A Ludic/Narrative Interpretation of the Willingness to Repeatedly Play Mobile Serious Games

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***Abstract* — Mobile game-based learning is a very promising sector for corporate training, but it still lacks of a robust scientific research investigating the underlying causal models to explain its working principles. The paper presents the results of an empirical study conducted on two different kits of mobile serious games, composed respectively by 30 and 20 games, both developed in the framework of an European project on mobile game-based learning for corporate training, titled "InTouch". The study analyzes the causal relationships that influence the players' willingness to play again the serious games and interprets those findings according to the distinction between ludic and narrative components of the games. The results emerging from the testing of the games on two separate samples of 54 and 118 people can be interpreted as an empirical evidence of the simultaneous, and yet independent, significant role of both the ludic and narrative component of a serious game in determining the willingness to play again. On the whole, for the considered games the ludic factor showed to have a stronger influence than the narrative one. This different weight of ludic and narrative components, however, can be interpreted as a consequence of the specific mobile serious games that were analyzed, and cannot be generalized to other game-based solutions. Furthermore, when analyzing different groups within the considered sample, males and younger people showed to be more influenced by the ludic component, while the narrative component resulted to be stronger than the ludic one for females and older people. The conclusion of the study suggests an implementation of the proposed research concept with other serious games to find if the ludic/narrative interpretative key can improve understanding the structure of the games.**

Keywords - Mobile Game-Based Learning; Corporate Training; Serious Games; Ludology; Narratology

I. INTRODUCTION

In the frame of two editions of an European project about mobile Game-Based Learning (mGBL) in the period 2010-2015 two different kits of serious games were developed and tested for a total of 50 games [1].

The analysis of the kit of serious games for mobile devices is here referred to a subject of debate about games, concerning the relationship between narrative and game design, namely between ludology and narratology [2].

Mobile game-based learning is an educational trend that is gaining more and more in popularity. Its main advantages are considered mobility and portability, flexibility, accessibility, and informality [3].

Thanks to mGBL, didactic contents are made available anytime and anywhere, and learning is linked to activities in the outside world environment [4][5]. Serious games for mobile devices can teach soft skills that support self-efficacy, self-directed learning, and reflection upon performance [6][7].

Research on game-base learning and serious games is rapidly growing in the last years [8], but there are still few specific validated instruments of analysis [9][10][11] and there is a scarcity of studies strongly based on causal relationships [12][13].

The debate between narratology and ludology can be dated approximately around the second half of the 1990s, reaching its climax in the 2000s, to definitively find a reconciliation in these very last years.

The narratological position considers games as novel forms of narrative that must therefore be studied using theories of narrative.

Ludologists, on the other hand, state that games are essentially formal, contrary to narratives that are basically interpretative [14].

Games according to narratologists are closely related to narrative and stories: even thought basically made of rules, they mainly tell stories, contain narrative elements, and show narrative structural sequences [15].

Ludologists think that the study of games should concern the analysis of the abstract and formal systems they describe, that is game structure, rules, interactivity and gameplay. These are the elements that give immersion and the feel of real experience of a game and are more important than optional narrative elements [16].

Other hybrid approaches emerged trying to conciliate and comprehend both points of view.

Ryan proposed to incorporate narratology inside ludology, since it deals with the construction of stories that is similar to the game mechanics [17].

Aarseth, although considered a radical ludologist, stated that games and narrative significantly overlap [18].

Lindley unified in a heuristic triangular space ludology, narratology, and simulation, describing the relationships between gameplay and narrative as a competition determining ludic interaction on one side, and narrative patterns perception on the other side [19].

Jenkins proposed a middle-ground position, talking about games as "spaces" with narrative possibility enriching gameplay [20].

The present study aims at giving an empirical contribution to the debate among ludologists and narratologists, referring to it as an interpreting key for the results obtained from the study of some causal models derived from the analysis of two sets of serious games.

Points of interest of the present study can be considered: (1) the fact that it adds empirical data and analysis to a field that has been mainly developed on theoretical basis, (2) the study of causal relationships in the field of serious games with the use of Structural Equation Models (SEM), (3) the focus on serious games for mobile devices that represent an expanding sector [21].

In particular, the considered mobile serious games are very short in duration (few minutes to complete each game) and are playable through a touch-screen interface using only one finger. That is to say, they are games the users can play in short casual bursts of time, anywhere and at any time, at work or at home, or even on the way to/from work/home [22]. It has been considered relevant to transfer the ludology/narratology debate, usually referred to more structured games, to this kind of games.

This paper will give a description of the project, whose main objectives were the development and testing of the serious games kits (Section II). Scope and hypothesis of the present study will then be illustrated (Section III). Methods and results of the empirical analysis will be reported, illustrating the statistical work that has been done and what it produced (Sections IV and V). The paper will end with a conclusion and future work section (VI), explaining how the results of the present study can be interpreted in the light of the ludology/narratology debate, the limits of the present study, and how a further deepening of these issues can be addressed.

