Hedonic and Pragmatic Qualities as Predictors for Motivation to Learn in Serious Educational Games

Panagiotis Zaharias
Open University of Cyprus
PO Box12794, 2252, Latsia,Cyprus
Tel. 00357 22 411600
pz@aueb.gr

Ioanna Chatzeparaskevaidou
Open University of Cyprus
PO Box12794, 2252, Latsia,Cyprus
Tel. 00357 22 411600
ioanna.chatzeparaskeyaidou@st.ouc.ac.cy

ABSTRACT
Serious games have both utilitarian and hedonic qualities. Their main goal is to advance learning and motivation to learn while providing fun and enjoyment. The complex issue of motivation to learn has been researched but results are inconclusive. How can hedonic and pragmatic qualities contribute to motivation to learn? In this study ARCS model of motivational design (Keller, 1987) and the UX model proposed by Hassenzahl et al. (2003) are employed as we are trying to interpret this complex phenomenon. A model with hedonic and pragmatic factors predicting motivation to learn is presented and discussed. A serious educational game is used and evaluated in elementary school settings as a complementary method to teach geography. Findings reveal that hedonic values are still strong and contribute in much higher degree to motivation to learn even though the purpose of the game is to learn. Understanding such relationships between motivation to learn and user experience perceptions (hedonic and pragmatic ones) may provide valuable input to the design and evaluation of serious games.

Categories and Subject Descriptors

Categories and Subject Descriptors
K.3.1 [**Computers and Education**]: Computer Uses in Education; H.5.2 [User Interfaces] – *Evaluation/methodology.*

General Terms
Measurement, Design, Human Factors.

Keywords
Serious games, motivation to learn, UX, hedonic qualities, pragmatic qualities.

1. INTRODUCTION
Hedonic systems focus on enjoyment and pleasure seeking [1]. Digital games (in general) fall under this category as the main motive behind playing games is to have fun. On the other hand, serious games have a purpose beyond entertainment, including (but not limited to) learning, social change etc. [2]. Serious games for learning and training purposes rely on the convergence between design techniques and pedagogical tenets of simulations, video games and digital learning systems. While learning is the primary goal one of the distinguishing characteristics that separates serious games from simulations and other e-learning environments, is the focus on fun [3]. Although there are many serious games that are deficient in this perspective researchers and practitioners believe that fun is or must be one of the basic inherent goals of these games.

According to the above serious games must be approached as being both utilitarian and hedonic systems as well. As [4] asserted hedonic systems are associated with intrinsically motivated intentions, such as having fun, whereas utilitarian systems are used for extrinsic purposes, such as completing a work task. In the case of serious games hedonic aspects relate with enjoyment and fun while utilitarian relate with learning. But how can these qualities contribute to the success of serious games? More specifically, how can motivation to learn – the main success determinant of serious games- be influenced by hedonic and pragmatic attributes?

Driving by this research question, the main goal of this study is to explain intrinsic motivation to learn that serious games can provoke under the perspective of their hedonic and utilitarian value. Authors take an instructional design focus on motivation to learn and not on motivation of game playing in general. The ARCS model of motivational design [5] and the UX model proposed by [6] are employed in this study while trying to interpret this complex phenomenon. A model with hedonic and pragmatic factors predicting motivation to learn is presented and discussed.

We argue that hedonic and not only utilitarian attributes of serious games, contribute to a greater learning experience and motivation to learn. To this end, understanding the relationships between motivation to learn and user experience perceptions may provide valuable input to the design and evaluation of serious games.

In the following sections the concept of motivation to learn when playing serious games is described along with perspectives on user experience. This is followed by description of study's method, the game employed in this study, the data analysis and results and the paper concludes with discussion of findings along with some ideas for future research.

2. SERIOUS GAMES AND MOTIVATION TO LEARN
Effective learning can be achieved when playing serious games and this is largely due to the motivation to learn, a factor that has been researched in many studies spanning from traditional learning to online and ubiquitous learning [7] [8] [9].

