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Mediated enactive experience versus perceived mastery experience: An enhancing mechanism versus a mediator of character attachment and internal political efficacy in serious games

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ABSTRACT

This study aimed to investigate whether mediated enactive mastery experiences provided by a serious game could enhance players' internal political efficacy (IPE) and further, to examine a path model of how character attachment and pretest IPE might influence perceived mastery experience and posttest IPE. A serious game that incorporates the enactive mastery experience and includes inventories of the measured variables was developed using Adobe Flash and JavaScript. One hundred thirteen college students participated in this study. The results of repeated measure analysis of variance revealed that the participants improved their IPE after playing the game, suggesting that the employed enactive mastery experience is effective. Moreover, results of structural equation modeling suggest that perceived mastery experience is an important mediator of character attachment and posttest IPE as well as a mediator of pretest IPE and posttest IPE. The findings of this study shed light on how to incorporate effective psychological mechanisms to enhance IPE in serious games.

1. Introduction

Serious games are digital games designed with purposes beyond entertainment, including games for learning, health, advocacy, and social change (Michael & Chen, 2006; Peng, Lee, & Heeter, 2010; Ritterfeld, Cody, & Vorderer, 2009). A number of serious games have been developed and proved to be effective in increasing domain-specific efficacy, such as scientific efficacy and healthy management efficacy (Meluso, Zheng, Spires, & Lester, 2012; Peng, 2009). However, the underlying mechanisms of their effects are seldom investigated, and few studies have focused on internal political efficacy (IPE). IPE refers to an individual's beliefs that their own or similar individuals' skills and confidence might have an impact on the political process (Riedel & Sullivan, 2001), which is important for the political development in democratic societies.

Mastery experience is the personal experience with success or failure; it has been suggested as an important mechanism for enhancing self-efficacy (Bandura, 1997; Feltz & Lirgg, 2001). To understand the relationship between gaming mechanisms and players' psychological processes, this study distinguishes "mediated enactive experience" from "perceived mastery experience". The former refers to the mastery experience when a player plays an avatar in a game and makes decisions for an avatar (Peng, 2008); it is an essential part of a game (Starks, 2014). The latter refers to a player's psychological evaluations of the experience in achieving certain tasks (Maddux, 2002). An effective mediated enactive experience in serious games should facilitate the player's perceived mastery experience and further enhance their IPE.

On the other hand, the perceived mastery experience may function as a mediator between players' prior IPE, character attachment, and their IPE in serious games with mediated enactive experience designs. People with better prerequisites often have higher learning outcomes (McNamara & Kintsch, 1996). Moreover, the more the players attach to their avatars, the more likely they are to transform their avatars' successful experiences into their own mastery experiences, because character attachment involves feelings of control over and identification with the avatar (Lewis, Weber & Bowman, 2008).

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Briefly speaking, the aims of this study were two-fold: First, to find out whether mediated enactive experiences provided in a serious game would enhance players' IPE. Second, to investigate whether the perceived mastery experience would mediate the influence of prior IPE and character attachment on IPE after game playing. The following sessions will, first, clarify the main concepts of this study and their relationships through literature review. Then, methods to achieve the goals of this study and the experimental results follow. Finally, discussion, conclusions, suggestions, and limitations based on the findings of this study are described.

2. Serious games for improving IPE

2.1. Definitions of IPE

Self-efficacy refers to a belief in one's capabilities to organize and execute the courses of action required to manage prospective situations. It influences how people think, feel, motivate themselves and act (Bandura, 1995). Developed from the concept of self-efficacy, "political efficacy" refers to the feeling that political and social change is possible and that the citizens can play a part in bringing about this change (Campbell, Gurin, & Miller, 1954). More recently, two types of political efficacy, namely, internal political efficacy (IPE) and external political efficacy, have been identified. IPE refers to an individual's beliefs that their own or a similar individual's skills and confidence might have an impact on the political process (Riedel & Sullivan, 2001). External political efficacy refers to the belief that political institutions will be responsive to a citizen's action in the political process, or the belief that one is effective when participating in political life (Riedel & Sullivan, 2001).

This study focuses on IPE rather than on external political efficacy for the following three reasons: First, IPE can be enhanced by education, whereas external political efficacy is influenced more by direct political participation (Riedel & Sullivan, 2001). Second, external political efficacy is related to a set of governmental actors such as political elites, political institutions, and officials (Kolln, Esaiasson, & Turper, 2013); it is difficult to change these outside actors' behaviors to bring about external political efficacy in short serious games. Third, there is no direct relationship between IPE and external political efficacy (Morrell, 2005); therefore, it is possible to change people's IPE regardless of the behaviors of outside actors.

2.2. Serious games and role-playing serious games

Zyda (2005) defined a serious game as "a mental contest, played with a computer in accordance with specific rules, that uses entertainment to further government or corporate training, education, health, public policy and strategic communication objectives". (p. 25). Recently, most researchers agree on a core meaning that serious games are digital games designed with purposes beyond entertainment, including games for learning, health, advocacy and social change (Peng et al., 2010; Ritterfeld et al., 2009).

Serious games can adopt different game genres such as simulation games, adventure games, role-playing games, and strategy games. Among these game genres, role-playing games are often suggested to be highly valuable for both educational and entertainment purposes (Bowman, 2011). Role-playing games are games in which players assume the roles of characters in a fictional setting. Players take responsibility for acting out these roles within a narrative, either through literal acting or through a process of structured decision-making or character development (Cover, 2010). Peng et al. (2010) mentioned that in role-playing games, players have to pretend that they are someone else and try to "take actions" to fulfill the social expectations of this other person in a make-believe situation. In role-playing games, the character controlled by a player is often called an avatar. An avatar is a game unit that is under the player's control. The word "unit" covers the physicality in space and the clear marking of this physicality on the screen (Kromand, 2007). According to Bowman (2011), three main advantages of role-playing are scenario building, problem-solving, and skill training. Moreover, role-playing scenarios are highly useful in encouraging growth across many dimensions of human psychology. For example, role-playing scenarios provide the opportunity to develop self-confidence, as players practice and learn to succeed at a task (Bowman, 2011). Although role-playing games have been widely used for educational and entertainment purposes, few studies have discussed the mechanisms underlying the benefits of learning through role-playing games. Therefore, this study employs role-playing games as the focal game genre to discuss the mechanisms for enhancing IPE.

