



# Validation of the 12-item Gamification User Types Hexad Scale in 1,610 Hong Kong Young Gamers

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## Abstract

The present study aimed to examine the psychometric properties of the Gamification User Types Hexad Scale (Hexad) and validate the 12-item short version (Hexad-12) in the Chinese context. An online survey recruited 1,610 young gamers aged between 11 and 29 (mean age = 23.1, SD = 4.18) in Hong Kong between May and June 2023, who completed the Hexad-24 and other validated measures. Factorial validity and measurement invariance of Hexad were evaluated by confirmatory factor analysis. Convergent validity of Hexad factors was examined with demographic and gaming characteristics, social support, internet gaming disorder (IGD) symptoms, depressive symptoms, and hikikomori. The 6-factor model provided mediocre fits (comparative fit index < 0.90 and standardized root mean square residuals > 0.07) to the original 24-item Hexad but adequate fits (comparative fit index = 0.97 and standardized root mean square residuals < 0.04) to Hexad-12 in split samples with substantial factor loadings and acceptable reliability. The Hexad-12 factors showed scalar measurement invariance across gender, age groups, and game genre. Disruptor was positively and moderately to strongly correlated with IGD and depressive symptoms, hikikomori, and suicidal ideation. Philanthropist and socializer were positively and moderately correlated with social support and meaning in life; free-spirits and achievers were negatively and weakly correlated with IGD and depressive symptoms, hikikomori,

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and suicidal ideation. The present findings demonstrated adequate psychometric properties for the Hexad-12, supporting its use for brief assessment of Chinese gamers' user types.

**Keywords** Factor analysis · Gaming motivations · Hexad user types · Internet gaming disorder · Psychometric properties · Scale validation

Excessive gaming behaviors can lead to internet gaming disorder (IGD) (Ji et al., 2022), with a pooled prevalence of 8.8%-10.4% among young people in a meta-analysis (Gao et al., 2022). Previous studies have found distinct associations between different (extrinsic, intrinsic, immersion, and social) gaming motivations and IGD symptoms (Gomez et al., 2022; Wang & Cheng, 2022). Gamification has gained considerable attention in recent years to understand user engagement and gamification user types have been linked to gaming motivations (Seaborn & Fels, 2015). Having a valid and reliable assessment of gamification user types could improve our understanding of the gaming motivations and help create personalized and engaging experiences for gamers with different user types. The Self-Determination Theory (SDT) posits that individuals seek activities to fulfil three essential psychological needs (autonomy, competence, and relatedness) and enhance their well-being (Ryan & Deci, 2020).

By leveraging the SDT framework, Tondello et al. (2016) developed the 24-item Gamification User Types Hexad Scale (Hexad-24). This scale assesses six different user types, each with distinct underlying motivations: Philanthropist, Socializer, Free Spirit, Achiever, Disruptor, and Player. Identification of the Hexad user types could provide valuable insights into the motivational factors of gamers and students in gamified learning environment. For example, Achievers are driven by desires to improve their abilities and may be more resilience amid challenges, and Socializers could have stronger social support networks which enhance their resilience. A previous study (Xi & Hamari, 2019) has associated gamification features with intrinsic need satisfaction in Chinese adults. Besides, the Hexad user types may show different associations with IGD symptoms and psychosocial factors given their distinct motivations and needs. For instance, Philanthropist and Socializer are motivated by building social relationships and helping others and these user types may be less susceptible to IGD. The development and validation of Hexad scale as a standardized scale could allow cross-cultural comparisons and facilitate identification of gamers who are at risk of IGD and psychosocial issues.

The Hexad-24 has been translated into five European languages, including Spanish and German. However, validation studies on the Hexad-24 have yielded mixed results regarding its psychometric properties. Firstly, despite the good model fit in several studies (Akgün & Topal, 2018; Manzano-León et al., 2020; Santos et al., 2023; Tondello et al., 2019), the Hexad model did not show acceptable model fits for the Hexad-24 in Dutch, German, and Brazilian versions (Krath & von Korfflesch, 2021; Ooge et al., 2020; Santos et al., 2022). Secondly, the original study (Tondello et al., 2016) and subsequent validation studies (Akgün & Topal, 2018; Tondello et al., 2019) identified several problematic items with low factor loadings or double loadings. A shorter version of Hexad scale has recently been tested in the Western context (Krath et al., 2023) to improve factorial validity and facilitate administration in applied settings. Thirdly, previous studies (Akgün & Topal, 2018; Manzano-León et al., 2020; Santos et al., 2022; Tondello et al., 2019) focused on factorial validity, reliability, and user type distribution, rather than convergent validity of the Hexad-24. Further evaluation of the convergent validity of the Hexad user types with psychosocial well-being is necessary to establish their clinical relevance.

