

## A Current State and the Future Possibilities of Serious Games

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### 1. Introduction

Although the computer game has been one of a growing industries in Japan, the growth rate is already saturated and the future drastic recovery seems very hard. In some countries, such as the US, the Netherlands and Korea, computer game industry is regarded as one of the key issues in their national strategic policies, and those governments hold them in great account. Why they can do it, and why we don't do it in Japan? One major reason is that the computer game is regarded only as an entertainment in Japan, although the other countries notices that computer game has many potential possibilities in the market of serious games.

In this paper, we will introduce the general overview and the current state of serious games, then show how to develop serious games efficiently, and discuss the future possibilities.

### 2. Overview of Serious Games

The term "Serious Games" first appeared in a book written by Clark C. Apt<sup>1)</sup>. In that book, he mentioned that game is effective for education and training, and named such games as Serious Games. It was written just before the computer games or video games became popular in the market. As the advancement of computer and software technologies, the contributions of computer game development companies in Japan performed a major role in the growth of computer game industries.

At the same time, the development of simulators and simulation systems for defense, space and aeronautics industries pushed the technology advancement of computer and computer games. In those fields, those systems were called Modeling and Simulation (M&S), and used for education, training, exercise support and strategic planning support.

In the years while computer game industry was rapidly growing in Japan, console game machines were in the center of the development. However, in the other countries, the targets shifted from console game machines to PCs. At the same time, there were many research laboratories which aimed to do R&D for game development technologies such as AI, CG and VR established in other countries such as the Entertainment Technology Centers in CMU or USC. In those research laboratories, the same researchers in the field of M&S and games for entertainments got together to study the most advanced computer technologies for creative industries. For an example, ICT (Institute for Creative Technology) at USC developed a game named FSW (Full Spectrum Warriors) which was aimed to be used for US Army's soldiers to do mission rehearsal before they will leave for a new battle space, but also it was sold as an entertainment game running on PCs, SONY's and MicroSoft's console games,

and it became well known as a dual-use game.

In 2004 at the GDC (Game Developers Conference), which were known as an entertainment game developer's conference started to open a "Serious Game Summit", and the name of "Serious Game" and the development become very popular in other countries.

As the above shows, the base technology of both serious and entertainment games overlaps, and both use the most advanced technologies in the field of Computer Science, Cognitive Science, Psychology, Physics, Mathematics, Arts and etc., and interdisciplinary studies are mandatory. The difference between serious and entertainment is the purpose if it's for serious or for entertainment. The term serious means if it is aimed to solve the problem in the real world or not, such as to improve the skill or knowledge, rehabilitation, medical treatments, training and exercises. Although M&S takes an important role in such field, it does not means that serious game is equal to M&S, since serious games does not always models the real world.

There are many project which employed existing entertainment games for serious purposes, and such are called "serious game projects"<sup>2)</sup> and we call it "serious uses of entertainment games" in this paper.

### 3. Preceding Studies

In this section, we introduce serious games that have been developed in several fields and purposes.

#### 3.1. Advertisement for Defense and Public Policies

A variety of systems has been developed in the field of defense and they are efficiently used for tactical or commander's decision making training and exercise support<sup>3)</sup>, and most of them are still called M&S.

On the other hand, the games which run on PC and used both for entertainment and serious are called serious games. FSW is one of such games, and America's Army (AA) which was developed in 2002 is also a well known serious game. AA was developed by the US Army for the purpose to promote US Army for recruitment. It is still well used serious game, and a new website is opened on Oct. 2012 for the latest version AA3.3. According to the survey held by a research company in the US, AA made the impression to the US Army better than before for the young persons between 16 to 24 years of age. The result also showed that the advertisement budget could be reduced to 0.25% among the total advertisement cost of the US Army, by introducing serious games.

