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Achievement goals influence mastery experience via two paths in digital creativity games among elementary school students

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Abstract

Although cultivating creativity is greatly emphasized in elementary school education and that digital games can be a promising tool for improving creativity, little research has been conducted to identify and explore how player-related factors might influence the learning outcomes of digital creativity games. This study identifies 3 individual traits pertaining to digital creativity game playing and examines how these determinants influence self-efficacy and mastery experiences of creativity using structural equation modelling. The participants were 275 4th through 6th graders, and the employed method was inventory investigation. The findings reveal that the participants spend a large proportion of time playing digital games after school. Moreover, the results suggest that motivation for achieving both mastery goals and performance goals is crucial to enhancing self-efficacy and achieving mastery experience in creativity. Additionally, such motivation might enhance mastery experience via two paths: the experience of flow states and the strengthening of self-determination and self-efficacy. The findings of this study shed light on the design of digital games for creativity training.

KEYWORDS

achievement goals, creativity, flow experience, mastery experience, self-determination, self-efficacy

1 | INTRODUCTION

Creativity is an important educational goal in a technological society. Although numerous studies have been conducted to understand the cognitive processes involved in creativity, only a few of them have attempted to integrate digital game-based learning (e.g., Lin, Yeh, Hung, & Chang, 2013; Yeh, Lai, & Lin, 2016; Yeh, Lai, Lin, Lin, & Sun, 2015). Digital games are immersive, voluntary, and enjoyable activities conducted through an internet or a computer in which a challenging goal is pursued. Recently, digital games have received considerable attention from both the game industry and design educators (Chuang & Huang, 2015). Many studies have also found that well-designed digital games with specific educational objective can attract attention, enhance learning motivation, and learning outcomes (e.g., Cohen, 2016; Hung, Hwang, Lee, & Su, 2012; Sung & Hwang, 2013). Consequently, a well-designed creativity game can be a promising tool for improving creativity (Ashton, 2016).

As game play is prevalent among pupils in modern societies, the use of game-based learning to improve creativity is feasible. To achieve this goal, it is necessary to understand which variables might encourage creativity while playing digital games. According to social cognitive theory (Bandura, 2001), interactive media such as digital games may be well-suited to cultivate learner's self-efficacy and mastery of experiences because the nature of digital games allows learners to practice recommended skills. In this study, we first aimed to identify the important antecedents and mediators of the learning outcomes of self-efficacy and mastery experience of creativity during game playing. Furthermore, we proposed a path model that captured the relationships among the identified antecedents (achievement goals), mediators (flow experiences and self-determination), and learning outcomes (self-efficacy of creativity and mastery experience of creativity) during game playing. Using structural equation modelling (SEM), the proposed model was examined to clarify the relationships among the identified variables.

Note. IAG-DG Factor 1 and Factor 2: "performance goals" and "mastery goals"; ISD-DG Factor 1 and Factor 2: "autonomy and self-regulation" and "competence"; IFE-DG Factor 1 and Factor 2: "confidence and concentration" and "fun and challenge"; IS-CDG Factor 1 and Factor 2: "ability to generate creative ideas" and "achievement of creative performance"; IME-CDG Factor 1 and Factor 2: "ability to solve problems" and "confidence in solving problems."

2 | LITERATURE REVIEW

2.1 | Self-efficacy and mastery experience in digital creativity games

In this study, we identified two learning outcomes of digital creativity games: the self-efficacy of creativity and the mastery experience of creativity. Self-efficacy refers to beliefs in one's capabilities to organize and execute the actions required to produce given outcomes (Bandura, 1977). It plays an important role in human self-development and adaptation (Bandura, 2012). Successful performance usually leads to increased self-efficacy, whereas repeated failures often result in lower self-efficacy (Barlow, 2010). These two components influence the actions taken during learning. A few recent studies have found that self-efficacy can be improved through game-based learning. For example, Leonard et al. (2016) found that students' self-efficacy in the context of video gaming increased significantly in a combined robotics/gaming environment.

In contrast, mastery experience is the personal experience of success. It has been suggested as an important mechanism for enhancing self-efficacy (Bandura, 1997; Feltz & Lirgg, 2001). Bandura (1986, 1997) claimed that mastery experiences can be achieved through four mechanisms: acquisition of required knowledge and skills, progressive goal setting, feedback on performance, and practice of skills in diverse settings. These mechanisms can also contribute to the enhancement of self-efficacy. During gaming, self-efficacy can facilitate the achievement of mastery experience, and the facilitated mastery experience may further enhance self-efficacy. Therefore, we propose that self-efficacy and mastery experience are interrelated in the context of game playing.

2.2 | Antecedents of self-efficacy and mastery experience during digital game playing

The identified antecedent of self-efficacy and mastery experience achievement during digital game playing is achievement goals. It has been suggested that goal setting is critical to achieving mastery experience (Bandura, 1986, 1997) and flow experience (Kiili, 2005). Achievement goals help construct a framework for how people interpret and experience a learning event (Bounoua et al., 2012; Nicholls, 1984), which guides learning efforts toward competence-relevant activities (Bounoua et al., 2012; Elliot, 1999). Two types of achievement goals are typically defined (e.g., Darnon, Dompnier, & Poortvliet, 2012; Hulleman, Schrager, Bodmann, & Harackiewicz, 2010): mastery goals and performance goals. Mastery goals are derived from a belief that ability is malleable and that errors are natural to learning, whereas performance goals are derived from a belief that ability is mostly fixed and that errors signal inabilities (Senko & Tropiano, 2016).

Elliot and McGregor (2001) proposed a 2 (definition of competence: absolute/intrapersonal vs. normative) × 2 (valence of competence: positive/desirable possibility vs. negative/undesirable possibility) model of achievement goals. The four types of achievement goals are (a) mastery-approach goals: competence is defined in absolute/intrapersonal terms and is positively valenced, (b) performance-approach goals: competence is defined in normative terms and is positively valenced, (c) mastery-avoidance goals: competence is defined in absolute/intrapersonal terms and is negatively valenced, and (d) performance-avoidance goals: competence is defined in normative terms and is positively valenced. Notably, these goals are not necessarily contradictory. Learners can have multiple goals during learning processes (Pintrich, 2000a).