II. THE INTOUCH PROJECT

In November 2010 a consortium of European partners from eight countries (Sweden, Lithuania, United Kingdom, Italy, France, Austria, Bulgaria, and Switzerland) started working on "Labour Market InTouch: new non-routine skills via mobile game-based learning" project, funded by Leonardo da Vinci Multilateral Projects for Development of Innovation Program.

At the beginning of the project a field research was conducted in order to define the top 10 crucial transversal competences for non-routine tasks. 62 managers and employers of business service SMEs were interviewed in order to detect which were the most requested non-routine skills in labour market, and, for each skill, a list of associated situational cases.

A structured questionnaire formed by 51 items describing tasks/behaviors related to skill management was used to identify the most relevant non routine skills. The factorial analysis of gathered data highlighted ten factors, interpreted as the crucial non-routine skills: Communication, Planning, Conflict Management, Openness to change, Decision Making, Teamwork, Flexibility, Strategic thinking, Initiative, Learning and improvement. Thus, the InTouch project designed and developed 30 games for mobile devices (3 for each non routine skill) to enable adult workers to improve their ability to deal with non routine situations at work.

In the light of the good results achieved with this first kit of 30 serious games, in November 2013 the InTouch project was refunded by Leonardo da Vinci Transfer of Innovation Program, with the aim of addressing the specific learning needs of ICT SMEs employees. The second edition of the InTouch project, named InTouch-ICT for its focus on ICT SMEs, conducted a new field research through surveying 238 respondents in four countries: Turkey, Hungary, Italy, and Sweden. In this case, people were directly faced with a list of 15 skills, asking to express the degree of importance for each one of them. According with the results of the survey, the 10 most important non routine skills for ICT SMEs managers and employees were: Communication, Team building, Planning, Learning and improvement, Openness to change, Creativity, Intelligibility, Decision Making, Innovativeness, Flexibility.

The consortium of the InTouch-ICT project developed 20 new games for mobile devices (2 for each non routine skill). The games were developed using the same methodology and the same technology of the previous ones, but new learning contents were created in order to match the specific learning needs of ICT SMEs.

III. THE SERIOUS GAMES

The games developed within the project take place in situations and contexts that are characteristic of day-to-day activities, namely within a small company titled "InTouch". The "InTouch" company is composed by several characters that were described giving their company role (Chief, PM-Design, PM-Development, PM-Assistance, Account, Account assistant, Supplier, Practitioner), personal information (name, surname, age, sex, star sign, hobbies), and a short bio (see Fig. 1).

Figure 1. Screenshots of the games. Clockwise from top left: the "InTouch" company team; a single character description (Chief); an interactive map example.

Games scenarios were obtained adapting situational cases found with the starting field research to the "InTouch" company and its characters.

The "InTouch" company elements that connect humor, sense and meaning, are characters' dossier and stories that were shortly given at the beginning of the games, and more extensively published on the "InTouch" Facebook page. Each dossier reported elements of the characters' lives, funny events from their past, additional information about their relationships, hobbies and funny photographs showing something weird about them. InTouch games, although short and simple, have thus a solid narrative structure, reinforced by the social media storytelling, in order to engage players, make them recognize narrative patterns referred to their work activities, and give them the right balance between fantasy and real working context situations.

In the development of the InTouch games attention was also paid to the ludic aspects. Even though challenges are not that complex, InTouch game design tried to respect requirements for the games to be relevant, explorative, emotive and engaging. Attention was paid to speed, level of difficulty, timing and range of feedback. Challenges of mastery and comprehension were inserted into games, together with strategy, and a perceived risk of failure to prevent boredom. Game mechanics were also made pleasant to create a positive climate, which is ideal when it comes to increase retention and recall. An entertaining gameplay was achieved through the use of funny graphics, novelty of the interactions, surprise, and humour in dialogues and scenarios.

All serious games were designed according to the same scheme, made of an opening scenario and a problem-based situation presenting the aim of the game (first frames), a bulk of interactivities (central frames) where players are asked to choose among different options, and the last frames showing the closing scenario, the score, and giving feedback to the player.

The narrative within the games is developed giving a short background story in the opening scenario, then it is influenced by user's action in the central frames, and ends up with the closing scenario.

The central frames are developed according to the following types of interaction:

- *Branching story*: the user reads the story and has to take different decisions. The story develops in different ways according to the choices made by users, and the final feedback and evaluation are the result of the combination of the choices.
- *Interactive map*: at the beginning of the game a problem-based situation is described in the "InTouch" company. To solve the problem, the user can choose three members of the company to talk to, but he/she needs to pick the right people to get the useful information. Once the user has read the three clues, he/she can choose one of the three available alternatives. Evaluation is based on the final decision and on the choice of the members of the "InTouch" company made by the player.
- *Multiple choice*: at the beginning of the game there is a description of a scenario and the aim of the game. The user has to help the main character with three different decisions in a limited time frame. The difficulty increases: in the first decision point only three out of the five listed options are correct, in the second one only two and in the third one only one. The final score and the feedback depend on how many correct answers the user chooses.
- *Quiz*: the game begins presenting a brief introduction of the main topic, then the player has to try to correctly answer three related questions. The player gets immediate feedback on the answer to each question and a summary at the end of game. The key objective is to gain points for fast and correct answers. Evaluation is based on a combination of the number of correct answers with the time taken to answer.
- *Task simulation*: during the game the user has to achieve a goal which foresees three different tasks. He/she has to make sure to do the right tasks in the right order, and then he/she has to answer to a question focused on the selected task. The score is determined from the number of correct answers and from the correctness of the order the user chose to prioritize the tasks.