Motivation to learn is of great importance in learning situations of all kinds including serious games. There is a growing body of research that shows positive effects on motivation after playing serious games focused on several topics such as science, mathematics, language, geography etc. [10] [11] [12]. Such findings are confirmed for both 2d and 3d serious games [13] [14]. With the advent of 3d environments several studies found that due to their perceived novelty these environments seem to increase motivation but many scholars assert that this increase is short-term and difficult to maintain [15] [16] At the same time there have been conducted other related studies that shown no significant gains in motivation to learn [17]. Since the results are somewhat inconclusive more evidence from empirical studies is needed explaining the complex phenomenon of motivation to learn when playing serious educational games.

In terms of methodology many studies have employed the ARCS model of Keller for motivational design [5]. This model has been extremely influential in motivation research and effectively integrates instructional design with key tenets of motivation theories such as expectancy-value theory [18] [19]. It suggests a design strategy that encompasses four components of motivation: arousing interest (*attention*), creating *relevance*, developing an expectancy of success (*confidence*), and producing *satisfaction* through intrinsic/extrinsic rewards. Studies employed this model investigated motivation to learn along with several critical parameters such as cognitive processing [20] experiential learning theory [17] etc**.**

3. FOCUSING ON UX: HEDONIC AND PRAGMATIC QUALITIES

During the current and the last decade there is a growing emphasis on user experience which is associated with both hedonic and utilitarian properties of interactive systems [21]. Despite its growing importance very few UX research efforts have been applied to Virtual Learning Environments including serious games [22] [23].

Numerous studies have investigated several UX qualities of games such as fun, challenge, frustration, flow, choice, engagement, immersion, pleasure, power, purpose [24] [25] [26]. Nevertheless the vast majority of these studies refer to video or online games built for entertainment purposes while the relevant research focused on serious games is still in its infancy.

More recently researchers have started to work systematically on serious games and UX. For instance scholars propose methods for evaluating UX in serious games [27] [28], frameworks for conceptualizing and defining UX in serious games [29], UX measurements [30] etc., but information regarding empirical validation and use of these frameworks and methods is still lacking. To this end, in this study - as the perspective comes from hedonic and utilitarian values - we rely on a well-recognized and validated UX model which has been proposed by [6]. This model was not developed specifically for a certain type of applications such as serious games but takes a broader view of interactive systems: according to this model there are two distinct UX qualities that can be perceived by the users of interactive systems, the pragmatic and the hedonic ones. Pragmatic quality is related with usability issues while hedonic is related with attractiveness, identification and stimulation. Based on this model an instrument was developed, the AttrakDiff questionnaire, which was employed in this study in order to measure UX perceptions and will be described in next section.

4. METHOD

4.1 The game

The game employed in this study was developed on the Scratch platform (http://scratch.mit.edu). The game scenario is quite simple and it is structured around an interactive geography map of Greece. According to the scenario the player has to choose a specific area from the map upon which he/she would like to be asked. The game follows a question and answer method: it prompts the player to choose one geographical region of the whole area and continues with several related questions that are region specific. This is happening repeatedly for other regions as well and the total number is twenty questions.