Mastery goals are related to cognitive strategy use, self-regulation, self-efficacy, and performance (Linnenbrink & Pintrich, 2002; Senko & Tropiano, 2016). They have been consistently found to be positively related to students' positive affect and school learning in general (e.g., Kaplan & Maehr, 2007; Pekrun, Elliot, & Maier, 2009; Pintrich, 2000a). On the other hand, while performance-approach goals are often positively related to learning outcomes (Pekrun et al., 2009), performance-avoidance goals are often negatively related to performance (e.g., Elliot & McGregor, 2001; Wolters, 2004). However, a recent study of elementary school children found that performance-approach goals and performance-avoidance goals converged into one factor, performance goals, and mastery-approach goals and mastery-avoidance goals converged into another factor, mastery goals. Moreover, these two goals were found to be positively correlated (Yeh, 2016). Accordingly, we used the two-factor structure (performance goals and mastery goals) of achievement goals in this study.

2.3 | Mediators of achievement goals and learning outcomes during digital game playing

Two mediators were identified in this study: flow experience and self-determination. It has been reported that games are the most successful and engaging when they facilitate flow experience (Kiili, 2005). Flow refers to an optimal experience in which individuals are completely absorbed or engaged in an activity (Csikszentmihalyi, 1990). It involves single-minded immersion and represents the optimal experience for controlling emotions while performing and learning. In a computer-mediated environment, the antecedents of flow may include focused attention, a clear set of goals, immediate and appropriate feedback, potential control, and a perception of challenges that are matched to one's skills, speed, and ease of use (Kiili, 2005). Moreover, flow experience may lead to enhanced learning and exploratory behaviour (Kiili, 2005; Skadberg & Kimmel, 2004). Therefore, flow experience should contribute to the development of self-efficacy and mastery experience while playing digital creativity games.

Self-determination theory, a dominant motivational theory in psychology, can be influential in the achievement of flow experience and learning outcomes. Self-determination theory attempts to combine innate human tendencies, social contexts, and motivations of human behaviour (Wehmeyer, Little, & Sergeant, 2009). It assumes that individuals' inherent growth tendencies and innate psychological needs are the bases for their self-motivation and personality integration (Ryan & Deci, 2000). Self-determination also implies that the needs for competence, relatedness, and autonomy are essential to facilitating the optimal functioning of the natural propensities for growth and integration. According to a mini-theory of SDT, cognitive evaluation theory (Ryan & Deci, 2000), events and conditions that enhance a person's sense of autonomy and competence may increase intrinsic motivation (Ryan & Deci, 2000; Ryan, Rigby, &

Przybylski, 2006). We, therefore, focused on two types of self-determination in this study: autonomy and competence. Autonomy pertains to a sense of volition or willingness when performing a task, whereas competence describes a need for challenge and feelings of efficacy (Ryan et al., 2006).

Accordingly, when people experience their behaviour as self-determined by intrinsic motivation, they experience both competence and efficacy. Moreover, Ryan et al. (2006) suggested that people typically play computer games because they are intrinsically satisfying or because they seek "fun." Flow is completely focused motivation; its hallmark is a feeling of spontaneous joy, fun, and even rapture while performing a task (Csikszentmihalyi, 1990, 1996). Therefore, self-determination may contribute to flow experience, self-efficacy, and mastery experience while playing digital creativity games.

2.4 | The proposed model and hypotheses of this study

Based on the aforementioned literature review, we hypothesized that achievement goals would enhance flow experience and self-determination, which would further lead to enhanced self-efficacy and mastery experience while playing digital creativity games. Moreover, we hypothesized that achievement goals would enhance self-efficacy and mastery experience directly and that self-efficacy and mastery experience would be interrelated in the context of playing digital creativity games (See Figure 2 for the proposed model).

3 | METHOD

3.1 | Participants

Two hundred seventy-five pupils (140 boys and 135 girls) participated in this study. The participants included 126 urban district pupils (45.8%) and 149 suburban district pupils (54.2%), 33.8% of whom were fourth graders, 32.4% of whom were fifth graders, and 33.8% of whom were sixth graders.

3.2 | Instruments

Five inventories developed by Yeh (2016) were employed in this study. They included a 4-point Likert-type scale, with response options ranging from *totally disagree* to *totally agree*. The construct validity, composite reliability, and the average variance extracted of all inventories were examined through exploratory factor analysis and confirmatory factor analysis (CFA). The exploratory factor analysis was performed by using 130 fourth through sixth graders, whereas the CFA was performed by using 176 fourth through sixth graders (Yeh, 2016). More details of the employed inventories are described in the following sessions.

3.2.1 | The inventory of achievement goals in digital games

The Inventory of Achievement Goals in Digital Games (IAG-DG) was employed to measure the participants' orientation of achievement goals during game play (Yeh, 2016). With a total of 12 items, the IAG-DG includes two factors: performance goals (6 items), which include performance-approach goals and performance-avoidance goals, and mastery goals (6 items), which include mastery-approach goals and mastery-avoidance goals. With factor loadings ranging from .658 to .855, 76.96% of the total variance was explained by the two factors. The correlations between the two factors and the total score were .952 and .933 ($p < .01$), respectively. The test items included statements such as "I hope I can get higher scores than others," "I pay full attention to playing games in order not to be slower than others in completing the tasks," "I try to learn more problem-solving skills during game playing," and "I pay full attention to playing games in order not to miss the learning of problem solving skills."

Regarding reliability, the Cronbach's α coefficients were .960, .943, and .905 for the IAG-DG, mastery-approach goals, and mastery-avoidance goals, respectively. Moreover, CFA indicated that the IAG-DG had good construct validity and reliability, $\chi^2(N = 176, df = 51) = 103.027$ ($p < .05$). In addition, the values of the goodness-of-fit index (GFI = .917), adjusted goodness of fit index (AGFI = .873), root mean square residual (RMR = .073), and root mean square error of approximation (RMSEA = .076) were good. In terms of relative fit measures, the normed fit index (NFI = .947), relative fit index (RFI = .932), incremental fit index (IFI = .973), and comparative fit index (CFI = .972) were all greater than .90. Finally, regarding the parsimonious fit measures, the parsimony normed fit index (PNFI = .732) and the parsimonious comparative fit index (PCFI = .751) were above .70. Finally, values of the composite reliability (ρ_c) of the two factors were .907 and .876. The average variance extracted (ρ_v) values were .621 and .546, respectively (Yeh, 2016). Based on the sample of this study, the Cronbach's α coefficient was .951 for the IAG-DG.

