An Empirical Study on the Ludic and Narrative Components in Mobile Game-Based Learning

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Abstract— **The paper presents the results of an empirical study conducted on a mobile game-based learning kit, composed by 30 serious games, developed in the framework of an European project on mobile learning for corporate training, titled "InTouch". The study analyzes the role of the interest of the goal, the fun of the gameplay, and the realism of the game narration in determining the willingness to play again, as expressed by a sample of 54 users. In the light of the debate between ludic and narrative approach to games, the study can be interpreted as an empirical evidence of the simultaneous, and yet independent, important role of both the ludic and narrative component of a serious game. The fun of the gameplay showed to a have a very important role in predicting the willingness to play again, with a robust direct effect, and significantly contributing to the indirect effect of the interest of the goal. The realism of the game narration exhibited a lower, even though significant, level of influence on the willingness to play again, contributing only in a direct form, and with a smaller amount compared to the level of fun. The interest of the goal has a significant direct influence on the willingness to play again, that can be enhanced by the fun of the gameplay, while it did not show to be significantly modified by the realism of the game narration.**

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

I. INTRODUCTION

Mobile game-based learning (mGBL) is an educational trend that is gaining more and more in popularity. Its main advantages are considered mobility and portability, flexibility, accessibility, and informality [1]. Thanks to mGBL, didactic contents are made available anytime and anywhere, and learning is linked to activities in the outside world environment [2][3]. Serious games for mobile devices can teach soft skills that support self-efficacy, self-directed learning and reflection upon performance [4][5].

In 2012, at the end of a two-year European Project, a kit of 30 pedagogical serious games for smartphones and tablets was developed and tested with a sample of Small and medium-sized enterprises' (SME) employees from the seven countries participating the project (Italy, England, Sweden, Switzerland, Austria, Lithuania, Bulgaria).

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 [6].

In short, 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 [7]. 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 [8]. 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 [9].

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 [10]. Aarseth, although considered a radical ludologist, stated that games and narrative significantly overlap [11]. 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 [12]. Jenkins proposed a middle-ground position, talking about games as "spaces" with narrative possibility enriching gameplay [13].

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 causal relationships among the interest for the goal and the willingness to play again, as mediated by the fun of the gameplay, and the realism of the game narration. Even if ludology and narratology are complex and multidimensional concepts, in fact, 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.

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 focus on serious games for mobile devices that represent an expanding sector [14]. 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 [15]. 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 kit (Section 2). Scope and hypothesis of the present study will then be illustrated (Section 3). Methods and results of the empirical analysis will be reported, illustrating the statistical work that has been done and what it produced (Sections 4 and 5). The paper will end with a conclusion and future work section, 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

The "Labour Market InTouch: new non-routine skills via mobile game-based learning project", in short InTouch, aimed to define an innovative approach enabling new generations of workers to develop ten non-routine skills: Communication; Planning; Conflict management; Openness to change; Decision making; Teamwork; Flexibility; Strategic thinking; Initiative; Learning and improvement.

All serious games were designed according to the same scheme, made of an opening scenario (frame 1), a problem-based situation presenting the aim of the game (frame 2), three interactive frames (frames 3, 4, 5) where players are asked to choose among different options, and the last frame (frame 6) 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 story develops in different ways according to the choices made by the player and the final feedback and evaluation are the result of the combination of the choices.

• *Interactive map*: the user can choose three characters to talk to. Basing on the obtained clues, the player can choose one of the three available alternatives. Evaluation is based on the final decision and on the choice of the characters.

• *Multiple choice*: the user has to help the main character with three different decisions in a limited time frame. 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 player has to try to quickly answer three related questions, getting immediate feedback on the answer to each question and a summary at the end of game. Evaluation is based on a combination of the number of correct answers with the time taken to answer.

• *Task simulation*: the player has to prioritize three tasks in order to achieve a goal. Each task is associated with a question to be answered. The score is determined from the number of correct answers and from the order the user chose to prioritize the tasks.

The contents of the games were studied to be relevant to the learner in an enjoyable and interesting way. An effort was made to connect contents to learners' work experiences. Each game scenario is set in a working context well known to the SME's employees, with characters archetypes designed on real SME's employees. By playing the games users discover the problems and possible solutions in a real life environment. The games take place in situations and contexts characteristic of day-to-day activities, namely within a small company titled "InTouch". Games scenarios were obtained adapting situational cases referred to the ten non-routine skills to the "InTouch" company, composed by characters that were described in terms of their company role, personal information, a narrative short bio, and some other charming details such as star sign and hobbies. The characters of the games were further developed and updated in a dynamic narrative way through Facebook. This social media storytelling reported elements of the characters' lives, funny events from their past, additional information about their relationships, hobbies and photographic illustrations showing something weird about them. InTouch games, although short and simple, have thus a solid narrative structure 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, so games become real living puzzles, with 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.

III.   SCOPE AND HYPOTESES

A summative evaluation was conducted measuring a set of game variables on a sample of players. For the scope of the present study the four game variables of interest are: (a) the players' willingness to play again, (b) the interest of the goal, (c) the fun of the gameplay, and (d) the realism of the game narration.

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 further 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.

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 (Figure 1), 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 1. Graphical scheme of the causal Model A.

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 will then be 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, theoretically possible models to assess relative fit compared to:

- 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 1 summarizes which causal paths, indicated with numbers of Figure 1, are present for each model.