All existing studies on the Hexad scale were conducted in the Western context. Internet gaming is popular in Asian countries such as China and South Korea, with a higher prevalence of IGD in the Asian regions (Liao et al., 2022). IGD is a prevalent issue of social deviance among Chinese gamers (Bax, 2016). Hong Kong presents a unique blend of Western and Eastern cultures with known cultural differences in gaming motivations and behavior (Snodgrass et al., 2019). Given the notable scarcity of research in the Eastern context, systematic validation of the Hexad scale is needed in this area. The present study had three objectives. First, we aimed to validate the Hexad scale in the Chinese context using a large sample of Hong Kong gamers. Second, we evaluated the measurement invariance of the scale across demographic and gaming characteristics. Third, we examined the convergent validity of the Hexad factors by assessing their associations with gaming characteristics and psychosocial variables.

## Materials and Methods

### Participants and Procedure

The present study sample originated from the baseline data of a longitudinal survey on mental well-being, gaming experiences, and IGD symptoms among Hong Kong gamers. Inclusion criteria of the survey were: 1) residing in Hong Kong in the past year, 2) aged 11–29, 3) having played internet games at least three hours per week. Participants were recruited through purposive sampling via an online survey on the Qualtrics platform between May and June 2023. Recruitment was promoted via mass emails to undergraduate students in local universities and posts on Facebook, Instagram, and Twitter channels. The purpose of the study, its voluntary, anonymous, and confidential nature was explained to the participants. The language of the questionnaire was traditional Chinese, and the questionnaire took around 10–15 min to complete.

Ethical approval was obtained from the Human Research Ethics Committee of the authors' university (Reference number: EA220044). Parental consent for under-aged participants was deemed not necessary by the ethics committee since the present study was judged to pose minimal potential risks to under-aged participants. One out of every five participants would receive a HKD100 e-voucher after survey completion. A total of 2,999 potential participants completed the screening questions and 1,676 of them fulfilled the inclusion criteria. Sixty-six of them were excluded because of complete missing data in the Hexad-24 or atypical timestamps in the responses (i.e. less than one minute to complete), which resulted in a final sample of 1,610 young gamers and a valid response rate of 53.7%.

### Measures

The self-report questionnaire included the Hexad-24 and questions on demographic and gaming characteristics. Validated measures were adopted to assess the psycho-social well-being of the participants in terms of social support, meaning in life, hikikomori, IGD symptoms, and depressive symptoms.

**Gamification User Types Hexad Scale** The 24-item Hexad scale (Hexad-24) (Tondello et al., 2016) was used in the present study to assess six domains of gaming motivations that catered to different user types: Philanthropist, Socializer, Free Spirit, Achiever, Disruptor, and Player.

Each of the six domains are measured by four items on a 7-point Likert scale (1 = “disagree extremely” to 7 = “agree extremely”) based on the respondents’ gaming experience over the past six months. Example items include ‘It makes me happy if I am able to help others’ (Philanthropist), ‘Interacting with others is important to me’ (Socializer), ‘Opportunities for self-expression are important to me’ (Free Spirit), ‘I like defeating obstacles’ (Achiever), ‘I like to provoke’ (Disruptor), and ‘I like competitions where a prize can be won’ (Player).

**Perceived social support** The 12-item Multidimensional Scale of Perceived Social Support (MSPSS) (Zimet et al., 1988) was a common assessment tool of perceived social support from three different sources: family, friends, and significant others. Social support from each source is assessed by four items on a 7-point Likert scale (1 = “disagree extremely” to 7 = “agree extremely”). The MSPSS covers emotional and instrumental support and encompassed such dimensions as availability, reliability, and satisfaction. Given the gaming context, the third source (significant others) was replaced by netizens for assessment of perceived social support from the gaming community. The four items are averaged to produce the aggregate score for social support from each source. The MSPSS has shown adequate reliability (Cronbach’s alpha  $\alpha=0.86 - 0.94$ ) in a previous sample of Hong Kong adolescents (Chou, 2000) and in the present sample (McDonald’s Omega  $\omega=0.86-0.90$ ).