2.3. Character attachment toward avatars in role-playing serious games

Some researchers (e.g., Jin, 2010; Jin & Park, 2009) have argued that the relationship between a player and the avatar can be considered a "parasocial interaction", whereas other researchers (e.g., Peng, 2008; Peng et al., 2010) have considered the relationship an "identification". The term "parasocial interaction" was coined by Horton and Wohl (1956) in an attempt to address some of the 'new media' around that time, specifically television, and to outline some of the audience behavior being noticed. It is often used to describe one-sided relationships in which one knows a lot about the other, but the relationship is not reciprocal (Ashe & McCutcheon, 2001). In contrast, identification is a process that culminates in a cognitive and emotional state in which the player is not aware of himself or herself as a player, but rather imagines being one of the characters in the text; this often leads the player to internalize the character's goals (Cohen, 2001).

According to Blinka (2008), both identification and parasocial interaction can exist in the relationship between a player and the avatar. Furthermore, in digital games, the relationship between players and avatars is "actual and tangible" (Lewis et al., 2008). In order to describe the psychological mechanism between the individual gamer and the game character, Lewis et al. (2008) proposed the new construct "character attachment". This new construct remains rooted in the parasocial interaction theories but incorporates notions such as suspense of disbelief, responsibilities, and control. Specifically, character attachment refers to an individual's (1) feeling of friendship toward the game character, (2) identification with a video game character, (3) willingness to suspense disbelief, (4) responsibility for the game character, and (5) control of the game character's actions (Lewis et al., 2008). To capture the entire psychological mechanism between a player and his or her avatar, character attachment is adopted in this study.

2.4. Mediated enactive experience versus perceived mastery experience in serious games

Most game-playing studies mix the concepts of "mediated enactive experiences" and "perceived mastery experiences". The former refers to a mastery experience provided by a game, and the latter refers to a player's subjective judgment of the experience (Feltz & Lirgg, 2001). According to Starks (2014), mastery experiences are "win" experiences in which the player is successful, and they are already an essential part of the game. Moreover, games provide a consistent mastery curve, which includes easy goals that

are easily mastered and progressively lead to more difficult goals. To be noticed, "win" experiences should not mean a game's final outcomes; rather, it should be referred to a process which keeps players engaged and moving forward in a game. Therefore, mediated enactive experiences should be positively related to perceived mastery experiences when players get to proceed in a game.

In terms of how to enhance mastery experiences through enactive experiences in a game, Bandura (1986, 1997) suggested that mastery experiences can be achieved through four mechanisms: (1) acquisition of needed knowledge and skills to perform the behavior, (2) progressive goal setting, (3) feedback on performance, and (4) practice of skills in diverse settings or situations. Moreover, Kolb's (Kolb & Kolb, 2005) key concept that knowledge is created through the transformation of experience in the experiential learning model and Kiili's (2005) major components in the experiential gaming model provide good suggestions for enhancing mastery experiences. Killi's model, built on Kolb's model, emphasizes the importance of providing the player with immediate feedback, clear goals, and challenges that are matched to his/her skill level. Specifically, Kiili (2005) claimed that the following four stages should be incorporated in a game to gradually develop flow experience through the building of positive experiences: (1) concrete experience: players meet challenges and develop ideas or preinventive ideas to overcome the challenges: (2) reflective observation: players receive feedback, and the observation of the feedback can lead to the construction of the schemata and enable the discovery of new and better solutions to the problems; (3) abstract conceptualization: players can conclude and learn from the experience; (4) active experimentation: players try out the solutions to the challenges and gain feedback from the challenge.

2.5. Character attachment, perceived mastery experience, and IPE in serious games

According to Bandura (1977), four sources might enhance self-efficacy, and each source has a different mode of induction: (1) Performance accomplishment: participant modeling, performance desensitization, performance exposure, and self-instructed performance; (2) vicarious experience: live modeling and symbolic modeling; (3) verbal persuasion: suggestion, exhortation, self-instruction, and interpretive treatments; (4) emotional arousal: attribution, relaxation, biofeedback, symbolic desensitization, and symbolic exposure. Among these sources, performance accomplishment is most influential, because it is based on personal mastery experiences (Bandura, 1997). Notably, success is often subjective. Accomplishments that are deemed successful by observers are not always judged as such by the performer. It is one's cognitive process of mastery experiences that influences self-efficacy beliefs. If one has repeatedly viewed these experiences as success, self-efficacy beliefs will increase; if one has repeatedly viewed these experiences as failures, self-efficacy beliefs will decrease (Feltz & Lirgg, 2001). Accordingly, self-perceived mastery should be critical to the improvement of IPE.

In terms of the relationship between an avatar and perceived mastery experience, Thompson (2012) suggested that the use of avatars can be a useful technique for promoting personal mastery. Since players often identify with their avatars, avatars may serve as powerful models, particularly when they are self-representative or bear a strikingly similar appearance to the player. Identification is an important characteristic of character attachment and is one of the most important psychological mechanisms that explain the relationship between an avatar and the player. Many findings have revealed that identification is critical to learning, especially when the models and audience are of the same sex (Andsager, Bemker, Choi, & Torwel, 2006) and when the models demonstrate opinions similar to the audience (Hilmert, Kulik, & Christenfeld, 2006). Moreover, the more people care about and become attached to their character, the more likely it will be that a video game's message is learned (Lewis & Weber, 2009). Accordingly, the more people identify with the media character, the more likely it is that the behavioral outcomes to the character are applicable to them.

The mediating role of mastery experience in the relationship between character attachment and IPE can be illustrated by Jang, Kim, and Ryu's (2010) study. In this online survey study, 675 South Korean game players were included to investigate the relationship between avatar-self similarity and the game players' performance as well as the relationship between mastery experience and the players' general self-efficacy. Their results showed that avatar-self similarity affected the mastery experience and, further, influenced players' general self-efficacy. Similarly, Peng (2008) found that the more people identify with their media character, the more likely it is that they have an increase in self-efficacy for performing the behaviors that the media characters had performed.

Furthermore, prior IPE might influence the IPE after game playing. According to Maddux (2002), people might form beliefs about future events, current situations and beliefs about their abilities and behavior according to their previous knowledge and experiences. This ability is called self-regulation and is an important assumption of social cognitive theory (Maddux, 2002).

To conclude, mediated enactive experiences provided by a political game should be positively related to perceived mastery experiences and carry effects on the players' IPE in serious games. Moreover, when players become more attached to their avatars, they might be more likely to transform the mediated enactive experience into their perceived mastery experience, and further, to facilitate their IPE. In contrast, prior IPE might influence the level of mastery experience and might further, enhance the players' IPE.