IV. SCOPE AND HYPOTESES

This section illustrates what are the scopes of the research that was done on the developed serious games, and what are the hypothesis guiding it through the study.

The research can be divided in two steps, according to the different editions of the InTouch project.

In the first edition of the project (2010-2012) a kit of 30 serious games was tested, launching the study of the ludic and narrative components role within the games [1].

In the second edition (2013-2015) the structure of both ludic and narrative components was further analyzed studying a kit of 20 newly developed serious games.

On the first kit of 30 serious games a summative evaluation was conducted measuring a set of game variables on a sample of players. The four game variables of interest are: the players' willingness to play again, the interest of the goal, the fun of the gameplay, and the realism of the game narration.

Even if ludology and narratology are complex and multidimensional concepts, the fun of the gameplay and the realism of the game narration can be considered, at least partially, two components of these constructs, and their causal role within a serious game can shed light on the juxtaposition between ludology and narratology.

The interest of the goal is considered a primary element. It can be found starting from the beginning of the game, when the player faces the game scenario and mission.

It is then interesting to observe how the development of the game in terms of fun and narration can influence the causal relationship between the interest of the goal and the willingness to play again.

For this reason, the causal relationship among the interest for the goal and the willingness to play again is hypothesized to be mediated by the fun of the gameplay, and by the realism of the game narration.

The present study explores the degree to which the data fit different nested causal models. In the "complete" model (with less degrees of freedom), indicated as Model A (Fig. 2), the relationship between the interest of the goal and the willingness to play again is partially mediated both by the fun of the gameplay and by the realism of the game narration.

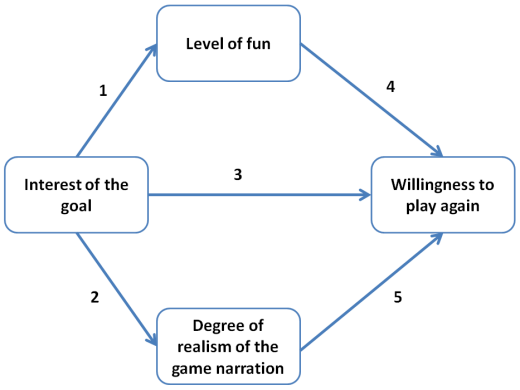

Figure 2. Graphical scheme of the causal Model A (first kit of serious games).

The fun of the gameplay and the realism of the game narration are hypothesized to positively influence the willingness to play again (paths 4 and 5). These hypotheses are based on the consideration that both the fun of the gameplay and the realism of the game narration are significant elements in determining the degree of satisfaction. It is also hypothesized that the interest of the goal positively influences the willingness to play again (path 3), since the engagement for the game mission can be considered as a natural predictor of the degree of satisfaction.

Some constraints of the complete model are then released, suppressing one or more causal paths, to obtain all the other nested models. In this way, the partial mediation of the fun of the gameplay and of the realism of the game narration will be substituted by their full mediation or by the lack of mediation. The complete Model A will thus be confronted with the following alternative models:

- Model B, where there is not mediation of the fun of the gameplay, path 1 is suppressed;
- Model C, where there is not mediation of the realism of the game narration, path 2 is suppressed;
- Model D, where there is not mediation either of the fun of the gameplay or of the realism of the game narration, paths 1 and 2 are suppressed;
- Model E, where there is full mediation both of the fun of the gameplay and of the realism of the game narration, path 3 is suppressed;
- Model F, where there is full mediation of the fun of the gameplay and there is not mediation of the realism of the game narration, paths 2 and 3 are suppressed;
- Model G, where there is not mediation of the fun of the gameplay and there is full mediation of the realism of the game narration, paths 1 and 3 are suppressed.

Table I summarizes which causal paths, indicated with numbers in Fig. 2, are present for each model.

TABLE I. CAUSAL PATHS OF TESTED MODELS

	Path 1	Path 2	Path 3	Path 4	Path 5
Model A	✓	✓	✓	✓	✓
Model B	--	✓	✓	✓	✓
Model C	✓	--	✓	✓	✓
Model D	--	--	✓	✓	✓
Model E	✓	✓	--	✓	✓
Model F	✓	--	--	✓	✓
Model G	--	✓	--	✓	✓

The comparison of nested models wants to establish if the hypothesized influence of the interest of the goal on the willingness to play again is better explained by partial mediation, full mediation, or no mediation at all of the fun of the gameplay and of the realism of the game narration.

