"*Learn to Lead*" a Web Based Game to Teach Leadership Theories in Vocational Courses

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***Abstract*—Learn to Lead (L2L) is a "virtual laboratory" (2D web based game) where an user (the leader) learns psychological leadership theories by governing a team of artificial agents (the followers). The game is based on the "Full-Range Leadership Theory", a scientific well known theory about leadership dynamics in small groups. The game mechanics is developed by using Artificial Intelligence techniques (agents based modeling and artificial neural networks). The L2L first version was used in several European vocational courses about Leadership and Human Resources Management.**

***Index Terms* — Serious Games, Vocational Courses, Leadership, Agents Based Modeling, Artificial Neural Networks**

I. Introduction

The effectiveness and efficiency of a team is an emergent property of the dynamics that develop within the team in a continuous cycle of "forming - storming- norming and performing". Effective team leaders manage these dynamics in ways that help the team to meet its objectives. As well as technical skills related to their area of business, leaders thus require competencies in "people management", resource management and organization. Effective training in these areas is scarce and is usually available only in high quality MBA programs or in major corporations. In this setting, Learn to Lead (L2L), a project funded by European Commission, is an attempt to implement, and test a novel, online approach to training in team leadership, suitable for use in SMEs, small government offices, NGOs etc. The training provided by L2L is based on an online serious game. In the game, each learner manages a simulated team of employees (e.g. a team of workers in a bank agency, a post-office or a local government office) which competes against other teams to maximize its objectives (e.g. profit, volume of services delivered, customer satisfaction). The game is designed as a virtual laboratory where an user can modify the (artificial) agents behaviors manipulating psychological and environmental variables. From a theoretical point of view L2L is based on a well-known Leadership scientific theory named "Full-Range Leadership Model" (FRL, [1]). From a programming point of view, L2L embeds our previous on-line platform for serious gaming [2],[3] and uses artificial intelligence techniques to control the artificial agents behaviors [4] [5].

The paper briefly presents the underlying psychological theory about leadership (section II), the game scenario (section III), and the modeling techniques used to develop L2L game (section IV). The conclusions will report some initial results obtained by first pilot studies.

II. Some hints on "Full Range Leadership Model"

The Full Range Leadership Model encompasses both transactional and charismatic/transformational dimensions in addition to laissez-faire (non leadership) behavior. Fundamental to the FRL model is that every leader displays each style to some amount. Laissez-faire (non leadership) behavior is more passive and "reactive": it does not respond to situations and problems systematically. Passive leaders avoid specifying agreements, clarifying expectations, and providing goals and standards to be achieved by followers. The leader takes no responsibility, makes no decisions, and gives no feedback or support to followers. Is represents the avoidance or absence of leadership and is, by definition, the most inactive, as well as the most ineffective leadership style. This style has a negative effect on desired outcomes — opposite to what is intended by the leader-manager.

As many authors pointed out, transformational leadership does not replace transactional leadership, it augments transactional leadership in achieving the goals of the leader, associate, group, and organization. Although transformational leaders can be transactional when appropriate, transactional leadership is often a prescription for lower levels of performance or non-significant change, according to a number of large scale surveys of industrial, military, governmental, and religious leaders. Within the FRL three important outcomes can be achieved as an effect of

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leadership: extra effort, group effectiveness and satisfaction. FRL model can be easily integrated with other models or theories pointing to personal characteristics of the leader (such as McClelland motives [6]) as well as to situational factors and their interaction with leaders and followers characteristics.

III. L2L GAME SCENARIO

In the L2L game, the player is hired to work in a large corporation. The CEO has picked the player out as a future leader and has organized for him to follow a programme of on-the-job training, where he will learn all of the knowledge necessary to become a great leader. The game is played across a number of levels. Across those levels the player will lead teams in a number of different departments of the corporation, from the catering department to the research and development department. During the game, the player has two goals:A) to ensure that the company runs efficiently and productively; an B) to ensure that his followers develop appropriately, as outlined by the Full-Range Leadership (FRL) model (see above).

The day-to-day running of the department involves dealing with jobs that have specified deadlines and workloads, and assigning staff to work on those jobs. Through astute management, it is possible to finish a respectable number of jobs within their deadlines. However, leadership is more than management, and if the player employes a strategy for developing his followers he will get a real advantage in the game. If the player considers his followers workload, ability, stress levels and personality while doing the typical management tasks of assigning players to jobs, he will perform better than a leader that simply manages. In addition, the player has the option of running workshops, organizing team-building events, performing one-to-one coaching, getting involved in the day-to-day work, sending memos, among other things in order to help develop his follower's ability and their intrinsic motivation. More developed followers can complete more jobs, thus, spending time on developing staff helps the player to reach both goals of efficiency and development.