3.2.2 | The inventory of self-determination in digital games

The Inventory of Self-Determination in Digital Games (ISD-DG) was employed to measure the participants' level of self-determination during game play (Yeh, 2016). With a total of 13 items, the ISD-DG includes two factors: autonomy and self-regulation (7 items) and competence (6 items). With factor loadings of .519 to .886, 63.36% of the total variance was explained by the two factors. The correlations between the two factors and the total score were .956 and .942 ($p < .01$), respectively. The test items included statements such as "The games provide many opportunities for me to freely develop my own thinking" and "I can think out answers quickly."

Regarding reliability, the Cronbach's α coefficients were .933, .887, and .881 for the ISD-DG and the two factors, respectively. Moreover, the CFA indicated that the ISD-DG had good construct validity and reliability, $\chi^2(N = 176, df = 26) = 79.867$ ($p < .05$). Additionally, the GFI = .919, AGFI = .860, RMR = .076, and RMSEA = .109. In terms of relative fit measures, the NFI = .915, RFI = .882, IFI = .941, and CFI = .940. Finally, regarding the parsimonious fit measures, the PNFI = .661 and PCFI = .679. Finally, the ρ_c values of the two factors were .882 and .864. The ρ_v values were .601 and .615, respectively (Yeh, 2016). Based on the sample of this study, the Cronbach's α coefficient was .917 for the ISD-DG.

3.2.3 | The inventory of flow experience in digital games

The Inventory of Flow Experience in Digital Games (IFE-DG) was employed to measure the participants' flow experience during game play (Yeh, 2016). With a total of 9 items, the IFE-DG includes two factors: confidence and concentration (5 items) and fun and challenge (4 items). With factor loadings of .682 to .901, 72.58% of the total variance was explained by the two factors. The correlations between the two factors and the total score were .946 and .886 ($p < .01$), respectively. The test items included statements such as "I can concentrate on the tasks in games" and "The games are funny."

Regarding reliability, the Cronbach's α coefficients were .914, .885, and .857 for the IFE-DG and the two factors, respectively. Moreover, the CFA indicated that the IFE-DG had good construct validity and reliability, $\chi^2(N = 176, df = 64) = 149.474$ ($p < .05$). Additionally, the GFI = .884, AGFI = .836, RMR = .095, and RMSEA = .087. In terms of relative fit measures, NFI = .877, RFI = .850, IFI = .926, and CFI = .925. Finally, regarding the parsimonious fit measures, PNFI = .720 and PCFI = .759. Finally, the ρ_c of the two factors were .866 and .845. The ρ_v were .485 and .483, respectively (Yeh, 2016). Based on the sample of this study, the Cronbach's α coefficient was .900 for the IFE-DG.

3.2.4 | The inventory of self-efficacy in creativity digital games

The Inventory of Self-Efficacy in Creativity Digital Games (IS-CDG) was employed to measure the participants' level of self-efficacy while playing creative games (Yeh, 2016). With a total of 9 items, the IS-CDG includes two factors: ability to generate creative ideas (6 items) and achievement of creative performance (3 items). With factor loadings of .606 to .879, 73.27% of the total variance was explained by the two factors. The correlations between the two factors and the total score were .965 and .887 ($p < .01$), respectively. The test items included statements such as "I believe that I can come up with many creative ideas" and "I am more creative than most of my classmates."

Regarding reliability, the Cronbach's α coefficients were .927, .908, and .844 for the IS-CDG and the two factors, respectively. Moreover, the CFA indicated that the IS-CDG had good construct validity and reliability, $\chi^2(N = 176, df = 26) = 64.113$ ($p < .05$). Additionally, the GFI = .929, AGFI = .877, RMR = .065, and RMSEA = .092. In terms of relative fit measures, the NFI = .945, RFI = .924, IFI = .967, and CFI = .967. Finally, regarding the parsimonious fit measures, the PNFI = .683 and PCFI = .698. Finally, the ρ_c of the two factors were .867 and .850. The ρ_v were .526 and .655, respectively (Yeh, 2016). Based on the sample of this study, the Cronbach's α coefficient was .922 for the IS-CDG.

3.2.5 | The inventory of mastery experience in creativity digital games

The Inventory of Mastery Experience in Creativity Digital Games (IME-CDG) was employed to measure the participants' level of mastery experience while playing creative games (Yeh, 2016). With a total of 8 items, the IME-CDG includes two factors: ability to solve problems (5 items) and confidence in solving problems (3 items). With factor loadings of .606 to .879, 73.28% of the total variance was explained by the two factors. The correlations between the two factors and the total score were .953 and .896 ($p < .01$), respectively. The test items included statements such as "When playing games that require creative ideas, I can think of solutions quickly" and "When playing games that require creative ideas, I am confident in developing creative ideas and solving problems."

Regarding reliability, the Cronbach's α coefficients were .903, .860, and .819 for the IME-CDG and the two factors, respectively. Moreover, the CFA indicated that the IME-CDG had good construct validity and reliability, $\chi^2 (N = 176, df = 18) = 48.397$ ($p < .05$). Additionally, the GFI = .932, AGFI = .863, RMR = .071, and RMSEA = .098. In terms of relative fit measures, the NFI = .933, RFI = .896, IFI = .957, and CFI = .957. Finally, regarding the parsimonious fit measures, the PNFI = .600 and PCFI = .615. Finally, the ρ_c values of the two factors were .799 and .755. The ρ_v were .448 and .521, respectively (Yeh, 2016). Based on the sample of this study, the Cronbach's α coefficient was .888 for the IME-CDG.

4 | PROCEDURES

This is an investigation study. The questionnaires that measured the examined variables were administered by the class instructor as part of the learning activity. It was a pencil-and-paper test; no strict time limit was imposed. However, all participants completed the questionnaires in the classroom within 40 min. All data were collected in the same week at the convenience of the instructor.

4.1 | Data analysis

SPSS 21.0 for Windows was employed to perform descriptive statistics and Pearson correlation analyses of the concerned variables. Moreover, SEM conducted using AMOS 21 with maximum likelihood estimation was employed to test the proposed path model. SEM has become a popular technique for testing path models in recent years.