Through the study on the second kit of 20 serious games the main scope of the research was to clarify if the ludic and the narrative components could be used to interpreter the causal structure of the games. For this reason, the set of considered variables was extended beyond those already analyzed during the first edition. The seven game variables of interest are in this case: the players' willingness to play again, the fun of the gameplay, the set of rules of the gameplay, the ways of interaction with the gameplay, the realism of the game narration, the narrative of the starting scenarios of the games, and the development of the narrative during the games.

The fun of the gameplay, the set of rules of the gameplay, and the ways of interaction with the gameplay are hypothesized to be indicators of the ludic factor of the games; while the realism of the game narration, the narrative of the starting scenarios of the games, and the development of the narrative during the games are considered as narrative indicators. This structure must be verified through a Confirmative Factor Analysis according to the scheme represented in Fig. 3.

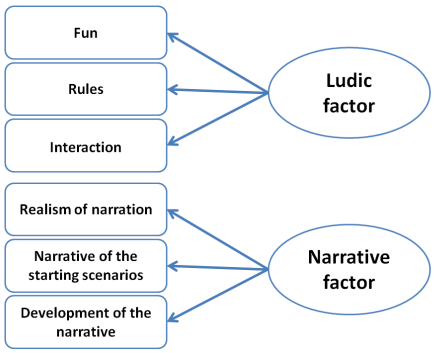

Figure 3. Graphical scheme of the factorial structure of the measured variables (second kit of serious games).

The willingness to play again is hypothesized to be positively influenced by all the other considered variables. As a consequence, the Structural Equation Model that will be tested can be represented with the ludic and narrative factorization, thus giving rise to the graphical scheme in Fig. 4, where paths are numbered starting from 6 to avoid confusion with the causal scheme referred to the first kit of serious games.

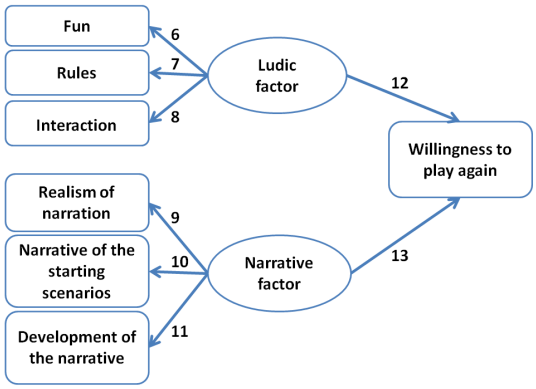

Figure 4. Graphical scheme of the Structural Equation Model (second kit of serious games).

V. METHODS

This section contains an illustration of the methods that were adopted in the present study: a description of the samples, the research procedure, the instruments, and the statistical analyses that were performed.

A. Participants

For the test of the first kit of 30 serious games the target sample consisted of 54 workers of 9 different SMEs from the eight countries participating in the first edition of the project and operating in different business sectors (ICT, business support, education/training, etc.). The SMEs were selected on the basis of their willingness to participate in the study. Work positions were: 28 managers and 26 employees. In total 30 were males (56%) and 24 were females (44%). The mean age was 41.94 years (SD = 9.70).

For the test of the second kit of 20 serious games the target sample consisted of 118 workers of 31 different SMEs from the five countries participating in the second edition of the project and operating mainly in the ICT sector. The SMEs were selected on the basis of their willingness to participate in the study. Work positions were: 23 managers and 95 employees. In total 61 were males (52%) and 57 were females (48%). The mean age was 36.64 years (SD = 7.35).

B. Procedure

To test the developed kits of mobile serious games the project partners held dedicated events, called "Learning Labs", in each country participating in the project for both the editions of the project. During each Learning Lab a structured questionnaire, with only slight differences in the two editions, was proposed to participants after the completion of the games. Participation to the Learning Labs and questionnaire compilation were obtained through an informed consent procedure asking for active consent from participants. Questionnaires took approximately 30 minutes to complete. Project staff members introduced the questionnaires, giving instructions about their compilation, explaining that they were voluntary and responses were anonymous and confidential. Project staff members were at the workers' disposal during the questionnaires' administration to answer questions and give explanations.

C. Measures

An Identifying Information Form was used to collect demographic information: age, gender, working role.

An articulated grading grid was proposed to participants, after the completion of the games, asking them to express on a 10 point Likert scale their like about several game variables.

The present study is taking in consideration the following variables: the willingness to play again ("Would you like to play again?"), the fun of the gameplay ("How fun was your interaction with the game mechanics?"), the interest of the goal ("How interesting was the goal proposed by the game?"), the realism of the game narration ("If compared to your experience, how realistic was the narrative of the game about the 'InTouch' company?"), the set of rules of the games ("How did you like the rules of the games?"), the ways of interaction with the gameplay ("Rate your satisfaction for the interactions within the games"), the narrative of the starting scenarios of the games ("How did you like the narrative of the scenarios that are proposed at the beginning of the games?"), and the development of the narrative during the games ("How did you like the evolution of the narrative during the games?").

D. Data Analysis

Preliminary Analysis

As a preliminary analysis, skewness and kurtosis of all game variables were checked. Overall, all variables showed to conform to the normal distribution.