**Meaning in life** The Meaning in Life Questionnaire-short form (Steger et al., 2006) was adopted to evaluate the presence of meaning in life of the respondents. The three items are rated on a 7-point Likert format (1 = “completely untrue” to 7 = “completely true”) and they are averaged to produce the score on presence of meaning in life. This scale has shown good reliability in a recent study ( $\omega=0.86$ ) among adolescents and young adults in Hong Kong (Fong et al., 2023b) and in the present sample ( $\omega=0.87$ ).

**Hikikomori** The 5-item Hikikomori Questionnaire (Teo & Gaw, 2010) was used to assess social withdrawal symptoms of the respondents. This instrument covered items on marked social isolation, avoidance of social situations and relationships, duration of social isolation, significant functional impairment, and distress brought by the social isolation. Diagnostic criteria of hikikomori was based on combination of the following three conditions (Kato et al., 2020): 1) marked social isolation in one’s home; 2) significant functional impairment or distress brought by the social isolation, and 3) duration of continuous social isolation of at least 6 months. This scale has shown satisfactory psychometric properties in recent studies among internet gamers and young adults in Hong Kong (Fong & Yip, 2023).

**Internet Gaming Disorder symptoms** The 9-item Internet Gaming Disorder (IGD) Scale – short form (Pontes & Griffiths, 2015) was used to assess nine criteria associated with IGD (preoccupation, tolerance, withdrawal, persistence, escape, problems, deception, displacement, and conflict) over the past six months. The nine items are rated on a 5-point Likert format (1 = “Never” to 5 = “Very often”) and summed to produce the total IGD score with a theoretical range from 9 to 45. This scale has shown good reliability ( $\alpha=0.88$ ) in a previous sample in Hong Kong (Fong et al., 2023a) and in the present sample ( $\omega=0.89$ ).

**Depressive symptoms and suicidal ideation** The 9-item Patient Health Questionnaire (PHQ-9) (Martin et al., 2006) was used to evaluate the depressive symptoms of the respondents in the past two weeks. The nine items are rated on a 4-point Likert format (0 = “Not at all” to 3 = “Nearly every day”) and the total PHQ-9 score has a theoretical

range from 0 to 27. The PHQ-9 has shown good reliability ( $\alpha=0.86$ ) in a previous Chinese sample (Wang et al., 2014) and in the present sample ( $\omega=0.85$ ). The participants were also asked whether they had considered suicide in the past year.

**Demographic and gaming characteristics** The online survey included questions on demographic characteristics such as gender, age, education level. Monthly income (HKD) of the household was asked on a 8-point scale (1 = '<10,000', 2 = '10,000–19,999', 3 = '20,000–29,999', 4 = '30,000–39,999', 5 = '40,000–49,999', 6 = '50,000–59,999', 7 = '60,000–69,999', and 8 = '≥70,000'). For gaming characteristics, the respondents reported the number of hours they spent in internet gaming per week in the past month, whether they played multiplayer online battle arena games (MOBA) and massive multiplayer online role-playing games (MMORPG) in the past month. Based on their gaming experience over the past six months, they were asked the frequency of helping other players and exposure to violent contents or images in internet games on a 5-point Likert scale (1 = 'never' to 5 = 'very often'). They also reported their intention to become a eSports player on a 7-point Likert scale (1 = "disagree extremely" to 7 = "agree extremely").

## Statistical Analysis

All Hexad-24 items showed acceptable levels of skewness (range = -1.08 – 0.09) and kurtosis (range = -0.83 – 1.19). None of the items showed substantial floor or ceiling effects (with > 25% of the respondents endorsing the minimum or maximum category). Given the 7-point response scale and symmetric item distributions, they were modelled as continuous variables in the analysis (Rhemtulla et al., 2012). The dataset was randomly split into two equal subsample 1 and subsample 2 ( $N=805$ ). A correlated 6-factor model for the Hexad-24 had 63 free parameters. The subsample size had an adequate N:q ratio of cases to free parameters = 12.8 cases per parameter that exceeded the minimum recommendations of 10:1 for factor analysis (Jackson, 2003). Psychometric properties of Hexad scale were examined in the following four steps.