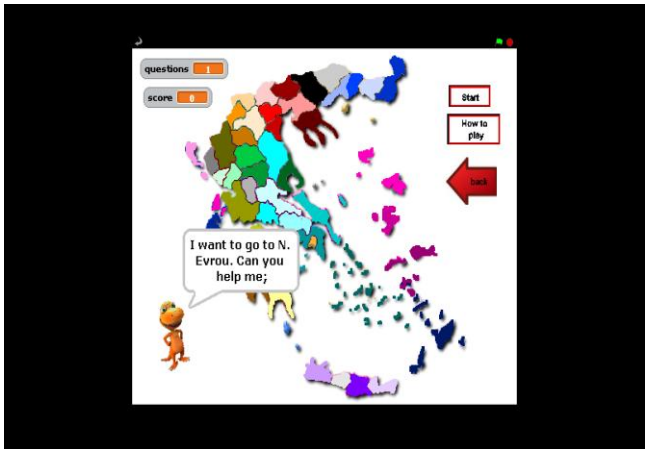

Figure 1: A snapshot of the game

Players had to follow a trial and error process which requires them to answer all the questions correctly in order to proceed, even if they gave wrong answers during their first attempts. The less wrong answers, the higher score the player earns. For each incorrect answer the score is reduced by one point while an accompanied sound that depicts failure buzzes. On the contrary, for each correct answer, the score is increased by three points followed by a clapping sound. For successful completion of the game, the player has to accomplish the mission of answering the right twenty questions, despite the wrong answers, and collecting higher score than the scheduled score by the game scenario. In this case success message is displayed. For lower scores failure message is displayed.

4.2 Participants

The participants were students from eight elementary schools located in Central Macedonia, in the prefecture of Pella in Greece. 78 students participated in the experiment, 54 of whom where girls (69.23%) and 24 boys (30.77%), attending the 5th and 6th grade, from 16 urban and suburban areas. The age ranged between 10 and 12 years old. Students were quite competent in using personal computers and browsing the web. As far as concerns their experience in playing video and online games, 91.8% of the students reported that they play games but the vast majority (66.7%) reported playing games less frequently than 1 or 2 times a week.

4.3 Procedure

Every school we visited has a computer lab and each one is equipped with 10 to 15 computers with an internet connection. The study was set up in these computer labs. Authors repeated the same procedure in each school: a short presentation was given to the students where the main purpose and the basic functions of the game were explained. Right after the presentation the students were encouraged to start playing the game. They were asked to play freely during a class period (i.e. 45 minutes). No specific task or other guideline was neither given nor any other information/hints regarding the game mechanics and narrative. Authors and the teachers of the students were present throughout the whole process making sure that no distractions or other problems emerge. After the game session, the students were asked to complete the UX and motivation to learn questionnaires.

4.4 Data Collection

Two questionnaires were used in order to elicit user experience and motivation to learn perceptions of the players of the game. The well-known questionnaire AttrakDiff2 was employed in order to measure UX qualities (appendix) both hedonic and utilitarian ones. As already mentioned this scale is based on a solid UX model which views an interactive system (in this case the serious game) as having pragmatic (utilitarian) and hedonic attributes.

AttrakDiff2 [6] is composed of four main constructs structured as a list of 28 semantic differentials arranged in 7-point scales. The four main constructs are:

- Pragmatic Quality (PQ), which is related to traditional usability issues (such as effectiveness, efficiency, learnability, etc.)
- Hedonic Quality Stimulation (HQS), which is about personal growth of the user and the need to improve personal skills and knowledge
- Hedonic Quality Identification (HQI), which focuses on the human need to be perceived by others in a particular way; and
- Attraction (ATT) which is about the global appeal of an interactive system or product.

As far as concerns the measurement of motivation to learn, a scale adapted from Keller's ARCS motivational design model [5] was employed. The scale consists of ten items. A composite variable (MoL) is used for the data analysis. A reliability analysis for internal consistency of the scales was performed using the Cronbach's Alpha coefficient. Results show that values for all the respective scales are above the suggested threshold of 0.7 indicating thus good reliability (table 1).

4.5 Data analysis and results

Table 1 presents information about descriptive statistics and reliability data for the AttrakDiff2 subscales and motivation to learn (MoL).

Table1: Descriptive statistics and reliability of scales

	N	Mean	Std. Deviation	Reliability (Cronbach Alpha)
PQ	78	5.172	0.977	α=0.737
HQI	78	5.655	1.082	α=0.715
HQS	78	5.616	0.729	α=0.692
ATT	78	5.863	1.102	α=0.922
MoL	78	3.845	0.618	α=0.747

Multiple regression analysis was performed in order to investigate the quantitative relationship of pragmatic and hedonic quality perceptions with motivation to learn when playing serious games. As we see in table 2 the Variance Inflation Factors (VIFs) are all by far below the rule-of-thumb cut-off of 10 [31], indicating that there are no serious problems with multicolinearity in the dataset.