5 | RESULTS

5.1 | Preliminary analyses

The percentages of principal caretakers were father (7.9%), mother (16.9%), both father and mother (70.3%), grandfather and/or grandmother (3.0%), and others (1.9%). Notably, most of the caretakers allowed the children to play digital games (83.4%). For all participants, the average time allowed by their caretakers for playing digital games was 1.64 hr/day ($SD = 3.0$). However, the actual time they spent on playing digital games was 5.59 hr/week ($SD = 8.50$ hr) and that on digital creativity games was 1.39 hr/week ($SD = 3.25$ hr).

All the questionnaires included 6-point Likert scales, with response options ranging from *totally disagree* to *totally agree*. The means and standard deviations of the measured variables in this study are displayed in Figure 1. Comparatively, among the measured variables, the participants reported the lowest score on "self-efficacy of achieving creative performance" ($M = 3.92$, $SD = 1.17$). Overall, the participants had an above-average score on all the measured variables.

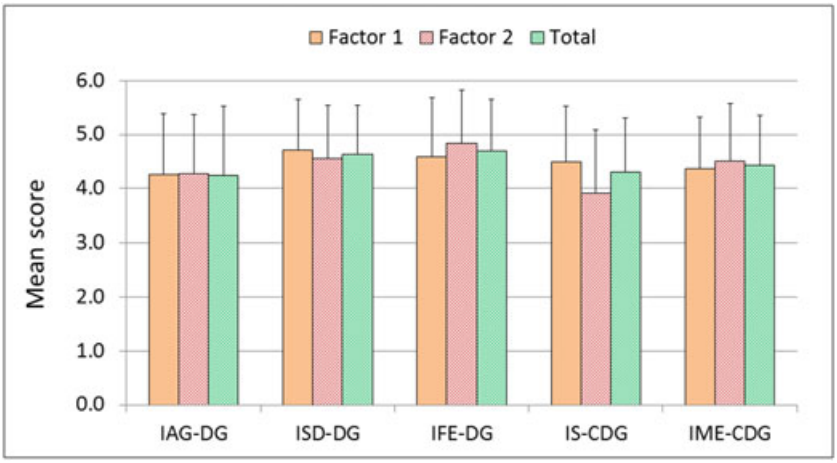

FIGURE 1 Means and standard deviations of all the examined variables. IAG-DG = Inventory of achievement goals in digital games; ISD-DG = Inventory of self-determination in digital games; IFE-DG = Inventory of Flow experience in digital games; IS-CDG = Inventory of self-efficacy in creativity digital games; IME-CDG = Inventory of mastery experience in creativity digital games [Colour figure can be viewed at wileyonlinelibrary.com]

With regards to the correlations among the subscales and the total scores of the measured variables, all correlations were significant, $r(274) = .325$ to $.963$ ($p < .001$; see Table 1).

5.2 | Results of the proposed model

In the proposed model, we hypothesized that achievement goals would directly influence self-efficacy of creativity and mastery experience of creativity as well as indirectly influence self-efficacy of creativity and mastery experience of creativity through flow experience and self-determination while playing digital games.

According to Bagozzi and Yi (1988), the following three indices should be employed to examine the goodness-of-fit of a model: preliminary fit criteria, overall model fit, and fit of the internal structure of the model. This study employed these indices to investigate the goodness-of-fit of the proposed model. The results of analyses revealed that all estimated parameters in this study met the criteria proposed by Bagozzi and Yi (1988). The important values in relation to the model are depicted in Figure 2. In addition, the following three dimensions of indices suggested by Hair Jr., Black, Babin, Anderson, and Tatham (2006) 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 hypothesized model was not a good fit, χ^2 ($N = 275$, $df = 25$) = 101.256, $p < .001$. However, the GFI (.933), AGFI (.853), RMR (.041), and RMSEA (.106) suggested that the proposed model was acceptable. In terms of relative fit measures, the NFI (.950), RFI (.910), IFI (.962), and CFI (.961) were all greater than .90. Finally, regarding the parsimonious fit measures, the values of the PNFI (.528) and the PCFI (.534) were acceptable (see Table 2).

Moreover, the direct effect of achievement goals on creativity efficacy and mastery experience were not significant. The direct effect of flow experience on creativity efficacy and mastery experience were

TABLE 1 The correlations among the examined variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1.000														
2	.957*	1.000													
3	.938*	.798*	1.000												
4	.627*	.603*	.584*	1.000											
5	.563*	.537*	.531*	.942*	1.000										
6	.614*	.597*	.567*	.930*	.754*	1.000									
7	.680*	.654*	.632*	.764*	.729*	.701*	1.000								
8	.685*	.668*	.629*	.717*	.673*	.670*	.942*	1.000							
9	.537*	.505*	.513*	.681*	.666*	.607*	.885*	.678*	1.000						
10	.356*	.331*	.344*	.472*	.497*	.382*	.447*	.430*	.383*	1.000					
11	.337*	.298*	.342*	.474*	.486*	.397*	.451*	.427*	.395*	.963*	1.000				
12	.325*	.326*	.285*	.382*	.425*	.284*	.358*	.355*	.291*	.882*	.722*	1.000			
13	.506*	.462*	.499*	.655*	.608*	.620*	.621*	.611*	.514*	.749*	.742*	.625*	1.000		
14	.536*	.493*	.525*	.675*	.607*	.662*	.628*	.622*	.513*	.690*	.676*	.588*	.955*	1.000	
15	.381*	.345*	.379*	.516*	.509*	.455*	.507*	.492*	.430*	.714*	.714*	.580*	.901*	.733*	1.000

Note. 1 = Achievement goals total score; 2 = Performance; 3 = Mastery; 4 = Self-determination total score; 5 = Autonomy and self-regulation; 6 = Competence; 7 = Flow experience total score; 8 = Confidence and concentration; 9 = Fun and challenge; 10 = Self-efficacy of creativity total score; 11 = Ability to generate creative ideas; 12 = Achievement of creative performance; 13 = Mastery experience total score; 14 = Ability to solve problems; 15 = Confidence in solving problems.

*$p < .001$.