2.6. Hypotheses

To differentiate the influence of mediated enactive experience and perceived mastery experience on IPE in serious games, a political game incorporating mediated enactive experience and measures of perceive mastery experience was developed to enhance IPE. The following two hypotheses were proposed in this study:

H1. After playing the political game, players would increase their IPE.

H2. The players' character attachment would interact with their prerequisite IPE and would then indirectly influence their IPE after game playing through perceived mastery experience. Meanwhile, the players' character attachment and their prerequisite IPE would also directly influence their IPE after game playing (see Fig. 6 for the hypothesized model).

3. Method

3.1. Participants

One hundred thirteen college students (34 males and 79 females) with a mean age of 21.72 years ($SD = 2.65$) participated in this study. Approximately 5 USD were rewarded for the participation.

3.2. Instruments

Three inventories developed by the researchers were employed

in this study. They were *Inventory of Character Attachment* (ICA), *Inventory of Perceived Mastery Experience* (IPME), and *Inventory of Internal Political Efficacy* (IIPE). All the inventories were 6-point Likert scales with response options ranging from "totally disagree" to "totally agree", which represented 1 point to 6 points.

The ICA, employed to measure the participants' character attachment to the avatar, was revised from the Character Attachment Scale (Lewis et al., 2008). Exploratory factor analysis revealed three factors, namely, identification (2 items), fantasy and control (4 items), and responsibility (3 items) (see Appendix A). The factor loadings ranged from .626 to .876. The cumulative variance explained by the three factors was 68%. Moreover, the correlation coefficients between each factor and the total ICA score were .656–.847, $ps = .001$. The results of item analysis using upper and lower 27% as cut-points also showed that all the items could discriminate those with a high level of character attachment from those with a low level of character attachment (all *t*-values were significant at the .001 level). In terms of reliability, the Cronbach's α coefficients for the ICA and the factors of "identification, "fantasy and control", and "responsibility" were .783, .609, .761, and .778, respectively.

The IPME was employed to measure the participants' perceived mastery experiences after playing the game in this study. Exploratory factor analysis revealed two factors: enhancement of ability (5 items) and enhancement of confidence (4 items) (see Appendix B). The factor loadings ranged from .525 to .920. The cumulative variance explained by the two factors was 61%. Moreover, the correlation coefficients between each factor and the total IPME score were .816 and .847, $ps = .001$. The results of item analysis using upper and lower 27% as cut-points also showed that all items could discriminate those with a high perceived mastery experience from those with a low perceived mastery experience (all t-values were significant at the .001 level). In terms of reliability, the Cronbach's α coefficients were .821, .751 and .864 for the IPME, the factor of enhancement of ability, and the factor of enhancement of confidence, respectively.

The IIPE was employed to measure the participants' internal efficacy of carbon emissions trade issues. Exploratory factor analysis revealed two factors: information access and confidence in ability (4 items) and interest and involvement (3 items) (see Appendix C). The factor loadings ranged from .619 to .956. The cumulative variance explained by two factors was 71%. Moreover, the correlation coefficients between each factor and the total IIPE score were .920 and .856, $ps = .001$. The results of item analysis using upper and lower 27% as cut-points also showed that all items could discriminate those with a high level of IPE from those with a low level of IPE (all t-values were significant at the .001 level). In terms of reliability, the Cronbach's α coefficients were .868, .863, and .777 for the IIPE, the factor of information access and confidence in ability, and the factor of interest and involvement, respectively.

3.3. The "empower" game and the experimental design

The Empower is a monopoly game designed with the topic of carbon tax issues. In the game, important arguments concerning carbon tax and carbon emission trading were collected from the past news and were carefully grouped to represent the pros and cons.

The Empower was designed to measure as well as to improve IPE in role-playing serious games. This study adopted Bandura's (1986, 1997) suggestions for achieving mastery experiences, Kolb's (1984) stages in experiential learning model, and Kiili's (2005) major concepts in experiential gaming model as major strategies in the Empower game. Moreover, perceived similarities with the avatar may play an important role during gaming. One leading hypothesis in media psychology (Hoffner & Cantor, 1991) is that characters who are similar to the audience are more likely to generate stronger character identification than non-similar characters. Perceived similarities may include demographic characteristics, personalities, behavioral tendencies, life experiences, attitudes, and so on. In Hoffner and Buchanan's (2005) study, young adults reported greater identification with same gender characters on fictional television and with characters who had similar attitudes with them. Accordingly, character attachment through the chosen avatar was incorporated in the Empower game. The main strategies employed in the Empower game are depicted in Table 1.

Two avatars were created and each of the avatars represented a political position toward the issue. Players were informed of the positions of these two avatars before they started to play the game. No other differences were attempted to be incorporated in these two avatars. In this study, we were interested in the influences of "attitude similarities between the avatar and the player", rather than other types of similarities on character attachment. Therefore, the players were asked to choose one avatar based on the similarity of their attitudes toward the concerned issue with the avatar first. Then, they went through twelve questions, in which the following mechanisms designed to improve the player's character attachment, mastery experiences, and IPE were incorporated (see Table 1 for more details): (1) Acquired needed knowledge and skills to perform the behavior through character attachment: Players played an avatar and were guided to answer public policy questions correctly (see Fig. 1). In the guiding process, players guessed and understood the perspectives of the avatar gradually. This process involved character identification, concrete experience, reflective observation, abstract conceptualization, and active experimentation. (2) Progressive goal setting: Players met challenges in different levels. The challenges were measurable by prizes. Each challenge was designed to meet the final goals (see Fig. 2). (3) Feedback on performance: When players succeeded in a task, some prizes and sound praises were provided. In the end of the game, players would also know the overall scores (see Fig. 3a). (4) Practice skills in diverse settings or situations: Players had to practice the learned knowledge in three different imaginary settings through typing out their viewpoints (See Fig. 3b). The more words they typed, the more coins they obtained. Word count below 10 got 500 coins, that between 10 and 20 got 1000 coins, and that beyond 20 got 1500 coins. In addition, by pretending to be the avatar and by thinking as the avatar, the player may gain mastery experiences through the attachment and guidance of the avatar.

Notably, after the player chose the avatar, he or she had to throw the dice and went to the next step. The avatar's full body was shown in the middle of the webpage. Once the avatar arrived at the assigned destination, one question would show up and the player had to choose the right answer from a multiple choice item. At this moment, a conversation was shown on the screen (See Fig. 2). If the player chose the wrong answer, the game would show a sound effect of failures and the player had to choose again until a right answer was chosen. By encouraging the player to think again, the player would, hopefully, change his/her perspectives to the avatar's perspectives. Furthermore, except for the similarities of the attitudes, the attachment to the avatar was also strengthened by giving clues to the player about the avatar's emotion and fame coins. By inferring the current state of the avatar, the player might feel more attached to the avatar.