Figure 1. An example of game scene

L2L is playable on-line and the player interacts with a 2D interface. The figure 1 shows an example of what the game interface looks like. At the center is the game scene representing the office where the (artificial) followers work. It varies across all game levels looking nicer and nicer as the player advances in his career. The player acts on the work environment and team dynamics by setting the working plan of each follower (figure 2). Each follower has an own "psychological state" that the player has to monitor carefully, if he wants to successfully advance in the game. The followers (artificial) psychology is composed by three variables taken from McClelland theory: a) Achievement: followers have a disposition for excellence in performance, a continuing concern for doing better all the time. This motive concerns achieving excellence through one's individual efforts; b) Affiliation: followers have a concern for establishing, maintaining, and restoring close personal relationships with others; b) Power: followers have a concern for acquiring status and having an impact on others. High power motivation induces highly competitive behavior.

It is important to stress that followers with different personalities should be managed in a different way to obtain optimal results.

The player receives feedback from his team by statistics, graphs (see figures 2 and 3) and the follower info and animations (figure 4).

Figure 2. The player has to assign jobs to the member of his team based on their ability

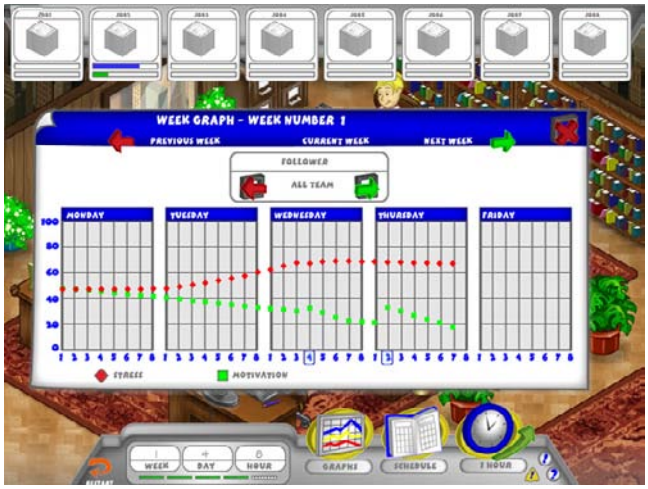

Figure 3. Graphs representing the varying levels of stress and motivation of the team members.

Figure 4. Monitoring the followers' "psychological" state

IV. GAME MECHANICS AND MODELING TECHNIQUES

In educational game design, the game mechanics should replicate, as closely as possible, the processes the player should carry out in the 'real world.' Designing educational game mechanics is essentially creating a context in which

examples of the theory that you are intending to teach can be performed and practiced. One of the requirements that we identified earlier was that the player is in a leadership role in an organization, and has a number of followers. This is a useful starting point upon which mechanics can be built. Another requirement for the game is that the leader must be able to apply appropriate leadership processes over the course of game play, and that these processes should have an effect on followers development and work output.

We have identified, from review of the FRL model, that during play, the goals that players should be aiming for are both the development of followers and the efficiency of the organization. So, it seems essential that the followers should work on jobs, and that these jobs should last over a period of time in which development can be observed. The third outcome of leadership – satisfaction of followers – has not been implemented, as this requires a value judgment, something we do not feel it would be appropriate for a game to make.

