gratch, J.; Van Lent, M.; Marsella, S. Teaching negotiation skills through practice and refl ection with virtual humans. *Simulation* **2006**, *82*, 685–701. [CrossRef]
40. Ebner, N.; Kovach, K.K. Simulation 2.0: The resurrection. In *Re-Thinking Negotiation Teaching Series, Vol. 2: Venturing Beyond the Classroom*; DRI Press: Saint Paul, MN, USA, 2011; p. 245.
41. Haferkamp, N.; Kraemer, N.; Linehan, C.; Schembri, M. Training disaster communication by means of serious games in virtual environments. *Entertain. Comput.* **2011**, *2*, 81–88. [CrossRef]
42. Kolb, D.A. *Experiental Learning*; Englewood Cliffs/Prentice Hall: Upper Saddle River, NJ, USA, 1984.
43. Coppard, L.C.; Goodman, F.L. Urban gaming/simulation: A handbook for educators and trainers. In *School of Education*; University of Michigan: Ann Arbor, MI, USA, 1979.
44. Thatcher, D.C. Promoting learning through games and simulations. *Simul. Gaming* **1990**, *21*, 262–273. [CrossRef]
45. Petranek, C.F.; Corey, S.; Black, R. Three levels of learning in simulations: Participating, debriefing, and journal writing. *Simul. Gaming* **1992**, *23*, 174–185. [CrossRef]
46. Di Ferdinando, A.; di Fuccio, R.; Ponticorvo, M.; Miglino, O. Block magic: A prototype bridging digital and physical educational materials to support children learning processes. In *Smart Education and Smart e-Learning*; Springer: Berlin, Germany, 2015; pp. 171–180.
47. Di Fuccio, R.; Ponticorvo, M.; Di Ferdinando, A.; Miglino, O. Towards hyper activity books for children. Connecting activity books and Montessori-like educational materials. In *Design for Teaching and Learning in a Networked World*; Springer: Berlin, Germany, 2015; pp. 401–406.
48. Nkambou, R.; Mizoguchi, R.; Bourdeau, J. *Advances in Intelligent Tutoring Systems*; Springer Science & Business Media: Berlin, Germany, 2010.
49. Freedman, R.; Ali, S.S.; McRoy, S. What is an intelligent tutoring system? *Intelligence* **2000**, *11*, 15–16. [CrossRef]

50. Pacella, D.; Dell'Aquila, E.; Marocco, D.; Furnell, S. Toward an automatic classification of negotiation styles using natural language processing. In Proceedings of the International Conference on Intelligent Virtual Agents, Stockholm, Sweden, 27–30 August 2017; pp. 339–342.
51. Ponticorvo, M.; Di Ferdinando, A.; Marocco, D.; Miglino, O. Bio-inspired computational algorithms in educational and serious games: Some examples. In Proceedings of the European Conference on Technology Enhanced Learning, Lyon, France, 13–16 September 2016; pp. 636–639.
52. Ferrara, F.; Ponticorvo, M.; Di Ferdinando, A.; Miglino, O. Tangible interfaces for cognitive assessment and training in children: LogicART. In *Smart Education and e-Learning*; Springer: Berlin, Germany, 2015; pp. 329–338.
53. Marocco, D.; Pacella, D.; Dell'Aquila, E.; Di Ferdinando, A. Grounding serious game design on scientific findings: The case of ENACT on soft skills training and assessment. In *Design for Teaching and Learning in a Networked World*; Conole, G., Klobučar, T., Rensing, C., Konert, J., Lavoué, É., Eds.; Springer: Berlin, Germany, 2015; pp. 441–446.
54. Dryden, W.; Constantinou, D. *Assertiveness Step by Step*; Sheldon Press: London, UK, 2004.
55. Rahim, M.A. A measure of styles of handling interpersonal conflict. *Acad. Manag. J.* **1983**, *26*, 368–376.
56. Rahim, M.A.; Bonoma, T.V. Managing organizational conflict: A model for diagnosis and intervention. *Psychol. Rep.* **1979**, *44*, 1323–1344. [CrossRef]
57. McGill, I.; Beaty, L. *Action learning: A Guide for Professional, Management & Educational Development*; Psychology Press: London, UK, 2001.
58. Shaw, M.E.; Corsini, R.J.; Blake, R.R.; Mouton, J.S. *Role Playing: A Practical Manual for Group Moderators*; University Associates: San Diego, CA, USA, 1980.
59. Turner, D.A. *Roleplays: A Sourcebook of Activities for Trainers*; Kogan Page: London, UK, 1992.
60. Van Ments, M. *The Effective Use of Role-Play: Practical Techniques for Improving Learning*; Kogan Page: London, UK, 1999.
61. Garrison, D.R. *E-learning in the 21st Century: A Framework for Research and Practice*; Routledge: Abingdon, UK, 2011.