3.4. Procedures

All participants completed the game in a computer laboratory. First, participants filled out the consent form and the pretest

Table 1
Mechanisms designed to improve the player's character attachment, mastery experiences, and IPE in the Empower game.

Key process of learning	Mechanisms designed to improve the player's mastery experiences and IPE
Acquired needed knowledge and skills to perform the behavior through character attachment	• **Character identification:** The player chose an avatar whose attitudes were similar to him/her. • **Concrete experience:** Players played an avatar guided to answer public policy questions. • **Reflective observation:** Players guessed the personalities and perspectives of the avatar. • **Abstract conceptualization:** Players understood the personalities and perspectives of the avatar gradually. • **Active experimentation:** Players tried to answer the questions based on their observations and conceptualizations of the avatar.
Progressive goal setting	• Players met different challenges in different levels. • The challenges were measurable by prizes. • Each challenge was designed to meet the final goals.
Feedback on performance	• When players succeeded in a task, some prizes and verbal praises were provided.
Practice skills in diverse settings or situations	• Players met different challenges in different scenarios. Thus, players could practice the learned skills. • Gain mastery experiences through the attachment and guidance of the avatar.

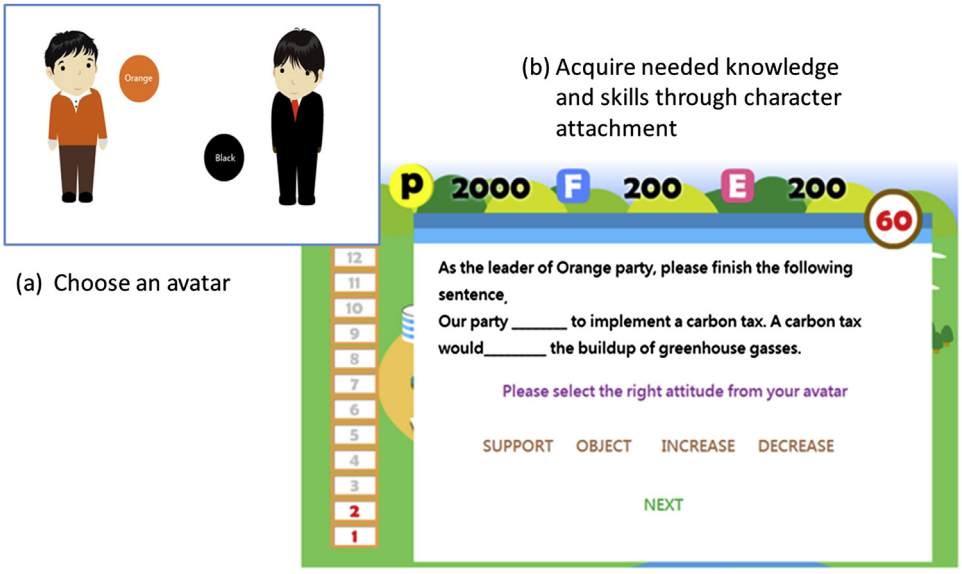

Fig. 1. A screen shot exemplifying how players chose their avatar.

Fig. 2. A screen shot exemplifying how players met challenges in different levels. *Note.* P means the coins a player won or lost from answering the questions in the game, whereas E and F mean "emotion" and "fame" of the avatar. E and F coins are designed to give hints about the reaction of the avatar toward the choice of the player. The player received the overall scores after playing the game.

inventory of IIPE. Next, they were requested to play the game. The game took approximately 60 min to complete depending on personal reaction time. Upon completion of the game, participants were asked to complete the posttest inventories, including the ICA, IIPE, and IPME. The total procedure took 1 h. The procedures were depicted in Fig. 4.

4. Results

4.1. Preliminary analysis

4.1.1. Descriptive analysis of the measured variables

The means and standard deviations of the measured variables in this study are displayed in Fig. 5. Overall, after playing the game, the participants had a medium level of character attachment ($M = 3.93$, $SD = .70$). More specifically, the results showed that players had a medium level of identification ($M = 3.71$, $SD = .88$), a medium level of fantasy and control ($M = 3.74$, $SD = 1.57$), and a slightly higher level of responsibility ($M = 4.34$, $SD = .70$). With regard to IPE, the participants had a medium level of perceived mastery experience ($M = 3.93$, $SD = .70$); moreover, the participants slightly increased their mean scores from 3.26 ($SD = .72$) in the pretest to 3.51 ($SD = .68$) in the posttest.

4.1.2. Gender difference in changes of IPE

To examine gender differences in changes of IPE, we conducted a

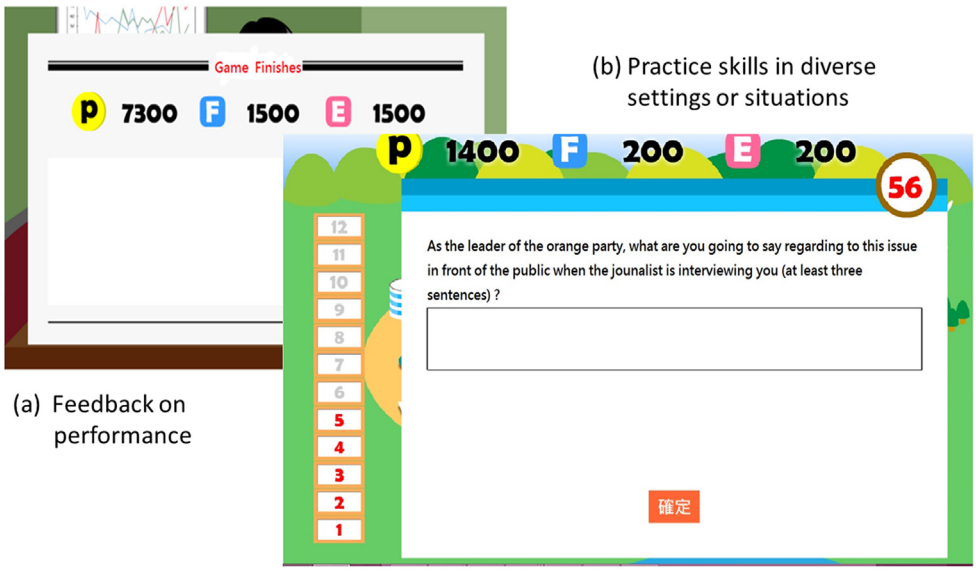

Fig. 3. A screen shot exemplifying receiving feedback and practicing skills.