First, confirmatory factor analyses (CFA) was conducted on the 6-factor model for the Hexad-24 in subsample 1 using the robust maximum likelihood estimator in Mplus 8.6 (Muthén & Muthén, 2017). Given the sensitivity of chi-square test to moderately large sample size, minor model misspecification could lead to significant chi-square results in the CFA model. Overall goodness of fit was evaluated using the following criteria (Hu & Bentler, 1999): comparative fit index (CFI) and Tucker-Lewis index (TLI)  $\geq 0.95$ , root mean square error of approximation (RMSEA)  $\leq 0.06$ , standardized root mean square residuals (SRMR)  $\leq 0.06$ . These fit indices provided alternative assessments of the model fit that took into account the model complexity and sample size. Factor loadings that were at least 0.50 were considered substantial (Howard, 2016). In accordance with prior studies on the development of short versions (Rammstedt & John, 2007), we aimed to develop a short version of the Hexad-24 by retaining the two best items in each subscale, resulting in the Hexad-12. Item selection was based on both statistical criteria (factor loadings from CFA and contribution to scale reliability) and theoretical criteria (unique contributions of the item to the user type) (Krath et al., 2023).

Second, CFA examined the model fit of the 6-factor models for both Hexad-24 and Hexad-12 in subsample 2. Reliability of the Hexad factors was evaluated in the whole sample using  $\omega$  coefficient, with values  $\geq 0.70$  indicating satisfactory composite reliability. Discriminant validity was evaluated by whether the correlations among the Hexad factors exceed 0.8, which indicates redundancy among the factors. Descriptive statistics were obtained for the Hexad factors,

and the main Hexad user type of each participant was determined based on his user type with the highest score. In cases of tied scores, equal weightings were applied to the user types.

Third, we investigated the measurement invariance of the Hexad factors in the full sample across subsamples, demographic subgroups, gaming genre, and mental health outcomes. In the present study, measurement invariance was evaluated across gender and age groups (adolescents aged 11–19 and young adults aged 20–29). Multiple-group CFA estimated the configural invariance models as the baseline model with different loadings and intercepts across groups. Then, scalar invariance models estimated equal item loadings and intercepts across groups (Van de Schoot et al., 2012). Model comparison between these two models was performed via the chi-square difference test and changes in fit indices, with  $\Delta\text{CFI} \leq -0.01$  or  $\Delta\text{RMSEA} \geq 0.01$  suggesting measurement non-invariance (Chen, 2007) and models with lower BIC indicating better model fit with greater parsimony. In the case of significant findings of non-invariance, practical significance of the non-invariant parameters was evaluated by considering a relative degree of non-invariance larger than 10% as indicative of substantial bias (Fong & Ho, 2021). Structural invariance tests then compared the Hexad factors means across subgroups on a standardized metric.

Fourth, convergent validity was evaluated via partial correlations between the Hexad factors and gaming characteristics, social support, meaning in life, IGD symptoms, and depressive symptoms in the overall sample. Age, gender, education level, game genre, and household income were controlled in the partial correlations. Values of 0.10, 0.30, and 0.50 denoted small, moderate, and large correlations, respectively. We examined the associations between the Hexad factors, hikikomori, and suicidal ideation. There was no missing data in the Hexad-24. Missing data in other variables were minimal and handled by full information maximum likelihood. Statistical significance was set at 0.01 given the relatively large sample size and 99% confidence intervals are reported for key estimates such as factor loadings, reliability, and correlations.

## Results

Table 1 presents the profile and descriptive statistics of the present sample. About half of the sample were males and the average age was 23.1 years ( $SD=4.18$ ). The respondents perceived significantly higher levels of social support from friends and family than netizens in gaming community (Cohen  $d=0.40$ – $0.66$ ,  $p<0.01$ ). The sample reported average levels of meaning in life, depressive symptoms, and IGD symptoms. The proportion of respondents with hikikomori and suicidal ideation was 9.5% and 27.8%, respectively. The two subsamples showed no significant differences in any characteristics ( $d=-0.06$  to  $0.06$ ,  $p=0.16$ – $0.88$ ).

### Factorial Validity and Reliability

As shown in Table 2, in subsample 1, the 6-factor CFA model provided a mediocre fit (CFI and TLI  $<0.90$  and SRMR  $>0.06$ ) for Hexad-24 but an adequate fit (CFI  $>0.95$ , TLI  $\sim 0.95$ , RMSEA  $<0.06$ ) for Hexad-12. In subsample 2, the 6-factor CFA model also provided a mediocre fit to Hexad-24 but an adequate fit to Hexad-12. Table 3 shows the factor loadings for the 12 retained items and correlations among the 6 Hexad-12 factors in the overall sample. All items showed substantial loadings ( $\lambda=0.55$ – $0.81$ ,  $p<0.01$ ) on their respective factor. Disruptor showed weak correlations ( $r=0.03$ – $0.11$ ) with the other five factors. Moderate correlations ( $r=0.33$ – $0.49$ ,  $p<0.01$ ) were mostly found among the other