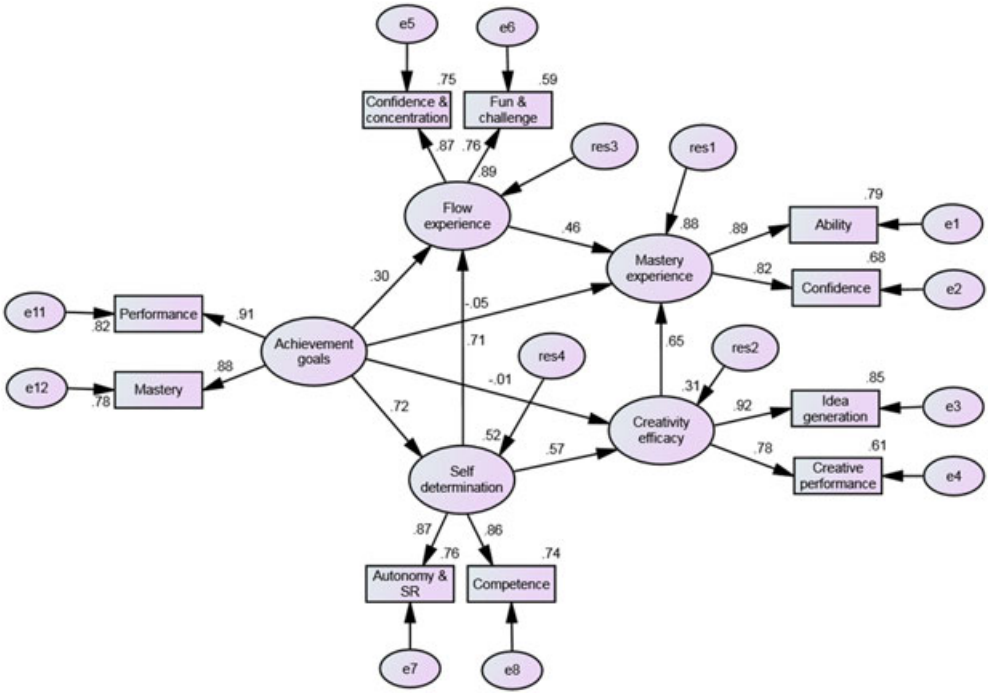

FIGURE 2 Results of the proposed path model [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 2 Direct, indirect, and total effects of the revised model

Paths between variables	Direct effect	Indirect effect	Total effect
Achievement goals ➜ Self-determination	.70*		.70*
Achievement goals ➜ Flow experience	.33*	.47*	.80*
Self-determination ➜ Flow experience	.67*		.67*
Self-determination ➜ Creativity self-efficacy	.57*		.57*
Flow experience ➜ Mastery experience	.37*		.37*
Creativity self-efficacy ➜ Mastery experience	.69*		.69*
Achievement goals ➜ Creativity self-efficacy		.40*	.40*
Achievement goals ➜ Mastery experience		.57*	.57*
Self-determination ➜ Mastery experience		.64*	.64*

*$p < .001$.

not significant. Furthermore, the direct effect of self-determination on mastery experience was not significant. Overall, analyses of the overall model fit measures suggested that the proposed model did not have a good fit to the data. Therefore, we revised the proposed model based on the results and the modification indices.

5.3 | Results of the revised model

5.3.1 | Goodness of fit of the revised model

The important values of the revised model are shown in Figure 3. Specifically, χ^2 (N = 275, df = 28) = 71.265, $p < .001$, GFI = .953, AGFI = .907, RMR = .040, and RMSEA = .075. These results revealed that the revised model was a good fit to the data. In terms of relative fit measures, all indices were greater than .90, NFI = .965, RFI = .943, IFI = .978, and CFI = .978. Finally, regarding the parsimonious fit measures, the PNFI = .600 and PCFI = .609, suggesting that the revised model had a good fit to the data. Moreover, all direct effects were significant ($p < .001$). Overall, the results suggested that the revised model had a good fit to the data.

In addition to comparisons of the overall fit measures, relative fit measures, and parsimonious fit measures (Bagozzi & Yi, 1998; Hair et al., 2006), we employed $\Delta\chi^2 = (\chi_1^2 - \chi_2^2)/(df_1 - df_2)$ to examine whether the revised model was better than the proposed model. Given that $\Delta\chi^2 = 29.991$, $p < .001$, the results revealed that the revised model had a better fit than the proposed model.

5.3.2 | Fit of the internal structure of the revised model

The standardized regression weights ranged from .774 to .915. The composite reliability coefficients for achievement goals, self-determination, flow experience, mastery experience, and creativity self-efficacy were .937, .918, .882, .911, and .908, respectively. The values of the extracted average variance for achievement goals, self-determination, flow experience, mastery experience, and creativity self-efficacy were .799, .749, .686, .735, and .731, respectively. These