Correlation

As a first step, the correlation matrix of both the set of variables measured by the questionnaires was calculated.

1) First kit of 30 serious games

For the first kit of 30 serious games a path analysis was done to test the casual models represented in Fig. 2 and to establish which model was to be preferred. All path models involving the aforementioned variables were analyzed with LISREL, using maximum likelihood estimation procedures [23]. For each tested model χ^2 is reported, as an absolute fit index (good fit between zero value and two times the degrees of freedom). Three more fit indexes were also reported: the non-normed fit index (NNFI); the comparative fit index (CFI); and the root mean square error of approximation (RMSEA). Higher CFI and NNFI values (in the range from 0.97 to 1.00 for a good fit) and lower

RMSEA values (in the range from 0.00 to 0.05 for a good fit) are assumed to evaluate model fit [24]. The Coefficient of determination (R-square) is reported, giving the percentage of variance of the willingness to play again explained by each model, to estimate the completeness of the considered set of predictors.

To establish which type of mediation (partial, full, or non-significant) was exercised by the fun of the gameplay and by the realism of the game narration, the comparison of the fit of alternative nested models was conducted analyzing for each pair of models the differences of the χ^2 values (indicated with $\Delta \chi^2$) between the less parsimonious model (i.e., the one with less degrees of freedom, in our case the complete Model A) and the more parsimonious one (i.e., in turn: Models B, C, D, E, F, and G). The significance of $\Delta \chi^2$ has successively been established looking at the p-value corresponding to the χ^2 distribution for a number of degrees of freedom given by the difference of degrees of freedom of the more parsimonious models and the complete one. Choosing a cut-off of $p = 0.01$, if the $\Delta \chi^2$ between two nested models is significant ($p < 0.01$), this implies that the complete model explains the data better; if there is no significant difference between two nested models ($p > 0.01$), this implies that the more parsimonious model explains the data equally well compared to the complete model, and must be preferred for its simplicity.

2) Second kit of 20 serious games

For the second kit of 20 serious games a preliminary Confirmatory Factor Analysis (CFA) was done to verify the correctness of the factorization with the ludic and the narrative factors, as represented in Fig. 3. After that, a complete Structural Equation Model, made of both measured and latent variables, as represented in Fig. 4, was analyzed with LISREL [23], reporting the same fit indexes already used with the first kit of games.

Thanks to the large enough sample size for the testing of the second kit of 20 serious games, it was possible to estimate the numerical values of the causal paths for different groups of respondents. For the reliability and validity of results it was chosen to differentiate males (61) from females (57), and the younger than 35 years (58) from the older than 35 years (60) people. For these categories of respondents, in fact, each group was enough large. On the contrary, the scarcity of managers (23) in the considered sample prevented to confront them with employees (95), since the results were at risk to be neither reliable or valid.

The multi-group analysis was conducted through a hierarchical increasingly restrictive set of steps [25]. It started with the determination of a well-fitting multi-group baseline model with the same pattern of parameters across groups (called "Configural model"). The subsequent tests involved the specification of cross-groups equality constraints for measurement equivalence, followed by structural equivalence. The comparison of the baseline model with the measurement invariant model, and of this latter with the structural invariant model, was done in the same way as for the nested models already exposed for the first kit of serious games. For each step (baseline - measurement invariance - structural invariance) the number of degrees of freedom grows, as an effect of the added invariance constraints, and the value of χ^2 for the fit is likely to grow. If the growth of χ^2 is not significant ($p > 0.01$) when considering a nested model, this latter must be preferred, and the invariance is demonstrated.

For the comparison of two groups, at least measurement invariance must be demonstrated, meaning that the form of the causal model is the same for both groups. After that, the similarity of parameters' values within the common form is studied trough the analysis of structural invariance across groups.

For the considered sample it was tested if the same form was valid for males and females, and for younger and older respondents. If so, the comparison of structural parameters was done, establishing if differences in causal paths' values were significant.

VI. RESULTS

This section contains the numerical results obtained for the previously illustrated data analysis: correlation, path analysis, comparison of nested causal models, Confirmatory Factor Analysis, Structural Equation Model, and multi-group analysis.

1) First kit of 30 serious games

Table II reports the correlation coefficients of the willingness to play again, the fun of the gameplay, the interest of the goal, and the realism of the game narration calculated with the first kit of 30 serious games. The level of significance (p-value) is indicated in the table footnote.

TABLE II. CORRELATION MATRIX OF THE FIRST KIT OF 30 SERIOUS GAMES (SUB-DIAGONAL COEFFICIENTS).

Variable	Willingness to play again	Level of fun	Interest of the goal
Level of fun	0.89*		
Interest of the goal	0.60*	0.35*	
Realism of the game narration	0.21	-0.12	0.19

b. *p < 0.01.

Table III reports the results of the path analysis for the seven tested models with the levels of significance of the causal paths (p-values) indicated in the table footnote. Path numbers are those indicated in Fig. 2.