Not only in the field of defense, other public organizations are developing serious games to promote their activities. The UN's WFP(World Food Programme) is the one that they have developed a serious game called Food Force (FF). The player of FF acts as an UN's staff to support and deliver food to the region where the food is

being a national problem. It was developed an English version in 2005, and a Japanese game development company localized for Japanese children. In 2012, it became an facebook application and it is used worldwide.

### 3.2. Study and Education

A serious game designed for to be used at high school to support history classes is Making History<sup>2)</sup> (MH). Players act as the presidents or prime ministers in the World War Second years, and they gather and hold the the world situation to consider the next strategies and decide the policies to overcome the situation. During this process, students can learn the modern history of the world. The difference between the other similar types of strategy game is that this game prepared instruction guide for teachers so that they can use this game in actual classes.

In Japan, correspondence course for junior high school students has been very popular, and Plus Eye (PE) is one of such services. The company which operates this PE has introduced a new game service with PE which aimed to improve and keep up the motivation of students who are doing PE. They have analyzed the usage of more than 100 thousands student, and reported the result that the utilization of PE system in 2011 has improved 1.5 to 2.0 times more comparing that of the previous year 2010<sup>7)</sup>. In this service, a student chooses an avatar in the game community, and they complete the scores through the avatars. This service both includes the characteristics of social games and serious game, and it is considered to be one of a new method for studying at home for junior high school students.

In Japan and other many countries, Brain Age (BA) is very popular not only for young persons but also for elder people for brain training type of educational game. BA was developed in Japan, and it has been expected for elderly persons to protect from the senility by activating our brains using games, but scientific papers written about the efficiency of BA has not been published. However, a paper was published in 2012 and it shows the results about the effectiveness BA used for elder persons<sup>6)</sup>. In their experiments, they have divided into two groups, and one use BA and the other use Tetris game, and did experiments to compare the performance of cognition and other functions between two groups. The results showed that BA has showed the partial effectiveness, but they also mentioned that it is too early to say the effectiveness of BA for all cognitive functions of humans.

### 3.3. Healthcare and Medical Treatment

In the field of healthcare for children, a game called Dance Dance Revolution (DDR) which was designed in Japan for entertainment is used at many schools for increasing the health of students<sup>2,3,8)</sup>. The results of the experiments show that it was effective to keep continuing the exercise for 8 to 12 years students, and several states such as California and West Virginia, DDR is very widely used at schools.

In the field of medical treatment, two types have been developed, one is for patients and the others is for medical treatment professionals<sup>9)</sup>. The most famous one for patient is Re-Mission (RM)<sup>10)</sup>, and it is specially made for young cancer patients to improve the knowledge of the cancer,

which is helpful to cure the anxiety of cancer patients. RM is used for three months for field test, and it is reported the efficiency of RM compared to without using this game.

There are several action games for entertainment used for the improvement of the surgical skills<sup>2, 10)</sup>. According to the field test report, the ratio of errors were 37% lower, and the surgical speed was 27% faster, by comparing the doctors who plays more than three hours in a week and less than that.

## 4. Design Process of Serious Games

As we have showed in the previous section, there are two types of development process, and the one is to use an existing entertainment game, and the other is to develop a new serious game for that purpose. Moreover, as the effective serious games are introduced, more serious games will be developed in many fields. In order to develop more serious games for new fields and new objectives, we need to have an efficient design and development process for serious games. In this section, we first introduce several existing processes, then we will introduce our original serious game design process (SGDP) that we are experimentally applying to develop several serious games.

### 4.1. Chris Crawford's Process

Most famous game design process is a Chris Crawford's Game Design Process (GDS)<sup>11)</sup>, which has widely been used by entertainment games. In GDS, game design process is divided into three phases which is shown in Table 1. As the table shows, the phase 1 is for planning and research step, the phase 2 is design and development step, and the phase one is for post-mortem activities.