Table 2: Multiple regression analysis for Motivation to Learn

Criterion	Adjusted R square	Predictors	β	B	VIF
MoL	0,952	PQ	,786	,497	1.827
		HQI	,226	,129	1.948
		HQS	1,272	1,078	2.112
		ATT	,968	,543	2.923

During this analysis we used the Enter method and a significant model emerged ($F_{4,72}=380.484$, $p<0.0005$, Adjusted R square = .952). All variables were found as significant contributors to the model: HQS (beta=1.272, $p<0.0005$), ATT (beta=.968, $p<0.0005$), PQ (beta=.786, $p<0.0005$) and HQI (beta=.226, $p<0.0005$).

5. DISCUSSION AND FUTURE RESEARCH

Findings reveal a solid model where hedonic and pragmatic qualities as described by Hassenzahl's model accounted for 95% of the variance of motivation to learn. It was found that pragmatic (utilitarian) qualities and hedonic qualities were significant predictors of motivation to learn.

Since the interactive system under evaluation is a serious game, one might expect that pragmatic qualities would have contributed much more to the model. However, as data analysis show the major impact on motivation to learn comes from hedonic values such as hedonic quality stimulation (HQS) and attractiveness (ATT). These results confirm pioneering research [32] [33] which argues that fun and entertaining characteristics as well as novelty are intended to provide motivation to learn to the players.

HQS is related with the human need for personal development, i.e. the need to improve personal skills and knowledge [34]. HQS was found to be the most significant contributor to the model, which implies that participants perceived the game as quite novel and interesting with stimulating functionalities and content. In addition attractiveness is also a significant predictor of motivation to learn.

This seems quite reasonable since attractiveness is related with visual design elements and appealing interfaces that can capture the attention of users which is a constituent of motivation to learn.

The influence of pragmatic quality on motivation to learn is also quite high even though it is lower than hedonic factors. Pragmatic quality refers to usability perceptions and task-related aspects of the interaction. It seems that such perceptions may have an influence on motivation to learn when playing serious games. This confirms relevant findings which can be found in e-learning studies [35] supporting that e-learning usability is a strong predictor of motivation to learn. On the other hand we see that pragmatic quality perceptions have a lesser contribution to the model under discussion. We can infer that the serious game in this study was primarily played by students for fun and enjoyment who seek to play for the challenges and the novelty that the game provides rather than learning per se. Similar findings can be found in [36] where students as players of an educational serious game perceived hedonic factors as being more important. Accordingly we could argue as [37] noted that pragmatic use of play is often hidden underneath the pleasurable experience.

An interesting outcome is that hedonic quality identification (HQI) is a less strong predictor of motivation to learn. Identification focuses on the human need to be perceived by others in a particular way. As [6] assert "humans communicate their personality over products". A possible explanation for the relatively low contribution of the HQI in this model is that this quality is more suitable for products and not interactive computing systems such as serious games. In addition the game employed in this study was single player with no communication functionalities or other built-in socialization structures.

The above quantitative findings are also confirmed by authors' informal observations when conducting this empirical study: the vast majority of students –despite the fact that they are not frequent game players- were quite enthusiastic for participating in this study which took place during typical school hours. They approached this experiment with a playful attitude and they tend to almost forget that the main goal of the game is to learn geography. To this end, it seems even if it is about a serious game hedonic perceptions are still strong factors that can predict motivation to learn. As a practical implication of all the above, it is important to note that designers and educational practitioners must cater not only for the pedagogical integrity of a serious game and its usability but also for other classic game-related qualities: challenges, levels and narrative, novelty, appealing interfaces etc.

A specific limitation of the study has to do with the sample whose geographical origin is quite narrow. For generalization of these findings more empirical studies are needed with different samples with different characteristics (i.e. prior gaming experiences, urban area lifestyle etc.) and other types of serious games on different topics and other learning objectives. Future studies must be set up to further advance our knowledge on this complex but very important parameter, i.e. players' motivation to learn. Future studies can take into account the findings of very recent studies that try to establish and validate new UX models customized to meet serious game requirements and specificities. In addition it is important that researchers take into account longer timespans in their studies. Longitudinal studies can be set up and long term UX investigation will shed light on motivation to learn that can be durable and go beyond short term evaluations. Albeit this will demand the development of more sophisticated games so that the players can continue playing the games for longer periods. Last but not least, there should also be a focus on the so-called Serious Experience which goes beyond positive and fun experiences.