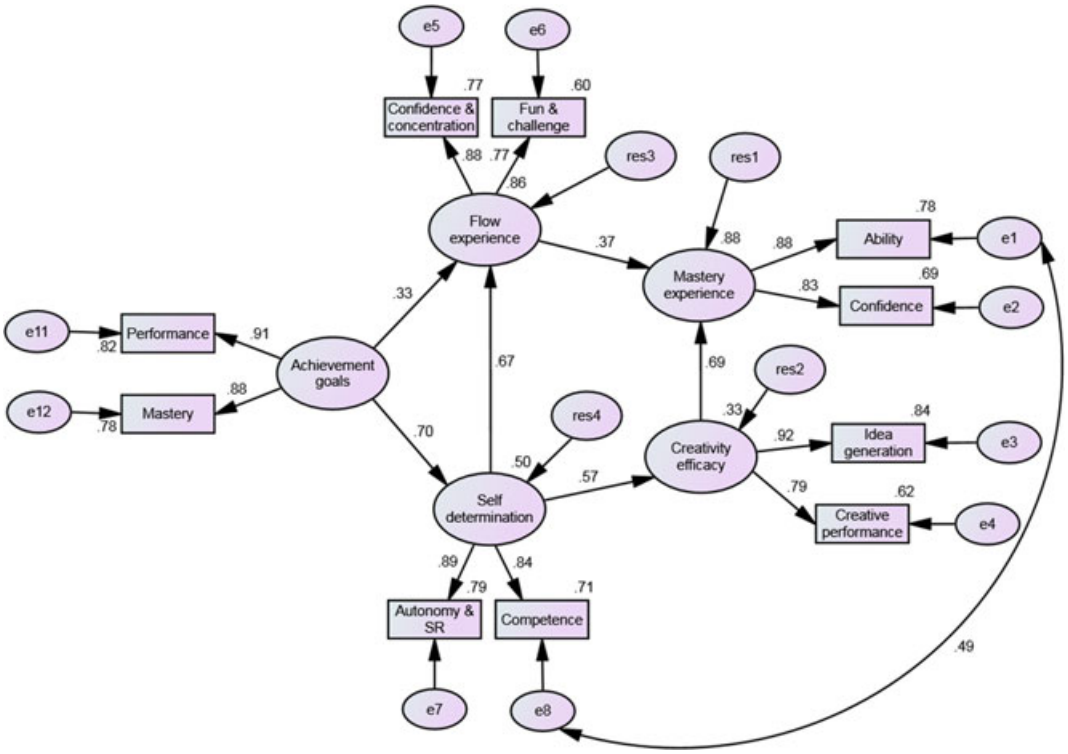

FIGURE 3 Results of the revised path model [Colour figure can be viewed at wileyonlinelibrary.com]

results indicated that the revised model had a good fit in terms of the internal structure.

5.3.3 | Analyses of direct effects, indirect effects, total effects, and explained variance

The standardized direct effects, indirect effects, and total direct effect of the latent variables are shown in Table 2. Regarding direct effects,the effect of achievement goals on self-determination, self-determination on creativity self-efficacy, and creativity self-efficacy on mastery experience were somewhat stronger than that of flow experience on mastery experience and achievement goals on flow experience. Moreover, the indirect effect of achievement goals on mastery experience and that of self-determination on mastery experience were somewhat stronger than that of achievement goals on creativity self-efficacy and achievement goals on flow experience. Finally, the total effects results showed that the effect of achievement goals on self-determination and that of achievement goals on flow experience were strong (see Table 2). In addition, the explained variance of self-determination was .496, that of flow experience was .860, that of creativity self-efficacy was .326, and that of mastery experience was .877 (see Figure 3).

6 | DISCUSSION

This study aimed to identify the antecedents and mediators of self-efficacy and mastery experience while playing digital creativity games and to propose a path model based on the relationships among these variables. We first analysed personal data and found that the time the children spent playing general digital games (M = 5.59 hr per week) was far greater than the time they spent playing digital creativity games (M = 1.39 hr per week). This difference may be because comparatively fewer creativity digital games have been developed. Moreover, although most of the caretakers were parents, 83.4% of the participants were allowed to play digital games for 1.64 hr/per day. The high prevalence and popularity of digital games in the lives of children has become a worldwide phenomenon, and careful examinations and analyses of digital games by educators and psychologies are required to ensure positive learning outcomes (Boyle, Connolly, & Hainey, 2011), especially in terms of cognitive and emotional development.

In this study, we focused on two positive outcomes related to creativity in the proposed model, namely, self-efficacy and mastery experience. The results revealed that the hypothesized model did not have a good fit. We therefore revised the model and reperformed all the analyses. The analytical results suggest that (a) both mastery and the performance achievement goals have positive effects on the achievement of flow experience and the enhancement of self-determination; (b) achievement goals enhance the level of mastery experience through the achievement of flow experience; (c) achievement goals enhance the level of creativity self-efficacy by facilitating self-determination, which further enhances mastery experience while playing digital creativity games; and (d) self-efficacy unidirectionally and positively influences the achievement of mastery experience during digital creativity game-playing.

The findings of this study confirm that achievement goals are important antecedents of self-efficacy and mastery experience during creativity game playing. Achievement goal theory (Dweck & Elliott, 1983) initially characterized mastery goals and performance goals as a good–bad duality of student motivation. Many study findings have lent support to this proposition, suggesting that mastery goals create a healthy orientation, high self-efficacy, positive affect, self-regulation, and cooperation (e.g., Kaplan & Maehr, 2007; Linnenbrink & Pintrich,

2002; Pekrun et al., 2009; Pintrich, 2000b; Senko & Tropiano, 2016), whereas performance goals elicit public self-consciousness, anxiety, and self-handicapping (e.g., Elliot & McGregor, 2001; Mun, 2016; Wolters, 2004). This study, however, found that both mastery goals and performance goals can provide benefits and be pursued together. Moreover, the findings of this study support the argument that learners may have multiple goals during learning processes (Harackiewicz & Elliot, 1998; Pintrich, 2000a). The findings of this study therefore suggest that both mastery goals and performance goals are important for achieving flow experience and mastery experience and for enhancing self-determination and self-efficacy while playing digital creativity games (Bandura, 1986, 1997; Kiili, 2005).

The findings of this study also suggest that to achieve mastery, individuals must not only experience self-efficacy, but they also need to experience their behaviour as self-determined by intrinsic motivation. This requires immediate contextual supports or abiding inner resources for autonomy and competence (Ryan & Deci, 2000). Achievement goals are among such inner resources. Moreover, human agentic actions are directed toward self-regulated goals that meet biological and psychological needs (Wehmeyer et al., 2009). According to self-determination theory (Ryan & Deci, 2000), the reasons individuals choose to participate, exert effort, and persist in an activity can be categorized along a continuum from a motivation to self-determination; self-determination is defined as engaging in an activity for the pleasure derived from the activity itself through self-regulation (Peng, Lin, Winn, & Pfeiffer, 2012; Ryan & Deci, 2000). In this study, self-determination was measured in terms of autonomy and competence. Autonomy involves the volition to perform a task, whereas competence involves a need for challenge and feelings of efficacy (Ryan et al., 2006). In addition, many researchers have suggested that enjoyment is a key determinant of the success of serious digital gamers (e.g., Cohen, 2016; Ritterfeld, Cody, & Vorderer, 2009). Flow experiences are peaks of intrinsic motivation that are manifestations of autonomous regulation (Rivkin, Diestel, & Schmidt, 2016); people usually experience a feeling of spontaneous joy and fun in such states (Csikszentmihalyi, 1996). Self-determination is therefore important for achieving flow experience, self-efficacy, and mastery while playing digital creativity games. The findings of this study are also consistent with reports indicating that when performance goals are pursued for autonomous reasons (e.g., enjoyment or challenge-seeking), they not only predicted adaptive outcomes (self-efficacy and interest) but also were compatible with mastery goals (Senko & Tropiano, 2016).