TABLE III. PATH ANALYSIS COEFFICIENTS FOR THE TESTED MODELS

	Path 1	Path 2	Path 3	Path 4	Path 5
Model A	0.35*	0.19	0.26**	0.83*	0.26**
Model B	--	0.26**	0.26**	0.83*	0.26**
Model C	0.39*	--	0.26**	0.83*	0.26**
Model D	--	--	0.26**	0.83*	0.26**
Model E	0.35*	0.19	--	0.93*	0.32**
Model F	0.39*	--	--	0.93*	0.32**
Model G	--	0.26**	--	0.93*	0.32**

c. * p < 0.01; ** p < 0.05.

Table IV reports the results of the comparison of the fit of the seven tested models, whose degrees of freedom (df) are indicated in the table, and with the level of significance of the difference between the complete and the nested models indicated in the table footnote.

TABLE IV. COMPARISON OF THE FIT OF ALTERNATIVE NESTED MODELS

Model	χ^2	NNFI	CFI	RMSEA	R^2	df	
A	0.00	1.00	1.00	0.00	0.95	1	
Alternative nested models							$\Delta\chi^2$
B	6.49	0.91	0.97	0.21	0.94	2	6.49
C	1.91	1.00	1.00	0.00	0.95	2	1.91*
D	9.39	0.91	0.96	0.20	0.94	3	9.39
E	27.79	0.31	0.77	0.50	0.89	2	27.79
F	28.85	0.53	0.77	0.41	0.89	3	28.85
G	31.09	0.47	0.73	0.42	0.89	3	31.09

d. *p > 0.01; R^2 = explained variance of the willingness to play again.

Looking at the results of the comparison of the nested models, Model C explains the data equally well compared to the complete Model A (p > 0.01) and must be preferred, being more parsimonious.

For the selected Model C the effects of the three predicting variables (Interest for the goal, Fun of the gameplay, Realism of the game narration) on the Willingness to play again (outcome variable) were calculated and are reported in Table V.

TABLE V. EFFECTS ON THE WILLINGNESS TO PLAY AGAIN (MODEL C)

Variable	Total effect	Direct effect	Indirect effect
Level of fun	0.83*	0.83*	--
Interest of the goal	0.58*	0.26**	0.32**
Degree of realism of the game narration	0.26**	0.26**	--

e. * p < 0.01; ** p < 0.05

Both the fun of the gameplay and the realism of the game narration have significant direct effects on the willingness to play again (path 4 = 0.83; path 5 = 0.26).

The interest of the goal has a significant total effect on the willingness to play again, obtained as the sum of a direct effect (path 3 = 0.26) and an indirect effect (path 1 × path 4 = 0.32) through the mediation of the fun of the gameplay.

The study on the first kit of 30 serious games demonstrated that, as hypothesized, both the fun of the gameplay and the realism of the game narration significantly influence the willingness to play again. Causal paths 4 and 5, in fact, are significant across all tested models.

In particular, the influence of the fun of the gameplay resulted to be more robust, with values of path 4 above 0.80, while the influence of the realism of the game narration, even though significant, was less pronounced, with values of path 5 around 0.30.

Furthermore, the fun of the gameplay resulted to significantly mediate the relationship between the interest of the goal and the willingness to play again. On the contrary, no significant mediation emerged for the realism of the game narration, insomuch as the causal Model C, where path 2 is suppressed, was preferred.

As a whole, the relationship between the interest of the goal and the willingness to play again is partially mediated by the fun of the gameplay, and non-significantly mediated by the realism of the game narration.

2) Second kit of 20 serious games

Table VI reports the correlation coefficients of (a) the willingness to play again, (b) the fun of the gameplay, (c) the set of rules of the games, (d) the ways of interaction with the gameplay, (e) the realism of the game narration (f), the narrative of the starting scenarios of the games, and (g) the development of the narrative during the games calculated with the second kit of 20 serious games.

TABLE VI. CORRELATION MATRIX OF THE SECOND KIT OF 20 SERIOUS GAMES (SUB-DIAGONAL COEFFICIENTS)

Variable	a	b	c	d	e	f
b	0.58*					
c	0.68*	0.76*				
d	0.51*	0.79*	0.70*			
e	0.32*	0.14	0.11	0.17		
f	0.33*	0.18	0.02	0.11	0.69*	
g	0.30*	0.20**	0.11	0.18	0.59*	0.79*

f. * p < 0.01; ** p < 0.05

Table VII reports the result of the Confirmatory Factor Analysis with the introduction of the ludic and narrative factors, as represented in Fig. 3.

TABLE VII. CONFIRMATORY FACTOR ANALYSIS LOADINGS

Variable/Factor		Ludic factor		Narrative factor
Level of fun		0.93*		--
Rules		0.81*		--
Interaction		0.85*		--
Degree of realism of the game narration		--		0.72*
Narrative of the starting scenarios		--		0.95*
Development of narrative		--		0.83*
χ^2	**NNFI**	**CFI**	**RMSEA**	**df**
14.92	0.97	0.98	0.09	8

g. * p < 0.01

The introduction of the ludic and narrative latent factors shows a good fit with the data, and the loading factors are high for all the considered variables.