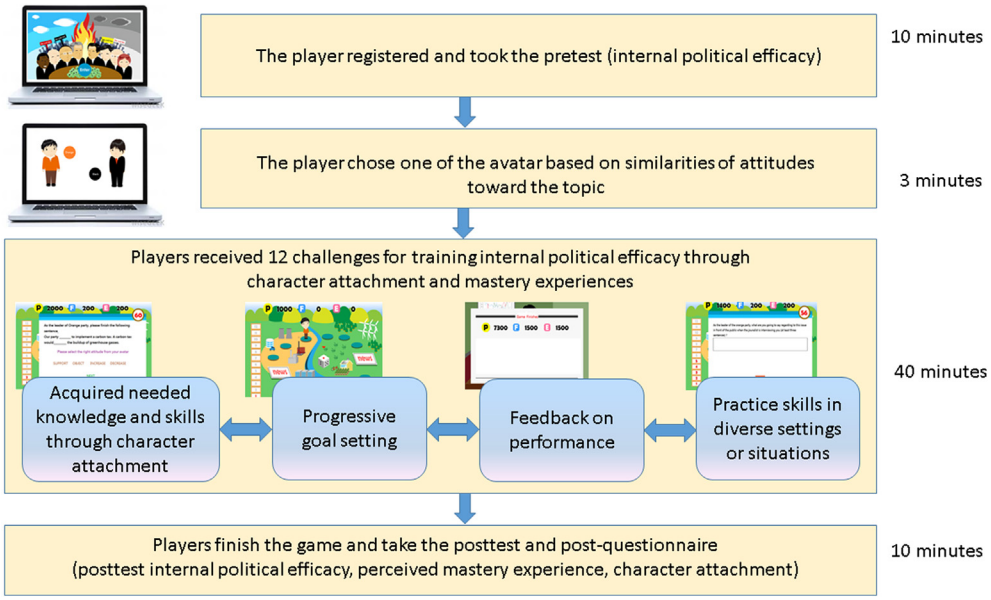

Fig. 4. Experimental design and procedures of the experiment.

2 (between variable: female vs. male) × 2 (within variable: pretest vs. posttest IPE) repeated measure analysis of variance (ANOVA). The results revealed a significant pretest-posttest effect, Wilks' $\Lambda = .795$, $p = .000$, $\eta_p^2 = .205$. However, no significant gender effect or interaction effect was found, $F(1, 111) = .049$, $p = .825$, $\eta_p^2 = .000$ and $F(1, 111) = .140$, $p = .709$, $\eta_p^2 = .001$, respectively. These results revealed that both genders improved their IPE after playing the games, and there were no significant differences in changes of IPE between the genders. We therefore proceeded with the SEM analysis using all participants.

4.1.3. Effects of training

To examine whether the training through the Empower game could enhance the participants' IPE, we conducted a repeated measure ANOVA. The results showed that there was a significant pretest-posttest effect on the change of IPE, Wilks' $\Lambda = .755$, $p = .000$, $\eta_p^2 = .245$. The finding indicated that the participants improved their IPE after playing the games (see Fig. 5 for *means* and *SDs*).

4.2. Results of the proposed model

Structural equation modeling conducted through AMOS 20 was employed to test the proposed model. Bagozzi and Yi, (1998) suggested that three indices should be employed to examine the goodness of fit of a model. These indices are preliminary fit criteria, overall model fit, and the fit of the internal structure of the model. The present study employed these indices to investigate the goodness-of-fit of the proposed model. Analyses considering these aspects revealed that all estimated parameters in this study met the criteria proposed by Bagozzi and Yi. The important values of the model are shown in Fig. 6.

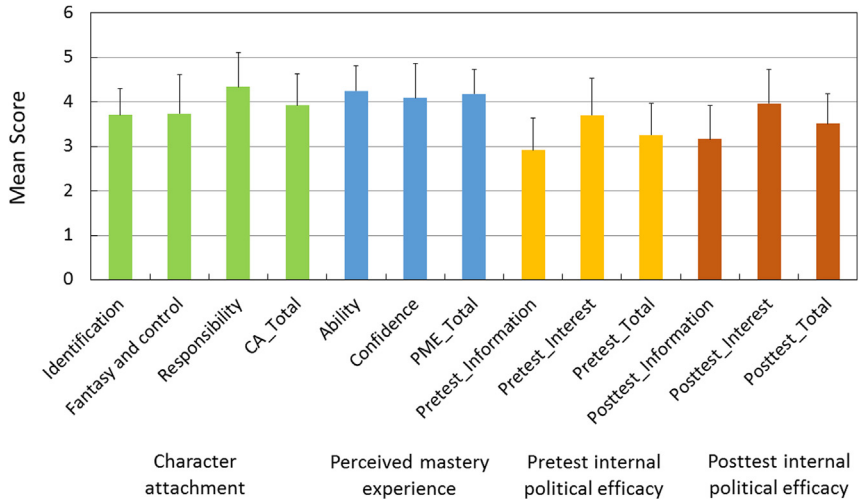

Fig. 5. Means and standard deviations of the measured variables.

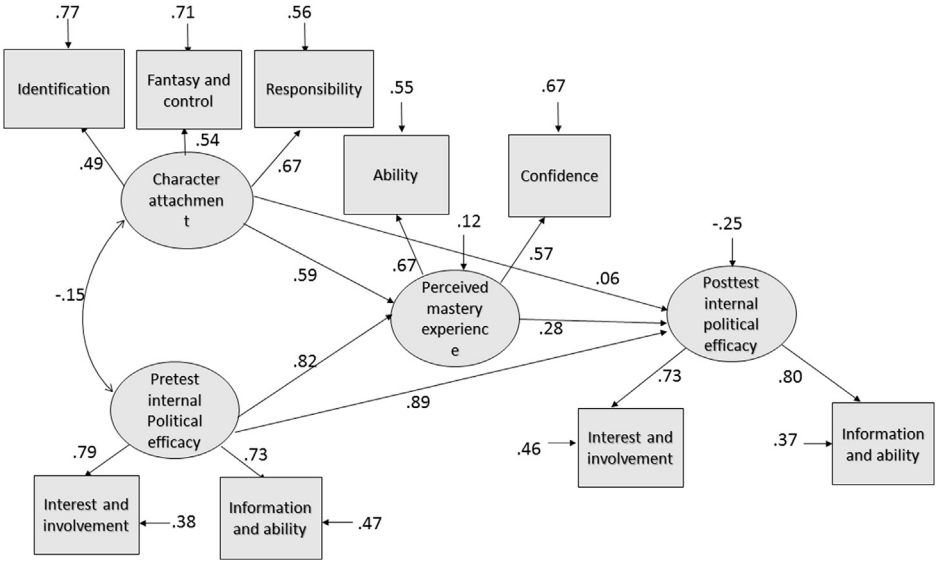

Fig. 6. The proposed path model.