**Table 1** Comparison of gaming, and psychosocial profiles of participants across samples

	Subsample 1 (N=805) N (%)	Subsample 2 (N=805) N (%)	$\chi^2$	<i>p</i>	
Females	360 (44.7)	363 (45.1)	0.02	0.88	
Age group			0.94	0.33	
<i>Adolescents (11–19 years)</i>	167 (20.7)	183 (22.7)			
<i>Young adults (20–29 years)</i>	638 (79.3)	622 (77.3)			
Education level			4.24	0.24	
<i>Secondary school</i>	156 (19.4)	185 (23.0)			
<i>Associate degree</i>	111 (13.8)	120 (14.9)			
<i>Bachelor degree</i>	452 (56.1)	418 (51.9)			
<i>Master or above</i>	86 (10.7)	82 (10.2)			
Played MOBA	403 (50.1)	375 (46.6)	2.02	0.16	
Played MMORPG	311 (38.7)	300 (37.3)	0.34	0.56	
Hikikomori	70 (8.7)	83 (10.3)	1.22	0.27	
Suicidal ideation	228 (28.3)	220 (27.3)	0.20	0.66	
	<i>Mean (SD)</i>	<i>Mean (SD)</i>	<i>t</i>	<i>p</i>	<i>d</i>
Age (years)	23.2 (4.15)	22.9 (4.21)	1.06	0.29	0.05
Household income	4.71 (2.09)	4.67 (2.07)	0.34	0.74	0.02
Gaming hour (per week)	21.3 (19.0)	22.4 (20.5)	-1.13	0.26	-0.06
Help others in games	3.23 (0.99)	3.18 (0.97)	1.14	0.25	0.06
Violent contents in games	2.78 (1.23)	2.80 (1.21)	-0.35	0.73	-0.02
Intent to join eSports	2.29 (1.51)	2.34 (1.50)	-0.58	0.56	-0.03
Social support—family	4.73 (1.31)	4.71 (1.30)	0.27	0.79	0.01
Social support—friends	5.04 (1.19)	5.09 (1.14)	-0.92	0.36	-0.05
Social support—netizens	3.96 (1.43)	4.02 (1.51)	-0.82	0.41	-0.04
Presence of meaning in life	4.16 (1.50)	4.25 (1.46)	-1.32	0.19	-0.07
IGD symptoms	22.0 (7.65)	22.2 (7.23)	-0.38	0.70	-0.02
Depressive symptoms	8.44 (5.33)	8.34 (5.11)	0.42	0.68	0.02

$\chi^2$ =chi-square; MOBA=multiplayer online battle arena game; MMORPG=massive multiplayer online role-playing game; IGD=Internet gaming disorder

**Table 2** Fit indices of 6-factor CFA models for the 24-item and 12-item Hexad scale in two subsamples

Model specification	$\chi^2$	df	CFI	TLI	RMSEA	SRMR	BIC
Subsample 1: (N=805)							
24-item, 6-factor CFA	710.4*	237	0.883	0.864	0.050	0.075	62323
12-item, 6-factor CFA	83.5*	39	0.969	0.948	0.038	0.030	31534
Subsample 2: (N=805)							
24-item, 6-factor CFA	862.0*	237	0.862	0.839	0.057	0.076	62002
12-item, 6-factor CFA	94.1*	39	0.965	0.941	0.042	0.032	31443

\*  $p < 0.01$ ; CFA=confirmatory factor analysis; Hexad=Gamification User Type Hexad Scale;  $\chi^2$ =chi-square; df=degree of freedom; CFI=comparative fit index; TLI=Tucker-Lewis index; RMSEA=root mean square error of approximation; SRMR=standardized root mean square residual; BIC=Bayesian information criterion

**Table 3** Factor loadings and factor correlations of the 6-factor CFA model for the 12-item Gamification User Type Hexad Scale in the overall sample