This result encourages to further continue in the use of the ludic and narrative latent factors to study the Structural Equation Model for the prediction of the willingness to play again.

Table VIII reports the results of the Structural Equation Model with paths numbered as in Fig. 4.

TABLE VIII. STRUCTURAL EQUATION MODEL COEFFICIENTS

Path	6	7	8	9	10	11	12	13
Coeff.	0.89*	0.86*	0.84*	0.72*	0.96*	0.82*	0.65*	0.26**
Fit index		χ^2		NNFI	CFI	RMSEA	df	
		40.91		0.91	0.95	0.13	13	

h. *p < 0.01, ** p < 0.05

The Structural Equation Model shows an overall good fit with the data. As a consequence, the casual model for the prediction of the willingness to play again can be adequately realized with the use of the two latent factors referred to the ludic and narrative components of the games. With such a schematization, both the ludic and the narrative contribute to the willingness to play again resulted to be significant, even if the ludic component (path 12) showed to be stronger than the narrative one (path 13).

The introduction of latent factors representing ludic and narrative components did not significantly worsen the fit with data if compared with the path analysis conducted with the first kit of serious games, where only measured variables were used. This is an important result that confirms the legitimacy of the interpretation of the casual relationships in terms of ludic/narrative contributes. Furthermore, the second study substantially confirms the same distribution of weight between ludic and narrative contribution to the willingness to play again that was found with the first study. Also, this result is encouraging, since it confirms that similar findings were obtained with different samples of users, thus cross-validating the ludic/narrative key of lecture that was adopted for both studies.

The results of the multi-group analysis, referred to males vs. females, and to younger than 35 years vs. older than 35 years, are reported in Table IX, where the baseline model (same patterns) is compared through the χ^2 distribution to the measurement invariant model, and this latter is compared to the structural invariant model.

TABLE IX. MULTI-GROUP ANALYSIS RESULTS

Groups	Configural Model df = 26	Measurement Invariant Model df = 40	Structural Invariant Model df = 42
Males (61) vs. Females (57)	$\chi^2 = 35.14$	$\chi^2 = 40.94$ $p\ (\Delta\chi^2)_{14} = 0.97$	$\chi^2 = 50.88$ $p\ (\Delta\chi^2)_2 < 0.01$
Younger (58) vs. Older (60)	$\chi^2 = 43.60$	$\chi^2 = 48.08$ $p\ (\Delta\chi^2)_{14} = 0.99$	$\chi^2 = 58.72$ $p\ (\Delta\chi^2)_2 < 0.01$

For both the pairs of groups the measurement invariance is verified, while there is a significant structural difference. In practice, measurement invariance corresponds to the similarity for each separated group of the factorialization with the Ludic and the Narrative factors that was done in the analyzed models. That is, independently from which group is being considered (males or females, younger or older people), the fun of the gameplay, the set of rules of the games, and the ways of interaction with the gameplay contribute similarly to the ludic factor; while the realism of the game narration, the narrative of the starting scenarios of the games, and the development of the narrative during the games contribute similarly to the narrative factor. In terms of Structural Equation Model, it is expected that coefficients of paths 6, 7, 8, 9, 10, and 11, as numbered in Fig. 4, are similar across groups.

On the contrary, each pair of groups has significant structural differences across groups, meaning that causal paths coefficients of the structural part of the models (paths numbered 12 and 13) are significantly different for males and females, and for younger and older respondents. In practice, the ludic and the narrative contribution to the willingness to play again strictly depends on what group is being considered.

Table X reports the results of the Structural Equation Model for separated groups of males and females with paths numbered as in Fig. 4.

TABLE X. STRUCTURAL EQUATION MODEL COEFFICIENTS (MALES VS. FEMALES)

Path	6	7	8	9	10	11	12	13
Males (61)	0.88*	0.84*	0.83*	0.70*	0.94*	0.81*	0.59*	0.26**
Females (57)	0.88*	0.83*	0.85*	0.82*	0.85*	0.77*	0.32*	0.76*

i. *p < 0.01, ** p < 0.05

As anticipated by the multi-group analysis, there is a strong similarity among those coefficients (numbered from 6 to 11) that refer to the ludic and narrative factorialization; while significant differences are present for coefficients 12 and 13, which correspond to the ludic and narrative contribution to the willingness to play again. Both for males and females the willingness to play again is significantly influenced by ludic and narrative components, but their order of importance is inverted. Males are mainly influenced by the ludic factor, while females are mainly influenced by the narrative factor

Table XI reports the results of the Structural Equation Model for separated groups of younger than 35 years and older than 35 years, with paths numbered as in Fig. 4.

