

The Effects of Drug Experience on Learners' Reaction to a Game-based Anti-Drug System

Jen-Hang WANG^a, Chang-Mai HUANG^a & Sherry Y. CHEN^{a*}

^a*Graduate Institute of Networking Learning Technology, National Central University, Taiwan*

*sherry@cl.ncu.edu.tw

Abstract: In this study, we proposed a game-based anti-drug system to assist people to understand the danger of drug abuse. In addition, we also examined how people's drug experience affected their reactions to the game-based anti-drug system. Thirty people, aged from 23 to 39, participated in this study and was classified into two groups, i.e., addictive people (N=14) and non-addictive people (N=16). Log files and a perception questionnaire were employed to collect and analyze participants' learning behaviors and learning perceptions, respectively. The results revealed that drug experience might affect people's reactions to the game-based anti-drug system. More specifically, the addictive people more focused on anti-drug materials while the non-addictive people emphasized on digital games, regardless of learning behaviors or learning perceptions.

Keywords: Drug experience, game-based learning, anti-drug materials

1. Introduction

In recent years, the spread of drugs endangers the life and health of the public. For example, the World Health Organization (2012) reported that there were 183,000 drug-related deaths around the world in 2012. Additionally, the sharing of injecting equipment among drug users made them particularly vulnerable to HIV (UNODC, 2014). Therefore, approaches, such as media broadcast news (e.g., Wakefield, Loken, & Hornik, 2010) and digital education programs (e.g., Longshore, Ghost-Dastidar, & Elickson, 2006), have been generally adopted to disseminate anti-drug materials and help people understand the harm caused by drug abuse. However, these two approaches have some limitations.

For example, Wakefield, Loken and Hornik (2010) found that people's attitudes towards or behaviors related to drugs were not positively changed by watching a national antidrug media campaign. On the other hand, Thangrattana, Pathumcharoenwattana and Ninlamot (2014) found that youth preferred anti-drug materials delivered by interactive activities, such as games, instead of being delivered by formal education programs. Therefore, there is a need to find another approach to deliver anti-drug materials effectively and enhance people's understandings of the dangerous side effects of drugs.

Among various approaches, game-based learning seems a potential approach to address the above issue. This is due to the fact that digital games are engaging and adaptable to many subjects (Feldman, Monteserin, & Amandi, 2014). For instance, Meluso, Zheng, Spires, and Lester (2012) incorporated science context into an RPG online computer game and examined the relationships between science learning context and learners' learning performance and self-efficacy. The results indicated that learners' performance and self-efficacy in science were greatly improved after they played the game. In addition, Padrós, Romero, and Usart (2012) employed the MetaVals game to help post-graduate students learn finance concepts. Their results suggested that this game improved their finance concepts and there was an increase in common finance knowledge convergence. The aforementioned findings indicated that game-based learning could help learners gain knowledge from learning materials via game context. Due to such benefits, this study develops a game-based anti-drug system (GADS), where digital game-based learning is incorporated into anti-drug materials. In other words, the GADS provides two elements, i.e., anti-drug materials and digital games.

On the other hand, game-based learning contains rich and complex media elements, such as visual and audio elements, which may increase learners' cognitive load due to the processing of these

elements (Nelson & Erlandson, 2008). Accordingly, it is also necessary to consider the risk of overloading a learner's working memory in game-based learning. In particular, not all of learners have such a capacity to cope with cognitive overload. For example, addictive people's neurocognitive functions may have been seriously damaged, including decision making and working memory. Regarding decision making, Brand, Roth-Bauer, Driessen, and Markowitsch (2008) examined how people with opiate dependence and healthy people performed differently while they played with a gambling game (i.e., the Game of Dice Task). Their results revealed that those with opiate dependence demonstrated abnormalities in decision-making and they chose the risky alternatives more frequently than the healthy subjects. Regarding working memory, Fernández-Serrano, Pérez-García, Río-Valle, and Verdejo-García (2010) analyzed the differential contribution of alcohol versus cocaine, heroin and cannabis use on the performance of working memory. The results indicated that substance-dependent individuals had significantly poorer performance of working memory than healthy control individuals.

To address aforementioned issues, the target learners of the GADS not only include people without drug addiction (or drug abuse) but also those with drug addiction. Therefore, diversities may exist between these two kinds of learners, in terms of capabilities or experience. To this end, the aims of this study are two-folded. One is to develop a GADS while the other is to examine the effects of drug experience on learners' reactions to the GADS. More specifically, two research questions are examined in this study:

How does drug experience influence learners' learning behaviors when they interact with the GADS?