6. ACKNOWLEDGMENTS

Authors would like to express their gratitude to the students and their teachers that participated voluntarily in our study.

7. REFERENCES

[1] Van der Heijden, Hans. 2004. "User Acceptance of Hedonic Information Systems," *MIS Quarterly*, (28:4)

[2] Winn, B. (2007). The Design, Play, and Experience Framework. Available online at: http://gel.msu.edu/winn/Winn_DPE_chapter_final.pdf

[3] Pavlas, D. (2010). A Model of Flow and Play in Game-based Learning:
The Impact of Game Characteristics, Player Traits, and Player States. PhD dissertation, available online at: http://www.navistudios.net/Pavlas_Davin_A_201012_PhD.pdf

[4] Lowry, P.B., Jenkins, J.L., Gaskin, J., Hammer, B., Twyman, N.W., Hassell, M., (2008). Proposing the hedonic affect model (HAM). In: Proceedings of JAIS Theory Development Workshop 2008, Sprouts: Working Papers on Information Systems. Available at: http://sprouts.aisnet.org/8-24.

[5] Keller, J. M. (1987). Development and use of the ARCS model of motivational design. Journal of Instructional Development, 10(3), 2-10.

[6] Hassenzahl, M., Burmester, M., &Koller, F. (2003). AttrakDiff: questionnaire to measure perceived hedonic and pragmatic quality. In Ziegler, J. &Szwillus G. (Eds.) Mensch & Computer 2003: Interaktion in Bewegung, 187–196.

[7] Kirriemuir, J., & McFarlane, A. (2004). Games and learning (Literature Review). Retrieved June 20 2012 from: http://telearn.archives-ouvertes.fr /docs/00/19/04/ 53/PDF / kirriemuir-j-2004-r8.pdf

[8] Mitchell, A., &Savill-Smith, C. (2004). The use of computer games for learning. Retrieved 23 July 2012 from: http://www.m-learning.org.

[9] Yang, Y.C. (2012). Building virtual cities, inspiring intelligent citizens: Digital games for developing students' problem solving and learning motivation.Computers & Education 59, 365–377.

[10] Lopez-Morteo, G., & Lopez, G. (2007). Computer support for learning mathematics: a learning environment based on

recreational learning objects. Computers & Education, 48(4), 618-641.

[11] Rosas, R., Nussbaum, M., Cumsille, P., Marianov, V., Correa, M., Flores, P. (2003). Beyond Nintendo: Design and Assessment of Educational Video Games for First and Second Grade Students. Computers & Education, 40(1), 71–94.

[12] Cordova, D.I., &Lepper, M. R. (1996). Intrinsic motivation and the process of learning: Beneficial effects of contextualization, personalization, and choice. Journal of Educational Psychology, 88(4), 715–730.

[13] Tüzün, H., Yilmaz-Soylu, M., Karakus, T., _Inal, Y., &Kizilkaya, G. (2009). The effects of computer games on primary school students' achievement and motivation in geography learning. Computers & Education, 52(1), 68–77.

[14] Virvou, M., Katsionis, G., & Manos, K. (2005). Combining software games with education: Evaluation of its educational effectiveness. Educational Technology & Society, 8(2), 54–65.

[15] Annetta, L. A., Minogue, J. M., Holmes, S. Y., & Cheng, M. T. (2009). *Investigating the impact of video games on high school students' engagement and learning about genetics*. Computers and Education, 53(1), 74–85.

[16] Blumenfeld, P. C., Kempler, T. M., & Krajcik, J. S. (2006). *Motivation and cognitive engagement in learning environments*. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* Cambridge, NY: Cambridge University Press, 475–488.