Following the suggestion of Hair, Black, Babin, Anderson, and Tatham (2006), the following three dimensions of indices were also employed to examine the overall model fit of the proposed model in this study: absolute fit measures, relative fit measures, and parsimonious fit measures. The absolute fit measures suggested that the model was not a good fit: $\chi^2(N = 131) = 91.484$, $p = .000$. Moreover, the goodness-of-fit index (GFI), the adjusted goodness of fit index (AGFI), the standardized root mean square residual (SRMR), and the root mean square error of approximation (RMSEA) did not meet the ideal criteria. In terms of relative fit measures, the normed fit index (NFI), the non-normed fit index (NNFI), the comparative fit index (CFI), the relative fit index (RFI) and the incremental fit index (IFI) were all less than .90. Finally, from the perspective of the parsimonious fit measures, the parsimony normed fit index (PNFI) and the parsimonious goodness of fit index (PGFI) were acceptable (see Table 2). Overall, analyses of the overall model-fit measures suggest that the proposed model was a poor fit. Moreover, the direct effect of character attachment on pretest IPE and posttest IPE were not significant. Therefore, we revised the proposed model based on modification indices.

Table 2
The comparisons between the proposed model and the revised model.

Measures	Proposed model	Revised model	Criteria and judgment
Overall fit measures			
χ^2	91.484	27.806	
p-value	.000	.146	$p > .05$, good
df	21	21	
GFI	.872	.949	>.90, good
AGFI	.726	.891	>.80, reasonable
RMSEA	.173	.054	<.05, good
			<.08, reasonable
Relative fit measures			
NFI	.784	.934	>.90, good
NNFI	.688	.970	>.90, good
CFI	.818	.982	>.90, good
IFI	.825	.983	>.90, good
RFI	.629	.887	>.80, reasonable
Parsimonious fit measures			
PNFI	.457	.545	The higher, the better
PGFI	.407	.443	The higher, the better
Normed χ^2 (NC)	4.356	1.324	1 < NC < 3 better

4.3. Results of the revised model

4.3.1. Goodness-of-fit of the revised model

To revise the model to a good-fit, the significance of direct effects were examined, and those insignificant paths were removed. Moreover, based on modification indices, we added the covariances between the factors of pretest IPE and posttest IPE. The important values of the model are shown in Fig. 7.

The absolute fit measures suggested that the revised model was a good fit, χ^2 ($N = 131$) = 27.806, $p = .146$. In addition, GFI, AGFI, SRMR, and RMSEA all reached the ideal criteria. In terms of the relative fit measures, the NFI, NNFI, CFI, and IFI were all greater than .90 (See Table 2). Finally, from the perspective of the parsimonious fit measures, PNFI and PGFI both reached the ideal level. Overall, analyses of the overall model-fit measures suggest that the revised model is a good-fit model.

Moreover, we employed $\Delta\chi^2 = (\chi_1^2 - \chi_2^2)/(df_1 - df_2)$ to examine the difference between the proposed model and the revised model. The $\Delta\chi^2 = 63.678$, $p < .05$. In addition, comparisons of the overall fit measures, relative fit measures, and parsimonious fit measures (Bagozzi & Yi, 1998; Hair et al., 2006) indicate that the revised model was a better-fit model than the proposed model.

4.3.2. Fit of internal structure of the revised model

The composite reliability for character attachment, perceived mastery experiences, pretest IPE, and posttest IPE was .59, .61, .74, .76, respectively; the extracted average variance for character attachment, perceived mastery experiences, pretest IPE, and posttest IPE was .33, .44, .59, .62, respectively. These results indicate that the revised model had an acceptable fit of internal structure.

4.3.3. Analyses of direct effects, indirect effects, total effects, and explained variance

The direct effect of character attachment on perceived mastery experience was .45, $p = .005$; The direct effect of perceived mastery experience on posttest IPE was .51, $p = .000$; therefore, the total effect of character attachment on posttest IPE was .23. In contrast, the direct effect of prior IPE on posttest IPE was .51, the direct effect of prior IPE on perceived mastery experience was .68, and the total effect of prior IPE on posttest IPE through perceived mastery experience was .35; therefore, the total effect of prior IPE on posttest IPE was .86 (see Table 3).

In addition, Fig. 7 shows that the residual variance of perceived mastery experiences was .33, indicating that character attachment and pretest IPE explained 67% of the variance of perceived mastery experience; the residual variance of posttest IPE was .12, indicating that character attachment, pretest IPE, and perceived mastery experiences explained 88% of the variance of posttest IPE.

5. Discussion

Two hypotheses were examined in this study. The first hypothesis concerns the effects of the developed serious game (Empower) in improving IPE. The results revealed that participants improved their IPE after playing the Empower game, suggesting that the mediated enactive experiences provided by the game were effective in enhancing IPE. The mediated enactive experiences employed in this study included providing guided practice for acquiring needed knowledge and skills through concrete experience, reflective observation, active experimentation, abstract conceptualization, progressive goal setting, and feedback on performance. The findings here lend support to Bandura's (1997) suggestions of achieving mastery experiences, Kolb's (1984) concepts in experiential learning model, and Kiili's (2005) stages in experiential gaming model. The results are also in line with both Starks' (2014) argument that mastery experiences are "win" experiences, which are an essential part of the game, and the claim that games provide a consistent mastery curve through goal setting. In this study, a player gradually learned how his or her character thinks of the carbon trade issue by being guided to answer the designed questions correctly. This mechanism may enhance a player's attachment to his or her character. Regarding the enhancement of mastery experiences, the mechanisms such as "requesting the player to practice the leaned skills in an imagery setting", "providing feedback such as prizes and points to reinforce the win experience", and "guiding progressive goal setting" should contribute to such an effect. Moreover, this study required a player to go through the aforementioned processes for four rounds (each