TABLE XI. STRUCTURAL EQUATION MODEL COEFFICIENTS (YOUNGER THAN 35 YEARS VS. OLDER THAN 35 YEARS)

Path	6	7	8	9	10	11	12	13
Younger	0.90*	0.85*	0.85*	0.72*	0.96*	0.82*	0.61*	0.25**
Older	0.91*	0.83*	0.86*	0.81*	0.89*	0.81*	0.34*	0.72*

j. *p < 0.01, ** p < 0.05

As anticipated by the multi-group analysis, and already seen in the case of males vs. females, also, for the differentiation between younger and older people of the sample, there is a strong similarity among coefficients numbered from 6 to 11; while significant differences are present for coefficients 12 and 13. Even if both the ludic and

the narrative factor contribute significantly to the willingness to play again, younger people of the sample are mainly influenced by the ludic factor, while older ones are mainly influenced by the narrative factor.

VII. Conclusion and Future Work

A. Contribution to the ludology/narratology debate

Interpreting the fun of the gameplay as a ludic indicator, and the realism of the game narration as a narrative indicator, the results of the study conducted on the first set of 30 serious games can be referred to the ludology/narratology debate.

The results seem to corroborate a point of view that takes in consideration both positions. This sort of reconciliation of the two different positions, however, is not gained through an assimilation of the realism of the game narration to the fun of the gameplay. As reported in Table II, in fact, their correlation coefficient is non-significant (and slightly negative), indicating their substantial independence (or even slight juxtaposition). The fun of the gameplay and the realism of the game narration must therefore be considered as separately, and differently, contributing to determine the success of a learning game.

The results of the study on the first kit of 30 serious games seem to mostly corroborate Jenkins' proposal of "game space", whose structure facilitates narrative experience [20]. In this sense, the interest of the goal can be interpreted as a feature of the "game space" that can enhance the degree of satisfaction of the players, determining their retention in a direct way, and indirectly, thanks to its contribution to the fun of the gameplay.

B. Limits and specificity of the study

If limited to the study on the first kit of 30 serious games, the association of the fun of the gameplay and of the realism of the game narration with the ludic and the narrative components of a serious games is exposed to criticism of being both partial and spurious. While the significance of the results is robustly consistent with the measured variables, it must be recognized that different types of narrative can be developed within a serious game, not limited to realistic ones. Having considered the realism of the narration is certainly only a partial representation of the narrative of a serious game. At the same time, fun in a serious narrative game can derive not only from the act of playing, but also from other components, like the fact to learn something interesting, or to take part in an engaging story. The fun of the gameplay can thus be referred not only, or at least not exclusively, to the ludic aspects of a serious game.

To have a more comprehensive insight of the ludic and narrative dynamics within a serious game, a larger number of indicators should be analyzed and validated, as referred to the ludic and to the narrative constructs. One more limit of the study conducted on the first kit of 30 serious games is the small size of the sample (n = 54) that prevented, for instance, to study differences between groups of participants for the scarcity of people in each group.

Some of the limits of the first study were addressed with the testing of the second kit of 20 serious games. The size of the sample was doubled (n=118), and the measured variables were explicitly treated as indicators of the ludic and narrative factors.

The prevalence of the ludic contribute to the willingness to play again was found in both the studies that were presented in this paper. This result, however, must be considered as strictly linked to the specific serious games that were analyzed and cannot be generalized to every game-based solution. Furthermore, it was found that when differentiating groups within the sample, for instance according to gender and age, the prevalence of the ludic and/or of the narrative factor can change. In the analyzed sample, males and younger people showed to be more influenced by the ludic component, while females and older people resulted to be more influenced by the narrative component.

The tested games were very basic as a consequence of their design for mobile devices. The serious games were conceived to be played anywhere and at any time, taking few minutes to be completed. Games' interface was designed in such a way that a simple touch, or click, was enough to interact, thus enabling one-hand playing. This simplicity can be the origin of the ludic predominance over the narrative. It can be hypothesized that game-based solutions with a predominant ludic component exhibit a behavior like the one found in this case. In different situations, for those game-based solutions that are more focused on the narrative component, or where both the ludic and the narrative components are equally juxtaposed, different solutions can be found.

C. Perspectives of implementation

The differences across groups (males vs. females, and younger vs. older people) that were found on the considered sample deserve to be more deeply studied and related to the existing literature in the field of game studies. Beside gender and age, it is worth analyzing the role of the ludic and of the narrative components according to the work position (employers vs. employees). This kind of analysis was not possible in the present study because the sample was not adequate for the scope (there were too few managers in the considered sample). In general, multi-group analysis was not among the initial objectives of the present studies, while gender differences and other issues that can be referred to game studies must be part of the experimental design from the beginning of the study to be adequately treated. All these suggestions must be verified and constitutes an indication for future work in view of an implementation of the proposed research concept with other serious games.

An interesting perspective of implementation comes from the substantial independence that was found between the ludic and the narrative contributes within the games. In both the presented studies, in fact, the correlation between the ludic and the narrative components resulted to be non-

significant. This suggests that, when designing a serious game, ludic and narrative components must be considered as separately, and differently, contributing to determine its overall success. Under an operational point of view, it would be a significant added value the creation of a validated instrument measuring ludic and narrative components within a serious game through the use of exploratory factorial analysis with multiple items, instead of a self-developed questionnaire, with one item for each variable, like the one that was used for the present study with the weak validation of the confirmatory factor analysis that was shown above.

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