**Table 1 Chris Crawford's Game Design Sequence**

Phase 1	Choose a Goal and a Topic	Clearly define a Goal Selection of Topic
	Research and Preparation	Study on that Topic
Phase 2	Design	I/O Structure
		Game Structure
		Program Structure
		Evaluation of the Design
Phase 3	Post-Mortem	Pre-programming
		Programming
		Play-testing
Phase 3	Post-Mortem	Evaluation by Critique
		Evaluation by Public

Chris Crawford also suggests 4 key issues for game<sup>11)</sup> (Representation, Interaction, Conflict and Safety), and the most game designers and developers for entertainment supports this 4 issues. However, although GDS has been effective for entertainment game developments, but it is not always applicable to the serious game developments. It is because that GDS was designed for commercial computer game development in general, and the evaluation which is done in the phase 3 is limited by the customer's or critics' evaluation. Moreover, GDS does not consider the process to evaluate the efficiency for the specific purposes of that serious game.



## 5.2. Education of Cooperation for Children

“Line Ho!ckey<sup>(21)</sup> is a table top game which aims to educate the importance of cooperation by experiencing a team play of a hockey type system.

## 5.3. Social Lubrication

It is usually not easy for most persons to communicate with unknown person. Especially at a care house for elderly persons, communication among them affects the quality of their lives. Therefore, we have targeted such place and persons, and developed two types of music tables, MU<sup>3</sup> Table and BBQ: Brain Beats Quartet<sup>18)</sup>, to support the communication among them.

## 5.4. Education of Language for Infants

It is known that a mother to read picture books for her infant is a good method to learn language. In order to have more efficient method for learning language, we have developed an electronic picture book system called MU<sup>3</sup> PictureBook, and a Peach Boy Version<sup>20)</sup> is being under field test for 4 years infants.

## 6. Conclusion

In this paper, we have introduced an overview of serious games and the conventional development process. We also showed the serious game design process (SGDP) that we have proposed and applying to develop our serious games in several fields. Although the development and the evaluation is still underway of those serious games, but some of them are being field tested for those evaluation. To show the effectiveness of those serious games, and also to evaluate the SGDP is our future works.

By showing the effectiveness of the above serious games, the importance of them will be more well understood. Then, we believe that we can make a new market of serious games, and more game developing companies can participate in that society. Moreover, as the social game for entertainment is drastically increased in a market, it might be a very good wave to develop social serious games. We are now focusing on this new field of game, and considering to apply them to education and health care professionals to reduce the medical errors.

Although a game industry has been one of a leading Japanese industries, but it is not in these years. In order to revive it, one way is to focus on a social serious game, because the social games for entertainment is drastically increasing, and serious game is required by users. As to the application field, we believe that serious games for the safety and health will be the most expected field.

## References

- 1) Clark C. Abt, “Serious Games”, ISBN: 978-0819161482, Viking Press (1970).
- 2) 藤本徹, “シリアスゲーム-教育・社会に役立つデジタルゲーム”, ISBN 978-4501542702, 東京電機大学出版局 (2007).
- 3) (財)デジタルコンテンツ協会編, “シリアスゲームの現状調査報告書”, (株)日本機械工業連合会 (2009).