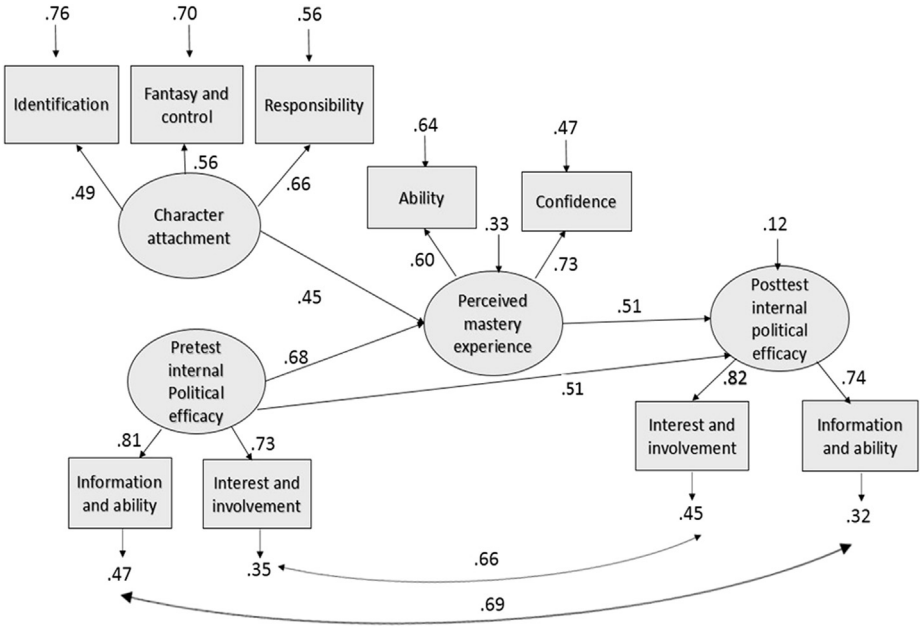

Fig. 7. The revised path model.

Table 3
Direct, indirect, and total effects of the revised model.

Paths between variables	Direct effect	Indirect effect	Total effect
Character attachment->Perceived mastery experiences	.45		.45
Perceived mastery experiences->Posttest IPE	.51		.51
Character attachment->Posttest IPE	.00	.23	.23
Pretest IPE->Perceived mastery experience	.68		.68
Pretest IPE->Posttest IPE	.51	.35	.86
Overall effects			2.73

round with three questions). Accordingly, the mediated enactive experience of this type of continuous learning and reinforcing process is effective in enhancing the players' mastery experiences in the Empower game.

The second hypothesis proposed in this study was that character attachment would influence posttest IPE directly and indirectly through perceived mastery experience, that prior IPE would influence posttest IPE directly and indirectly through perceived mastery experience, and that character attachment and prior IPE would be correlated. However, the analysis of structural equation modeling failed to support either the relationship between character attachment and posttest IPE or that between character attachment and prior IPE. The revised model revealed that IPE can be enhanced through two paths in which perceived mastery experience acted as a mediator.

For the first path, this study found that character attachment influenced posttest IPE through perceived mastery experiences, which suggests that the more the players attach to their avatars, the more they perceive their mediated enactive experiences as their own mastery experiences, and the greater IPE is enhanced. However, the mean scores and the factor loadings in the path model (see Fig. 7) suggest that role-playing through avatars with similar attitudes are more effective in enhancing responsibility as well as fantasy and control than identification in character attachment. Although supporting Hoffner and Cantor's (1991) findings, these results suggest that role-playing through avatars with similar attitudes or positions alone may not powerful enough to enhance great character attachment. On the other hand, the results did not show a direct effect between character attachment and post IPE, suggesting that a player's efficacy would not be enhanced merely because he or she attaches to the avatar. In other words, internalizing character attachment of an avatar through sufficient enactive experiences, rather than just identifying oneself with the avatar, is critical to the enhancement of IPE in a serious game. Therefore, the use of avatars may be a useful technique for promoting personal mastery (Thompson, 2012). However, it should be employed under the condition that players can transform the mediated enactive experiences from an avatar to their own mastery experiences. The findings here not only lend support to the Jang, Kim, and Ryu (2010) study, which demonstrated that avatar-self similarity, mastery experience, and general self-efficacy are positive related, but also illustrate the possibility of enhancing domain-specific efficacy through serious games.

In addition, many serious games in the past requested participants to perform a task similar to that of the avatar did (e.g., Peng, 2008). In this study, however, we did not request an avatar to perform any specific tasks, but instead asked an avatar to imagine what to say in a scenario. Such a design obviously facilitated the connection of avatar attachment and perceived mastery experience and, further, enhanced the participants' IPE. Accordingly, efficacy can be strengthened not only by asking players to do the same behaviors as an avatar, but also by asking players what to do in a scenario.

For the second path, this study found that prior IPE influenced post IPE both directly and indirectly through perceived mastery experiences, suggesting that prior IPE from real life experience influences IPE after playing a serious game. The result is in line with the basic assumption of social cognitive theory (Maddux, 2002) which states that people may form beliefs about their abilities and behavior according to their previous knowledge and experiences. Moreover, social cognitive theory and self-efficacy theory assume that we have the capacity for self-regulation and self-initiated change (Maddux, 2002). Therefore, a person's efficacy can be influenced by his or her self-regulation from past experiences.

Notably, this study found that although prior IPE had a great influence on IPE after playing games, perceived mastery experience brought about by the mediated enactive experience was also critical to the enhancement of IPE. These findings do not support the "hypodermic needle theory", which implies that mass media has a direct, immediate and powerful effect on its audiences (Croteau & Hoynes, 1997), but instead lend support to the "negation model", which emphasizes the idea that mass media has potentially strong attitudinal effects and these effects depend heavily on predispositions, schema, and other characteristics of the audience (Scheufele & Tewksbury, 2007).

Another interesting finding of this study was that the covariance of character attachment and prior IPE was not significant in the revised model, suggesting that even though a player has higher prerequisite IPE, he or she does not necessarily have higher character attachment to the avatar in serious games, and vice versa. This result might lend support to the finding that perceived similarity is a significant predictor of identification with the characters (Hoffner & Cantor, 1991; Jang, Kim, Ryu, 2010) and suggest that avatar-self similarity is more predictive of character attachment than prerequisite beliefs of self-efficacy. Accordingly, regardless of the level of prior IPE, serious games can be a good vehicle for enhancing players' IPE as long as the players can attach to their avatars and transform their successful mediated enactive experiences into perceived mastery experiences.

6. Conclusions

IPE is the confidence of an individual in his or her own ability to understand politics and to act politically, which has been regarded as an effective predictor of political participation. New media such as internet and serious games provide a potential vehicle for college students to engage in important public issues and empower their political efficacy. Therefore, this study employed serious games to explore the mechanisms of enhancing college students' IPE and to investigate the factors influencing this efficacy. The findings of this study suggest that mediated enactive experience in serious games that incorporates guided practice, reflective observation, active experimentation, abstract conceptualization, progressive goal setting, and feedback on performance can significantly enhance college students' IPE. Moreover, such mediated enactive experience can facilitate the connections between prior IPE, character attachment, and posttest IPE through the mediation of perceived mastery experience in serious games.