7 | CONCLUSIONS

Cultivating creativity is increasingly emphasized at all levels of school education. However, little research has been conducted to identify and explore how player-related determinants might influence learning outcomes in creativity digital games. The current study identifies three personal traits pertaining to digital creativity game-playing and examines how these determinants influence self-efficacy and mastery experiences of creativity. The findings suggest that motivation for achieving both mastery and performance goals is crucial for enhancing self-efficacy and achieving mastery experience, and it may enhance mastery experience during digital creativity game play via two paths: the experience of flow states and the strengthening of self-determination and self-efficacy. Accordingly, taking advantage of the ability of digital games to stimulate intrinsic motivation by providing an individually calibrated balance of challenge and skill is crucial for enhancing self-efficacy and mastery experiences of creativity.

In addition, this study found that digital-game playing is prevalent and popular among elementary school children and that most care-takers allow them to play digital games for long periods of time per day. These factors can be detrimental or beneficial to children's cognitive and emotional development, depending on which digital games they are playing. If well-designed digital creativity games are provided, they can improve creative thinking tremendously. However, compared with games that are played just for fun, games for improving creativity can be more time and energy consuming, which can decrease the motivation to play them. Accordingly, motivation determinants (such as achievement goals, flow experience, and self-determination) should be given top emphasis in game designing. However, flow experience —the emotional state embracing perceptional distortion and enjoyment—may lead to compulsive behaviour and addiction in gaming (Chou & Ting, 2004). How to avoid falling into this pitfall should be considered; parents or care-takers must help children built a strong dependence and self-control on playing gaming.

To date, the number of well-designed digital games for improving creativity is limited. Educators, psychologists, and programmers are encouraged to cooperate to develop various digital creativity games to help learners enhance their self-efficacy and mastery experience and improve their creativity. The findings of this study shed light on the design of digital games for creativity training.

8 | LIMITATIONS AND SUGGESTIONS

This study only included fourth to sixth graders. Further studies could also include first to third graders and compare the models between these two cohorts to determine whether there are differences between younger and older elementary school children that may contribute to designing games that are optimally suited for different age levels. Moreover, this study is a correlational study; further studies could conduct experiments to confirm the relationships among the variables investigated in this study. In this study, the participants' creativity efficacy and mastery experience in creativity were measured by recalling experiences in playing creativity-related games; the framework of the games they recalled may not be open enough to support creativity. To ensure the validity of such recalling, it is better to design one's own creativity games and then measure the participants' creativity efficacy and mastery experience after they play the games.

Interestingly, this study found that both performance goals and mastery goals contribute to self-efficacy and mastery experiences during digital creativity game play. A recent study (Mun, 2016) concerning the influence of goal orientation on creativity during game-playing found that those who were primed with a process goal orientation for a cognitive-based game reported experiencing high levels of fun and were likely to be creative on a subsequent creativity task. Therefore, mechanisms for enhancing performance goals and

mastery goals (or process goals) should be simultaneously considered when designing digital creativity games for children. In addition, self-determination was found to be influential to creativity efficacy and mastery experience. Further studies can consider how to strengthen self-determination to enhance the learning outcomes of creativity.

Finally, including interactive media that allow the direct practice of recommended skills is a powerful way to promote efficacy because it enhances resilience and self-confidence even in the face of failure (Bandura, 2001). Moreover, the commonly used mobile technology has made digital games a popular form of entertainment for the young generation. Therefore, 3D or 4D interfaces built into mobile devices can be attractive to young learners and engage them in creativity games. Educators and game designers are encouraged to cooperate to develop such digital creativity games.

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REFERENCES

Ashton, P. T. (2016). Promises and perils of video game–induced creativity. *PsycCRITIQUES*, *61*(9). https://doi.org/10.1037/a0040170.

Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, *16*(1), 74–94.

Bandura, A. (1977). *Social learning theory*. New York: General Learning Press.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1997). Self-efficacy: Toward a unifying theory of behavioral change. *Psychology Review*, *84*(2), 191–215.

Bandura, A. (2001). Social cognitive theory of mass communication. *Media Psychology*, *3*, 265–299.

Bandura, A. (2012). On the functional properties of perceived self-efficacy revisited. *Journal of Management*, *38*, 9–44.

Barlow, J. (2010). Self-efficacy in the context of rehabilitation. In J. H. Stone, & M. Blouin (Eds.), *International encyclopedia of rehabilitation*. http://cirrie.buffalo.edu/encyclopedia/en/article/35/

Bounoua, L., Cury, F., Regner, I., Huguet, P., Barron, K. E., & Elliot, A. J. (2012). Motivated use of information about others: Linking the 2 × 2 achievement goal model to social comparison propensities and processes. *British Journal of Social Psychology*, *51*(4), 626–641.

Boyle, E., Connolly, T. M., & Hainey, T. (2011). The role of psychology in understanding the impact of computer games. *Entertainment Computing*, *2*(2), 69–74.

Chou, T. J., & Ting, C. C. (2004). The role of flow experience in cyber-game addiction. *Cyberpsychology & Behavior*, *6*(6), 663–675. https://doi.org/10.1089/109493103322725469

Chuang, T. Y., & Huang, Y. H. (2015). An analytic creativity assessment scale for digital game story design: Construct validity, internal consistency and interrater reliability. *Creativity Research Journal*, *27*(4), 322–327.

Cohen, E. L. (2016). Enjoyment of a counter-hedonic serious digital game: Determinants and effects on learning and self-efficacy. *Psychology of Popular Media Culture*, *5*(2), 157–170.

Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. New York, NY: Harper & Row.

Csikszentmihalyi, M. (1996). *Creativity: Flow and the psychology of discovery and invention*. New York, NY: Harper Perennial.

Darnon, C., Dompnier, B., & Poortvliet, P. M. (2012). Achievement goals in educational contexts: A social psychology perspective. *Social and Personality Psychology Compass*, *6*(10), 760–771.