How does drug experience influence learners' learning perceptions when they interact with the GADS?

2. Methodology Design

To correspond to the aforementioned research questions, an empirical study was conducted to evaluate the effects of the game-based anti-drug system. The details are described in this section, including the implementation of the game-based anti-drug system, participants, questionnaire, experimental procedure, and data analysis.

2.1 The Implementation of Game-based Anti-Drug System

In order to deliver anti-drug materials through a game-based learning context, this research developed a game-based anti-drug system (GADS), where a drug dictionary was employed to present drug information. Unlike traditional anti-drug systems, the GADS allowed learners to customize four game elements, i.e., drug information, story mode, music/sound, and game hints so that the GADS could accommodate the needs of diverse learners.

- **Drug Information:** The information presented in the drug dictionary (Figure 1) consisted of three categories: drug pictures, side effects, and other information. As advised by Hsu and Chen (2010), adaptive ordering was adopted to allow users to modify the sequence of drug information based on their own preferences. Thus when users click one of the categories on the right side, the relevant drug information will be presented on the left side.
- **Story Mode:** As suggested by Wouters, Van Oostendorp, Boonekamp and Van der Spek (2011), the storytelling of games could increase learners' curiosity in game-based learning. Thus, users with the GADS could either choose a text-mode instruction or a story-mode instruction (Figure 2) to understand the scenarios, the goals, and the rules of the games.
- **Music/Sound:** As shown by Nacke, Grimshaw and Lindley (2010), music and sounds could help players engage in a game. Accordingly, six kinds of music were offered for the option of background music, including classic, blue, dancing, pop, metal, and horror, based on users' preferences. On the other hand, sounds will be used as alerts while users make errors. Furthermore, users could also turn on/off background music and sounds or modify their settings during the gaming process (Figure 3).

- Game Hints: The GADS includes three game tasks, i.e., farm management, drug dictionary and sheep curing. As indicated by Marchiori, Del Blanco, Torrente, Martinez-Ortiz, and Fernández-Manjón (2011), game hints could facilitate players to complete tasks so game hints were applied to provide additional support to help players accomplish these game tasks (Figure 4).

In summary, the design rationale of the GADS was learning by doing. While playing with the GADS, users' drug knowledge could be enhanced by completing the game tasks. By doing so, the GADS could help them realize the harm caused by drug abuse.



Figure 1. Drug Dictionary



Figure 2. Story Mode



Figure 3. Music/Sound



Figure 4. Game Hints

2.2 Participants

Thirty people, aged from 23 to 39, participated in this study. All of them have completed at least the high school education and have the basic computing and Internet skills to use the GADS. They were divided into two groups: addictive learners (N=14) and non-addictive learners (N=16). The former were recruited from the members of a nonprofit detoxification organization while the latter were selected from university students in Taiwan.

2.3 Questionnaire

To investigate how drug experience influenced learners' responses to the GADS in this study, we developed a questionnaire, which majorly included two parts to collect learners' preferences. The first part contained 30 questions with five-point Likert scale, ranged from 1 "strongly disagree" to 5

“strongly agree”. Thus, learners were required to indicate the level of agreement or disagreement with each statement that most closely reflected their opinions.

Furthermore, these questions were concerned with three topics, i.e., (1) the presentation of content and materials, such as “I like to see that the rules of the game are presented in a text-based way.”, (2) the operation and elements of the system, such as “Music can help me be more immersed in the game.”, and (3) the integration between materials and the game, such as “I have enough time to read the drug dictionary during the gaming process”. In other words, the design rationale of these topics was based on the key elements of the GADS, i.e., anti-drug materials and digital games, to capture learners’ perceptions to the presentations of anti-drug materials and the operations and elements of digital games.

The second part consisted of six open questions, which focused on identifying their experience about using the GADS. Therefore, learners were required to describe the problems they came across during the gaming process and their perceptions to the anti-drug materials and game elements offered by the GADS. The reliability of the questionnaire was found to be acceptable ($\alpha=0.78$).

2.4 Experimental Procedure

To achieve the aims of this study, the procedure of this study consisted of two stages. Initially, all participants were introduced about the GADS and instructed how to use tools provided by the GADS. Subsequently, all participants were required to complete the game tasks by interacting with the GADS, and their playing behaviors were recorded in log files. After completing the game tasks, they needed to fill in the questionnaire to express their perceptions.