[17] Kebritchi, Mansureh, Atsusi, Hirumi, Haiyan, Bai (2010). The effects of modern mathematics computer games on mathematics achievement and class motivation. Computers & Education archive, 55(2), 427-443.

[18] Vroom, V. (1964). *Work and motivation*. New York: Wiley.

[19] Porter, L.W., and Lawler, E.E. (1968). *Managerial attitudes and performance*. Homewood, IL: Dorsey Press.

[20] Huang, L. Y. (2011). *Designing serious games to enhance political efficacy and critical thinking disposition for college students: the case of Taiwan.* In proceedings of 3rd International Conference in Games and Virtual Worlds for Serious Applications. Athens, Greece.

[21] Hassenzahl, M., & Tractinsky, N. (2006). User experience - a research agenda. *Behaviour & Information Technology*, *25*(2), 91-97.

[22] Zaharias, P. and Mehlenbacher, B. (2012). Exploring User Experience in Virtual Learning Environments. International Journal of Human Computer Studies, 70 (7), 475-477.

[23] Savin-Baden, M., Tombs, C., Poulton, T. Conradi, E., Kavia, S., Burden, D. e Beaumont, C. (2011.) An evaluation of implementing problem-based learning scenarios in an immersive virtual world. International Journal of Medical Education, 2, 116-124.

[24] Gow, J., Cairns, P., Colton, S., Miller, P., Baumgarten, R., Capturing Player
Experience with Post-Game Commentaries. In *CGAT* (2010). Singapore.

[25] Pedersen, C., Togelius, J., Yannakakis, G. (2009). Modeling Player Experience in Super Mario Bros. In Proceedings of the 2009 IEEE Symposium on Computational Intelligence and Games, September 7-10, 2009, Politecnico di Milano, Milano, Italy.

[26] Nacke, L., Lindley, C. A. (2008). Flow and Immersion in First-Person Shooters: Measuring the player's gameplay experience. In Proceedings of FuturePlay 2008, November 3-5, Toronto, Ontario, Canada, 81-88.

[27] L. Nacke, A. Nacke, C. A. Lindley (2009) Brain training for silver gamers: effects of age and game form on effectiveness, efficiency, self-assessment, and gameplay experience. *CyberPsychology & Behavior* 12 (5) 493-9.

[28] Raybourn, E M. (2007). Applying Simulation Experience Design Principles to Creating Serious Games for Adaptive Thinking Training. *Interacting with Computers, 19 (2),* Elsevier, 206-214.

[29] Marsh, T., Costello, B. (2012) Experience in Serious Games: Between Positive and Serious Experience. In the proceedings of the *Third International Conference on Serious Games Development and Applications*, Bremen Sept 26-27, 2012,pp.255-267.

[30] Gutjahr, M. (2010). Development of a user experience & game design questionnaire. Internal Technical Report, TU Darmstadt.

[31] Neter, J., Wasserman, W., & Kutner, M. H. (1990). *Applied linear statistical models: Regression, analysis of variance, and experimental designs.* Homewood, IL: Irwin

[32] Berlyne, D. E. (1960). *Conflict, Arousal, and Curiosity*. New York: McGraw Hill.

[33] Malone, T.W.: Toward a theory of intrinsically motivating instruction. Cognitive
Science 4, 333–369 (1981)

[34] Schrepp, M., Held, T., & Laugwitz, B. (2006). The influence of hedonic quality on the attractiveness of user interfaces of business management software. *Interacting with Computers*, *18*(5), 1055-1069.

[35] Zaharias, P. and Poulymenakou, A. (2009). Developing a usability evaluation method for e-learning applications: beyond functional usability. International Journal of Human-Computer Interaction, 25 (1), 75 – 98.

[36] Zaharias, P., Gatzoulis, C., Chrysanthou, Y. (2012). Exploring user experience while playing educational games: focus on temporality and attractiveness. International Journal of Gaming and Computer-Mediated Simulations 4 (4).

[37] Nacke, L. E., Drachen, A. and Goebel, S. 2010. Methods for Evaluating Gameplay Experience in a Serious Gaming Context. *International Journal of Computer Science in Sport*. 9, 2010.