Dweck, C., & Elliott, E. (1983). Achievement motivation. In E. Heatherington (Ed.), *Handbook of child psychology: Socialization, personality, and social development* (Vol. 4) (pp. 643–691). New York: Wiley.

Elliot, A. J. (1999). Approach and avoidance motivation and achievement goals. *Educational Psychologist*, *34*, 169–189.

Elliot, A. J., & McGregor, H. A. (2001). A 2 × 2 achievement goal framework. *Journal of Personality and Social Psychology*, *80*(3), 501–519.

Feltz, D. L., & Lirgg, C. D. (2001). Self-efficacy beliefs of athletes, teams, and coaches. In R. N. Singer, H. A. Hausenblas, & C. M. Janelle (Eds.), *Handbook of sport psychology* (2nd ed.) (pp. 340–361). New York, NY: John Wiley.

Hair, J. F. Jr., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis* (6th ed.). Upper Saddle River, NJ: Pearson Prentice.

Harackiewicz, J. M., & Elliot, A. J. (1998). The joint effects of target and purpose goals on intrinsic motivation: A mediational analysis. *Personality and Social Psychology Bulletin*, *24*, 675–689.

Hulleman, C. S., Schrager, S. M., Bodmann, S. M., & Harackiewicz, J. M. (2010). A meta-analytic review of achievement goal measures: Different labels for the same constructs or different constructs with similar labels? *Psychological Bulletin*, *136*, 422–449.

Hung, P. H., Hwang, G. J., Lee, Y. H., & Su, I. (2012). A cognitive component analysis approach for developing game-based spatial learning tools. *Computers & Education*, *59*(2), 762–773.

Kaplan, A., & Maehr, M. L. (2007). The contributions and prospects of goal orientation theory. *Educational Psychology Review*, *19*, 141–184.

Kiili, K. (2005). Digital game-based learning: Towards an experiential gaming model. *The Internet and Higher Education*, *8*(1), 13–24.

Leonard, J., Buss, A., Gamboa, R., Mitchell, M., Fashola, O. S., Hubert, T., & Almughyirah, S. (2016, in press). Using robotics and game design to enhance children's self-efficacy, STEM attitudes, and computational thinking skills. *Journal of Science Education and Technology*, *25*, 860–876. https://doi.org/10.1007/s10956-016-9628-2

Lin, C. F., Yeh, Y., Hung, Y. H., & Chang, R. I. (2013). Data mining for providing a personalized learning path in creativity: An application of decision trees. *Computers & Education*, *66*, 199–210.

Linnenbrink, E. A., & Pintrich, P. R. (2002). Achievement goal theory and affect: An asymmetrical bidirectional model. *Educational Psychologist*, *37*(2), 69–78.

Mun, J. (2016). The effect of game playing, goal orientation, and game difficulty level on subsequent creative new product development outcomes: A multi-process account. *Dissertation Abstracts International Section A: Humanities and Social Sciences*, *76*, 12 -A(E).

Nicholls, J. G. (1984). Achievement motivation: Conceptions of ability, subjective experience, task choice, and performance. *Psychological Review*, *91*, 328–346.

Pekrun, R., Elliot, A. J., & Maier, M. A. (2009). Achievement goals and achievement emotions: Testing a model of their joint relations with academic performance. *Journal of Educational Psychology*, *101*(1), 115–135.

Peng, W., Lin, J.-H., Winn, B., & Pfeiffer, K. (2012). Need satisfaction supportive game features as motivational determinants: An experimental study of a self-determination theory guided exergame. *Media Psychology*, *15*(2), 175–196.

Pintrich, P. R. (2000a). Multiple goals, multiple pathways: The role of goal orientation in learning and achievement. *Journal of Educational Psychology*, *92*, 544–555.

Pintrich, P. R. (2000b). The role of goal orientation in self-regulated learning. In M. Boekaerts, P. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation: Theory, research and applications* (pp. 451–502). San Diego, CA: Academic Press.

Ritterfeld, U., Cody, M., & Vorderer, P. (2009). *Serious games: Mechanisms and effects*. New York, NY: Routledge.

Rivkin, W., Diestel, S., & Schmidt, K. (2016). Which daily experiences can foster well-being at work? A diary study on the interplay between flow experiences, affective commitment, and self-control demands. *Journal of Occupational Health Psychology*, *23*, 99–111. https://doi.org/10.1037/ocp0000039.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68–89.

Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The motivational pull of video games: A self-determination theory approach. *Motivation and Emotion*, *30*, 347–363.

Senko, C., , & Tropiano, K. L. (2016). Comparing three models of achievement goals: Goal orientations, goal standards, and goal complexes. *Journal of Educational Psychology*, *108*(8), 1178–1192.

Skadberg, Y. X., & Kimmel, J. R. (2004). Visitors' flow experience while browsing a web site: Its measurement, contributing factors, and consequences. *Computers in Human Behavior*, *20*, 403–422.

Sung, H. Y., & Hwang, G. J. (2013). A collaborative game-based learning approach to improving students' learning performance in science courses. *Computers & Education*, *63*, 43–51.

Wehmeyer, M. L., Little, T. D., & Sergeant, J. (2009). Self-determination. In S. J. Lopez, & C. R. Snyder (Eds.), *Oxford handbook of positive psychology* (2nd ed.) (pp. 357–366). New York, NY: Oxford University Press.

Wolters, C. A. (2004). Advancing achievement goal theory: Using goal structures and goal orientations to predict students' motivation, cognition, and achievement. *Journal of Educational Psychology*, *96*, 236–250.

Yeh, Y. (2016). *Self-determined game-based learning in creativity: The development of learning system and investigation of cognitive processes* (Project Rep. MOST 104–2511-S-004-002-MY3). Taipei City, Taiwan: Ministry of Science and Technology.

Yeh, Y., Lai, S. H., & Lin, C. W. (2016). The dynamic influence of emotions on game-based creativity: An integrated analysis of emotional valence, activation strength, and regulation focus. *Computers in Human Behavior*, *55*, 817–825.

Yeh, Y., Lai, G. J., Lin, C. F., Lin, C. W., & Sun, H. C. (2015). How stress influences creativity in game-based situations: Analysis of stress hormone, negative emotions, and working memory. *Computers & Education*, *81*, 143–153.

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