2.5 Data Analyses

The independent variable of this study was students’ drug experience whereas the dependent variables were their learning behaviors and learning perceptions. Learning behaviors were extracted from learners’ log files, such as the frequencies of using game hints, the frequencies of modifying music categories, and the frequencies of using the drug dictionary. Learning perceptions were determined by their responses to the closed and opened questions presented in the questionnaire. In other words, the results of this study consisted of both quantitative measurement and qualitative evaluation. The former was collected from the closed questions and analyzed with an Independent T-test, which is suitable to test “the difference between the means of two independent groups” (Howell, 2007), to identify differences between addictive learners and non-addictive learners. The level of significance was set at $p < .05$ for all comparisons.

The latter was collected from the opened questions of the questionnaire, and the responses of each group (i.e., addictive learners and non-addictive learners) were coded under the following categories: (1) the presentation of content and materials, (2) the operation and functions of the system, and, (3) the integration between the materials and games. Such qualitative evaluation can be applied to explain the results obtained from the quantitative measurement so that this study can obtain comprehensive information to clearly differentiate the needs and preferences of addictive and non-addictive learners.

3. Results and Discussion

To answer the research questions presented in Section 1, both learning behaviors (Section 3.1) and learning perceptions (Section 3.2) were analyzed in this study. Regarding the former, the effects of learning behaviors were extracted from the log files. Regarding the latter, students’ learning perceptions were examined with quantitative measurement and qualitative evaluation, which were conducted with the closed and opened questions of the questionnaire, respectively.

3.1 Effects on Learning Behaviors

Learners' learning behaviors were described by the log files of the GADS. According to the log files, significant differences were found between addictive learners and non-addictive learners (Table 1 and Table 2). More specifically, addictive learners made more clicks to complete game quests related to anti-drug materials, such as selecting antidotes to heal addictive sheep, while non-addictive learners made more clicks to complete game quests associated with digital games, such as planting fruits and shaving sheep. In brief, these findings implied that the addictive learners focused on the anti-drug materials while the non-addictive learners emphasized on digital games.

Table 1: Game quest related to anti-drug materials.

Variables	Drug Experience	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
The frequencies of healing the addictive sheep	addictive learners	226.57	85.19	2.665	.013*
	non-addictive learners	161.81	44.07		
The frequencies of attempting to select the antidotes	addictive learners	33.64	11.53	2.576	.016*
	non-addictive learners	24.31	8.22		

* $p < .05$

Table 2: Game quest related to digital games.

Variables	Drug Experience	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
The frequencies of planting fruits in the garden	addictive learners	366.07	228.57	-3.214	.003*
	non-addictive learners	697.75	321.20		
The frequencies of shaving the sheep	addictive learners	29.14	20.624	-3.258	.004*
	non-addictive learners	49.13	10.77		

* $p < .05$

3.2 Effects on Learning Perceptions

3.2.1 Quantitative Measurement

An independent T-test was conducted to examine whether addictive learners and non-addictive learners made different responses to the closed questions of the questionnaire. It was interesting to see that significant differences between addictive learners and non-addictive learners were found in the aspects of anti-drug materials and digital games. Regarding anti-drug materials, significant differences existed in Q12 and Q16 (Table 3), which were applied to examine learners' responses to the content and presentation of anti-drug materials provided by the GADS.

As shown in Table 3, the addictive learners would more prefer to read all the information provided by the GADS even though some of the information might not be helpful for them to heal addictive sheep, as suggested by the results of Q16 (*I would read all the side effects of the drug dictionary even some of them could not be applied to heal the sheep which is addicted*). Conversely, the non-addictive learners majorly focused on game activities which might not be related to anti-drug materials. More specifically, the non-addictive learners would relatively ignore the drug information which was not associated with the game quests during the gaming process, as implied by the results of Q12 (*I would not read the drug information which would not be applied to complete the game quests even I have enough time*).

Furthermore, the non-addictive learners would only favor to read the information of side effects that could be used to play the quests, e.g., to heal addictive sheep. Such responses from the non-addictive learners echoed their learning behaviors presented in Section 3.1, which indicated that the non-addictive learners paid more attention to playing digital games. Regarding digital games, a significant difference was found between the addictive learners and non-addictive learners in their

responses to Q27 (*Completing the game tasks is the most important thing during the game process*). More specifically, the non-addictive learners would more strongly consider that completing the game tasks was the most important thing when interacting with the GADS, compared with the addictive learners (Table 3). Once again, this findings suggested that playing the digital games was what the non-addictive learners were very concerned.

Table 3: Learning perceptions of addictive and non-addictive learners.