The solution to these requirements include the following:
In each level, there are jobs that need to be completed. Each job has a deadline and a specific workload. The basic challenge is to ensure that followers finish all jobs in time.
The leader is in control of assigning followers to work on jobs. Each follower has an ability level and a motivation level. These two variables combined define the amount of work the follower can do in any given day.
In addition to assigning followers to work on jobs, the player can carry out actions that have effects on followers' motivation and ability. For example, the follower can be sent on a training course, can be lectured about poor performance and can be inspired through evocative speeches at staff meetings.
Followers experience stress, which affects their ability to work. Stress can be caused by demanding more work of the follower than their level of ability allows, and is also naturally increased by imminent deadlines.
The score obtained for a level is not based purely on the number of jobs finished, but also on the development of staff ability and motivation.
A turn-based structure to play is implemented, so that players always have an unlimited amount of time to carefully consider their actions, and consult reference material about FRL if necessary before making a decision.
Each level has a specified length in time; for example, a week. Each hour in that week, the player will have the opportunity to view the performance and progress of their team, make any changes to job assignments and perform any leadership tasks they feel necessary. Once satisfied, the player will press a button to advance the game one hour, whereupon the game engine will calculate what happened in that hour.
In order to recreate the dynamics that occur in real teams, we simulated the way in which interactions among team members and managerial actions combine to create the outcomes (e.g. profit, production, customer satisfaction), used to "score" the player's performance. First of all, the creation of the model involved the creation of a formal framework for the definition of the personalities, motivations and skills of team members (and the team leader), based on concepts and tools already recognized in the literature. In particular, we focused on the Transformational Leadership Theory as a framework for our project, and specifically the Full-Range Leadership Model. Moreover, we adopted an agent based approach, in which every agent is modeled by a connectionist network, or controlled by a human being. In particular, the user takes the role of one of the agents, more specifically the leader, whereas the followers are controlled by artificial agents. The idea underlying this general framework, is that in some given conditions, the leader agent (i.e. the user) has to take some decision about one or more followers. These decisions are then encoded in the follower's network as some combination of inputs. Based on the inputs received from the leader, and the ones coming from the environment, the agent's internal states will change and influence his contribution to the team job. The followers' network represents the way the Full Range Leadership is implemented inside the Learn2Lead game. Indeed, a simulation-based model is just a way to express a scientific theory, and we used such a model to implement the FRL theory. Of course, as usually happens when creating a model, we had to simplify many aspects, and selecting only the principles that are, according to us, the most important ones. Finally, the interactions between the followers and the leader are monitored by an artificial evaluator that, based on the user's behavior and decisions, creates an user's profile, according to the leadership literature.
The game scenario above described requires a method for simulating the behaviour of followers. The player must feel as if their actions have reliable and realistic consequences on the behaviour and development of their followers. For a number of reasons, it seems that the most flexible way of simulating follower dynamics is through agent-based modeling techniques. Agent based simulations are extensively used in many branches of natural and social sciences to study complex phenomena that are not safely reducible to a set of mathematical equations. These phenomena typically emerge from the interaction among individual entities. Examples are organisms living in an ecosystem or human beings acting in a society.
Using computer simulations to express scientific knowledge is particularly advantageous for educational purposes. The aim of a computer simulation is to represent a scientific theory in a sort of "working version" that reproduces the underlying phenomena. In a sense, computer simulation allows players to play with the scientific knowledge. Indeed, computer allow for the contextualization of knowledge. It is important to create a context in which examples of the theory that you are intending to teach can be performed and practiced. In that respect, an agent based simulation of the

FRL theory allows us the ability to create an infinite number of specific contexts in which the knowledge can be experienced and practiced.
To build an agent based simulation of the FRL theory we started modeling followers as artificial agents. Artificial Agents are essentially input-output systems with an internal state that changes over time depending on the external input and some internal variables. Every follower has some internal variables that affect the final contribution in getting through the jobs assigned. The most relevant to the FRL theory is the motivation. The motivation level is affected by three subcomponents: intrinsic, reward and fear. The intrinsic component models the dynamics of intrinsic motivation and it's related to the transformational leadership style, while the reward and fear components model extrinsic motivation and are related to the transactional leadership style. What differs among the three is the time dynamics, and specifically their decay. For example, the intrinsic component has a slower decay than the reward and fear, but can be activated only by appropriate leader behaviours (typically pertaining transformational style).
The stress variable is linked to some external inputs like social interaction, workload and deadlines. It affects the contribution and is an important aspect to keep under control during the game. Stress also has a modulator effect on the leader motivation oriented behaviours. Personality and ability try to capture what the FRL theory says about individual consideration. Ability level is linked to follower performance. Personality is conceived as a modulator for the leader behaviour so that the same leader action may have a different impact on followers with different personality. On the contrary the leader that aims at raising the motivation of the team as high as possible needs to perform some individualized consideration.

V. L2L Current State of the Art

The first L2L beta version runs on project website (www.learn2lead.unina.it) and it has been tested in three trial sessions in France, Italy and Spain with approximately 10 "friendly users"/site. User feedbacks are used to refine the methodology and the software which will then be subjected to a large scale "summative evaluation" (approx 30 users/site). In the 2012 will be released a freeware version and a commercial version. The commercial version will belong to the "Learn to Lead" partnership that will use the game to offer tutor-supported training to their customers. The partnership is constituted by: Institute of Cognitive Sciences and Technologies, National Research Council, Italy; Entropy KN, Italy; Università degli Studi di Napoli Federico II, Italy; Universitat Jaume de Castellon, Spain; MF & Partners Consulting, France, Lincoln University, England.

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