To conclude, the main contributions of this study are as follows. First, this study distinguishes two types of mastery experiences: the mediated enactive experiences in a game and the perceived mastery experiences of a player. Second, this study employs a new construct—character attachment—to investigate the relationship between an avatar and a player. Third, this study constructs a path model of how IPE can be improved in serious games. Finally, this study incorporates theories from different disciplines such as communication, education, and psychology and provides experimental data to support effective mechanisms in serious games. Therefore, this study can contribute to future studies concerning improvement of domain-specific efficacy and serious game design.

7. Limitations and suggestions

The importance of social interaction in game-based learning is gradually being emphasized (Egenfeldt-Nielsen, 2005; Prensky, 2001). Social interaction is critical for building "collective efficacy", which is important for political participation. Collective efficacy represents the beliefs of group members concerning the performance capability of a social system as a whole (Bandura, 1997). As an exploratory study in the concerned model, this study does not consider the effects of social interactions on IPE nor does it compare the effects of the Empower game on individual IPE and collective IPE. Future studies can be extended to investigate the effects of social interaction on individual and collective IPE in serious games.

In this study, character attachment to an avatar is found to be an influential factor to IPE. However, the participants only had a medium level of character attachment ($M = 3.93$) to the avatar. Moreover, the SEM analysis revealed that, compared to other indices of character attachment, identification to the avatar had a lower power in predicting mastery experiences and IPE. This study focused on attitude similarities between the avatar and the player; other similarities (e.g., psychical characteristics, demographic background, and life experiences) between the avatar and the player and other elements in games (e.g., storylines and engaging narratives) were not employed. Future studies are suggested to enhance other types of similarities and to design more engaging narratives and complex storylines to generate stronger character attachment to the avatar.

This study asked the players to choose an avatar who held similar political attitudes with them. However, the players were not experts in these topics. Therefore, by pretending to be the avatar and by thinking as the avatar, they may gain mastery experiences through the attachment and guidance of the avatar. Further studies can compare the effects of character attachment by employing a control group in which the player is assigned an avatar that believes the opposite of what the player believes, and let the player plays the game while answering as that avatar.

Finally, due to technical constraints, this study did not give immediate feedback in the practice session based on the quality the player answered. Instead, the immediate feedback was given only based on the quantity of answers (how many words the player typed) since the quality of answers would need artificial ratings latter on. Further studies can employ a control group in which the player practices the learned knowledge and skills through multiple-choice or essay-like formats to compare what types of practice can better enhance the player's IPE.

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Appendix

Appendix A. Inventory of Character Attachment

Instructions:

The following questions are designed to understand your attachment to the character during the game you had just played. Character attachment refers to identification, friendship, suspension of disbelief, responsibility and a sense of control toward the character when you play the game. We will not disclosure your personal data. Please choose the answers according to your actual feelings. Please remember to answer each of the questions.

	Strongly disagree	Moderately disagree	A little bit disagree	A little bit agree	Moderately agree	Strongly agree
1. I sometimes forgot my own feelings and thought I was the character.	1	2	3	4	5	6
2. I enjoyed pretending that my character was a real person.	1	2	3	4	5	6
3. I enjoyed pretending that I was my character.	1	2	3	4	5	6
4. I daydreamed about my character.	1	2	3	4	5	6
5. I enjoy controlling my character.	1	2	3	4	5	6
6. I controlled my character.	1	2	3	4	5	6
7. I knew what my character wanted.	1	2	3	4	5	6
8. I knew what my character needed.	1	2	3	4	5	6
9. I made decisions with my character's best interests in mind.	1	2	3	4	5	6

Appendix B. Inventory of Perceived Mastery Experience

Instructions:

The following questions are designed to understand your perceived mastery experiences toward the issues in the game. Perceived mastery experience refers to your personal feelings of successes. We will not disclosure your personal data. Please choose the answers according to your actual feelings. Please remember to answer each of the questions.

	Strongly disagree	Moderately disagree	A little bit disagree	A little bit agree	Moderately agree	Strongly agree
1. By playing this game, my critical thinking ability about this policy has been enhanced.	1	2	3	4	5	6
2. By playing this game, my ability to express ideas about this policy has been enhanced.	1	2	3	4	5	6
3. By playing this game, my ability to take action about this policy has been enhanced.	1	2	3	4	5	6
4. When playing this game, I tried to play according to the avatar‘s behaviors and performances.	1	2	3	4	5	6
5. When playing this game, I tried to think about how to apply the responses from the game to the policy-relevant issues in real life.	1	2	3	4	5	6
6. After playing the game, my thinking has changed from —It is impossible to influence the government‘s policy for common people like me” to Even for common people like me, as long as a person tries hard, every person can influence the government‘s policy.	1	2	3	4	5	6
7. After playing this game, I find it is not as difficult to understand this policy as I thought before.	1	2	3	4	5	6
8. After playing this game, I find it is not so difficult to participate in political discussions as I thought before.	1	2	3	4	5	6
9. After playing this game, I find it is not as difficult to take part in political action about this policy as I thought before.	1	2	3	4	5	6

Appendix C. Inventory of Internal Political Efficacy

Instructions:

The following questions are designed to understand your internal political efficacy with regard to carbon tax and carbon emission trading issues. A carbon tax is defined as a tax based on greenhouse gas emissions (GHG) generated from burning fuels. Carbon emissions trading is a common method utilized by countries in order to meet their obligations specified by the Kyoto Protocol, which aims to reduce future climate change by reducing carbon emissions. We will not disclosure your personal data. Please choose the answers according to your actual feelings. Please remember to answer each of the questions.

	Strongly disagree	Moderately disagree	A little bit disagree	A little bit agree	Moderately agree	Strongly agree
1. I take initiative to access information related to carbon emission trade issues in my everyday life.	1	2	3	4	5	6
2. I am capable of participating in discussions about carbon emission trade issues.	1	2	3	4	5	6
3. I am better informed about carbon emission trade issues than most people.	1	2	3	4	5	6
4. I understand carbon trade emission issues quite well.	1	2	3	4	5	6
5. I am interested in carbon emission trade issues.	1	2	3	4	5	6
6. I can identify problems in discussions about carbon emission trade issues.	1	2	3	4	5	6
7. I am willing to spend time thinking about carbon emission trade issues.	1	2	3	4	5	6

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