TABLE I.   CAUSAL PATHS OF TESTED MODELS

	Path 1	Path 2	Path 3	Path 4	Path 5
Model A	YES	YES	YES	YES	YES
Model B	NO	YES	YES	YES	YES
Model C	YES	NO	YES	YES	YES
Model D	NO	NO	YES	YES	YES
Model E	YES	YES	NO	YES	YES
Model F	YES	NO	NO	YES	YES
Model G	NO	YES	NO	YES	YES

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 other two considered variables (the fun of the gameplay and the realism of the game narration).

IV. METHODS

This section contains an illustration of the methodology that has been adopted in the present study: a description of the sample; the research procedure; the instruments and the statistical analyses that were adopted.

A. Participants

The target sample consisted of 54 workers of different SMEs (N = 9) from the seven countries participating in 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).

B. Procedure

To test the developed kit of 30 mobile serious games the project partners held dedicated events (Learning Labs) in the seven countries participating in the project. During each Learning Lab a structured questionnaire was proposed to participants after the completion of the games. Participation to 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. All participants to different Learning Labs responded to the same questionnaire packet.

C. *Measures*

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

- Game variables. 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 ten variables: the willingness to play again, the game duration, the game interface (graphics, colors, etc.), the fun of the gameplay, the quality of the instructions, the adequacy of the level of difficulty, the interest of the goal, the learning/educative content, the quality of the feedbacks, and the realism of the game narration. The present study is taking in consideration only four variables, namely, (a) the willingness to play again ("Would you like to play again?"), (b) the fun of the gameplay ("How fun was your interaction with the game mechanics?"), (c) the interest of the goal ("How interesting was the goal proposed by the game?"), and (d) the realism of the game narration ("If compared to your experience, how realistic was the narrative of the game about the 'InTouch' company?").

D. *Data Analysis*

1) *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.

2) *Correlation*

As a first step the correlation matrix of all the variables measured by the questionnaire was calculated.

3) *Path Analysis*

All path models involving the aforementioned four variables (Fun of the gameplay, Realism of the game narration, Interest of the goal, Willingness to play again) were analyzed with LISREL, using maximum likelihood estimation procedures [16].

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 [17].

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.

4) *Comparison of Nested Causal Models*

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.

V. RESULTS

This section contains the numerical results obtained for the previously illustrated data analysis: correlation, path analysis, and comparison of nested causal models.

Table 2 reports correlation coefficients of (a) the willingness to play again, (b) the fun of the gameplay, (c) the interest of the goal, and (d) the realism of the game narration. The level of significance (p-value) is indicated in the table footnote.

TABLE II. CORRELATION MATRIX

Variable	Willingness to play again	Fun of the gameplay	Interest of the goal	Realism of the game narration
Willingness to play again	1.00	0.89*	0.60*	0.21
Fun of the gameplay	0.89*	1.00	0.35*	-0.12
Interest of the goal	0.60*	0.35*	1.00	0.19
Realism of the game narration	0.21	-0.12	0.19	1.00

b. *p < 0.05.

Table 3 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.

TABLE III. PATH ANALYSIS COEFFICIENTS

	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 4 reports the results of the comparison of the fit of the seven tested models, with the level of significance of the

difference between complete and 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 = coefficient of determination; df = degrees of freedom.

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 were calculated and are reported in Table 5, with the level of significance (p-values) indicated in the table footnote.

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

Variable	Total effect	Direct effect	Indirect effect
Fun of the gameplay	0.83*	0.83*	--
Interest of the goal	0.58*	0.26*	0.32**
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 will 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.

VI. CONCLUSION AND FUTURE WORK

For all the tested models, the R-square values of the willingness to play resulted to be very high (about 90% of the variance explained). This can be seen as an overall confirmation of the right choice of the models' variables and their causal arrangement.

As hypothesized, both the fun of the gameplay and the realism of the game narration resulted to significantly influence the willingness to play again for all the models. 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.

Interpreting the fun of the gameplay as a ludic indicator, and the realism of the game narration as a narrative indicator, these results can be referred to the ludology/narratology debate. The results of the present study seem to corroborate a point of view that takes in consideration both positions, even though assigning ludology an higher relevance. 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 2, 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 present study seem to mostly corroborate Jenkins' proposal of "game space", whose structure facilitates narrative experience [13]. 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.

The association of the fun of the gameplay and the realism of the game narration with the ludic and the narrative components of a serious games, however, is exposed to criticism of being both partial and spurious. While the significance of the results of the present paper 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 games, a larger number of indicators should be analyzed and validated as referred to the ludic and to the narrative constructs.

The present work suggests to further deepen the study of the role of the fun of the gameplay as an important determinant of the effectiveness/engagement of serious games, analyzing different causal paths and relations between fun itself and other variables. A wider sample group

and more specific analysis tools must be adopted to go beyond the limits of the present study. It must be underlined, in fact, the small analyzed sample size (n = 54) and the weak reliability of the measuring instrument. Instead of a generic self-developed questionnaire, with one item for each variable, a validated instrument should be adopted, mapping multiple items to variables through factorization.

Some of the limits of the present study are going to be addressed thanks to a Transfer of Innovation project, funded by European Commission, named InTouch-ICT, for the period 2013-2015. The InTouch-ICT Project is adapting previous project results to suit the learning needs of business professionals of ICT SMEs in Turkey, re-designing the existing m-learning kit to fit the requirements of Turkish ICT SMEs, and upgrading it with the most recent findings, both technological and methodological, in the field of mobile game-based learning.

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