- 4) 古市昌一, 尾崎敦夫, 高橋勝己, 松川仁, 分散型ウォーゲームシミュレーション構築環境の試作と評価-概要-, 第17回シミュレーション・テクノロジーコンファレンス(1998), pp. 113-116.
- 5) David Mollick, Ethan Edery, “Changing the Game: How Video Games Are Transforming the Future of Business”, ISBN- 978-0132171472, FT Press (2008), pp. 141.
- 6) Nouchi R, Taki Y, Takeuchi H, Hashizume H, Akitsuki Y, Shigemune Y, Sekiguchi A, Kotozaki Y, Tsukiura T, Yomogida Y, Kawashima R, “Brain Training Game Improves Executive Functions and Processing Speed in the Elderly: A Randomized Controlled Trial”, PLoS ONE, 7(1) (2012).
- 7) 古野了大, “ユーザ行動可視化とコミュニケーションツールとしてのゲームの効果-教育領域へのゲーミフィケーション実践事例-”, 日本デジタルゲーム学会 2011年次大会予稿集(2012), pp.160-162
- 8) Ute Ritterfeld, Michael Cody, Peter Vorderer, “Serious Games: Mechanisms and Effects”, ISBN- 978-0415993708, Routledge(2009), pp. 158-159.
- 9) Pamela M. Kato, “Video Games in Health Care: Closing the Gap”, Review of General Psychology 2010, Vol. 14, No. 2, American Psychological Association (2010), pp. 113-121.
- 10) Pamela M. Kato, Steve W. Cole, Andrew S. Bradlyn, Brad H. Pollock, “A Video Game Improves Behavioral Outcomes in Adolescents and Young Adults With Cancer: A Randomized Trial”, Pediatrics, 122 (2008), pp. e305-e317.
- 11) Chris Crawford, “Art of Computer Game Design”, ISBN 978-0881341171, Osborne/McGraw-Hill,U.S. (1984).
- 12) 日本工業規格, “JIS 0160 :2012 (ISO/IEC 12207 : 2008), ソフトウェアライフサイクルプロセス” (2012).
- 13) 古市昌一, 和泉秀幸, “分散シミュレーションのための統合基盤アーキテクチャ HLA の紹介”, 情報処理学会学会誌「情報処理」, 第 41 卷 12 号(2000), pp. 1382~1386.
- 14) IEEE Std 1516.3-2003, “IEEE Recommended Practice for High Level Architecture Federation Development and Execution Process (FEDEP)” (2003).
- 15) 古市昌一, 渡部修介, 重野寛, 岡田謙一, 松下温, “災害時における指揮官意思決定訓練のための分散仮想環境構築手法”, 日本バーチャルリアリティ学会論文誌, 第 9 卷, 第 2 号(2004), pp. 131-140
- 16) 志甫侑紀, 花村成慶, 菅原祐人, 小林佳雅, 古市昌一, “チーム協調型シリアスゲームにおける異種システム連携法の提案”, 情報処理学会第 72 回全国大会(2010), 3ZC-1.
- 17) 佐々木 夏朗, 萩原 佑亮, 岩脇 貴久, 中山 智博, 古市昌一, “チーム協調型ゲーム AI 構築法の提案”, 情報処理学会第 72 回全国大会(2010), 4T-9.
- 18) 花村成慶, 武田智裕, 菅原祐人, 栗飯原萌, 志甫侑紀, 古市昌一, “複数ユーザ認識機能を備えたテーブルトップ型 HMI の協調型音楽制作への応用法に関する研究と評価”, 第 73 回 情報処理学会全国大会予稿集(2011), 5ZB-4.
- 19) 大竹駿希, 神野貴之, 花村成慶, 武田智裕, 古市昌一, “タッチパネルを用いた多人数協調型音楽制作システムの提案”, 第 73 回 情報処理学会全国大会予稿集(2011), 2ZA-2.
- 20) 志甫侑紀, 秋元菜那, 君塚翔太, 田邊直人, 古市昌一, “大規模災害時における複数組織指揮官意思決定訓練用シリアスゲームの開発(2)-階層型意思決定機構-”, 第 74 回 情報処理学会全国大会予稿集(2012), 1ZC-5.
- 21) 栗飯原萌, 菅原祐人, 武田智裕, 古市昌一, “子供向け電子絵本における集中力持続のためのインタフェースの開発と初期評価”, 信学技報, vol. 112, no. 66, ET2012-7(2012), pp. 35-38.
- 22) 武田智裕, 古市昌一, “チーム対戦テーブルトップ型シリアスゲーム Line Ho!ckey の開発”, 情報処理学会インタラクティブセッション(2012), pp. 717-722.
- 23) 大竹駿希, 小林貴之, 飯塚梨沙, 山田涼平, 菅原祐人, 杉沼浩司, 古市昌一, “音楽療法向け多人数協調型音楽演奏シリアスゲームシステムの提案”, 第 10 回情報科学技術フォーラム予稿集, J-014(2011).