Variables	Drug Experience	<i>M</i>	<i>SD</i>	<i>t</i>	<i>p</i>
Q12	addictive learners	3.29	0.99	-2.303	.029*
	non-addictive learners	4.06	0.85		
Q16	addictive learners	3.21	1.00	-2.621	.014*
	non-addictive learners	2.13	1.26		
Q27	addictive learners	2.43	1.22	-3.093	.004*
	non-addictive learners	3.81	1.22		

* $p < .05$

In brief, the addictive learners and non-addictive learners focused on different elements of the GADS. The addictive learners showed major interests in the anti-drug materials of the GADS so they would like to read all the anti-drug materials while completing the game quests. On the other hand, the non-addictive learners majorly concentrated on the digital games of the GADS and the information related to the game guests. Such a difference might be because the addictive learners and non-addictive learners had different past experience. More specifically, the addictive learners ever took drugs so the anti-drug materials provided by the GADS were linked to their past experience. However, the non-addictive learners so far did not touch drugs so the anti-drug materials were not associated with the experience of the non-addictive learners.

3.2.2 Qualitative Evaluation

Based on the responses from the opened questions, qualitative evaluation was conducted to illuminate the aforementioned phenomena identified in the quantitative data, which revealed that the addictive learners focused on the anti-drug materials while the non-addictive learners concentrated on digital games. On the other hand, the qualitative results indicated that (1) the addictive learners would spend effort to remember the information displayed in the drug dictionary during the gaming process, (2) they perceived that the GADS could help them learn more about drugs, and (3) they did not pay attention to the game elements that were irrelevant to the anti-drug materials, as shown in Table 4.

Conversely, the game tasks were the focus of the non-addictive learners and their immersion and anxiety could be affected by the outcomes of digital games, as shown in Table 5. Such qualitative findings were not only consistent with those from the quantitative measurement presented in Section 3.2.1, but also might explain why the addictive learners and non-addictive learners were interested in different aspects of the GADS.

Table 4: The perceptions of addictive learners.

Qualitative information		
Addictive Learner	●	Anti-drug Materials
	1.	I try hard to remember the information of the drug dictionary during the gaming process .
	2.	The game help me learn more information about drugs.
	3.	I do not pay much attention to the game elements because these elements are not related to the drug information.

Table 5: The perceptions of non-addictive learners.

Qualitative information		
Non-addictive Learner	●	Digital Games
	1.	I focus on completing the game tasks so I do not read the drug dictionary carefully.
	2.	I feel nervous if sheep eat drugs and become ill so I do not read the drug dictionary carefully.
	3.	I am immersed in taking care of sheep so I did not pay too much attention to drug information.

3.3 Discussion

As shown in the previous sections, drug experience has impacts on learners' learning behaviors and learning perceptions when they interacted with the GADS. More specifically, the addictive learners favored to read the whole information of anti-drug materials even though some information was irrelevant to the game quests of the GADS while the non-addictive learners were more concerned about the digital games of the GADS so they paid less attention to the anti-drug materials that were not helpful to complete the game quests of the GADS. In other words, learners might have different characteristics, which might influence how they used the GADS.

Therefore, there is a need to provide personalization so the design of game-based anti-drug systems could support the needs of diverse learners. More specifically, the drug dictionary should be personalized. The addictive learners could complete the game quests (e.g., the healing of addictive sheep) with partial drug information while the non-addictive learners should use complete drug information presented in the drug dictionary to play the game quests. By doing so, the addictive learners could perceive the entertainment provided by the GADS whereas the non-addictive learners could use the GADS to improve their understandings of drug information.

4. Conclusion

We proposed a game-based anti-drug system (i.e., the GADS) to assist people to understand the side effects of drugs and investigated how people reacted to the GADS. In addition, people' drug experience was also considered in this investigation. Accordingly, two research questions were examined in this study. Regarding the first research question, i.e., how does drug experience influence learners' learning behaviors when they interact with the GADS, the results suggested that the addictive learners more concentrated on anti-drug materials whereas the non-addictive learners put more emphasis on digital games.

Regarding the second research question, i.e., how does drug experience influence learners' perceptions when they interact with the GADS, likewise, the results revealed that the addictive learners were more interested in the anti-drug materials while the non-addictive more focused on digital games, regardless of quantitative measurement or qualitative evaluation. These aforementioned results provided interesting findings on how drug experience affected learners' reactions to a game-based anti-drug system and such findings could be employed in the design of personalized game-based anti-drug systems that can accommodate people with different characteristics, skills and background. However, this study is conducted with a small-scaled sample so a large-scaled sample should be undertaken in future work to provide more evidence.

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