Scale item	Philanthropist	Socializer	Free-spirit	Achiever	Disruptor	Player
P2. Help others orient	.61 (.54-.68)*					
P3. Share knowledge	.65 (.58-.72)*					
S2. Part of a team		.78 (.72-.84)*				
S4. Enjoy group activity		.70 (.64-.76)*				
F1. Follow own path			.62 (.53-.71)*			
F3. Be independent			.56 (.48-.65)*			
A2. Master hard task				.68 (.62-.75)*		
A4. Emerge victorious				.78 (.72-.84)*	.55 (.30-.80)*	
D3. See myself as rebel					.81 (.45-1.17)*	.68 (.61-.76)*
D4. Dislike obeying rule						.77 (.70-.84)*
R2. Motivated by reward						
R4. Put in effort						
Correlations	Philanthropist	Socializer	Free-spirit	Achiever	Disruptor	
Socializer	.54 (.50-.59)*					
Free-spirit	.41 (.35-.46)*	.22 (.16-.28)*				
Achiever	.49 (.44-.53)*	.48 (.42-.52)*	.41 (.35-.46)*			
Disruptor	.11 (.05-.17)*	.04 (-.03-.10)	.09 (.02-.15)*	.09 (.02-.15)*		
Player	.41 (.35-.46)*	.33 (.27-.39)*	.37 (.32-.43)*	.41 (.35-.46)*	.03 (-.04-.09)	

*N* = 1610; \*  $p < 0.01$ ; CFA = confirmatory factor analysis; 99% confidence intervals are shown in parenthesis. All factor loadings are greater than 0.50



five factors. Acceptable reliability was found for three of the Hexad-12 factors: Socializer ( $\omega=0.70$ , 99% CI=0.65 – 0.74), Achiever ( $\omega=0.73$ , 99% CI=0.69 – 0.77), and Player ( $\omega=0.73$ , 99% CI=0.69 – 0.78). Lower reliability was found for the remaining three factors: Philanthropist ( $\omega=0.66$ , 99% CI=0.62 – 0.71), Free Spirit ( $\omega=0.65$ , 99% CI=0.59 – 0.71), and Disruptor ( $\omega=0.69$ , 99% CI=0.40 – 0.99). The six Hexad-12 factors showed very strong correlations ( $r=0.83 – 0.92$ ,  $p < 0.01$ ) with the respective Hexad-24 factors.

## Measurement and Structural Invariance

Table 4 shows the fit indices of the measurement invariance models of the Hexad-12 factors across different subgroups. The configural invariance models demonstrated adequate model fits (CFI > 0.95, RMSEA < 0.05, and SRMR < 0.040) for all subgroups. Chi-square difference tests between the configural and scalar invariance models found significant results across game genres ( $\Delta\chi^2=33.1–36.6$ ,  $\Delta df=12$ ,  $p < 0.01$ ) but not across subsamples, gender, age groups, hikikomori, and suicidal ideation subgroups ( $\Delta\chi^2=7.64–23.0$ ,  $\Delta df=12$ ,  $p=0.03 – 0.81$ ). In the metric invariance models across game genres, the highest degrees of non-invariance were found in the two Disruptor items across MOBA (% non-invariance = 9.6%–9.7%) and MMORPG (% non-invariance = 10.2%–10.6%), with those who played MOBA/

**Table 4** Measurement invariance tests of the 12-item Gamification User Type Hexad Scale across gender, age groups, game genre, and mental distress subgroups

Invariance	$\chi^2$	df	CFI	RMSEA	SRMR	BIC
Across subsamples (805 in subsample 1 and 805 in subsample 2):						
Configural	177.6	78	0.967	0.040	0.031	63047
Scalar	190.4	90	0.967	0.037	0.034	62973
Across gender (887 males and 723 females):						
Configural	188.1	78	0.963	0.042	0.032	62998
Scalar	204.5	90	0.962	0.040	0.036	62930
Across age group (350 adolescents and 1260 young adults):						
Configural	200.0	78	0.961	0.044	0.032	63022
Scalar	212.0	90	0.961	0.041	0.034	62942
Across MOBA game (779 played and 831 did not play):						
Configural	202.4	78	0.960	0.045	0.034	62872
Scalar	235.4	90	0.953	0.045	0.044	62828
Across MMORPG (612 played and 998 did not play):						
Configural	169.1	78	0.970	0.038	0.032	62850
Scalar	204.8	90	0.962	0.040	0.039	62811
Across hikikomori (1457 without and 153 with):						
Configural	203.2	78	0.961	0.045	0.032	62937
Scalar	223.2	90	0.958	0.043	0.035	62871
Across suicidal ideation (1162 without and 448 with):						
Configural	204.1	78	0.959	0.045	0.033	62742
Scalar	227.5	90	0.956	0.044	0.037	62685

$\chi^2$  = chi-square; df = degree of freedom; RMSEA = root mean square error of approximation; CFI = comparative fit index; SRMR = standardized root mean square residual; BIC = Bayesian information criterion; MOBA = multiplayer online battle arena; MMORPG = massive multiplayer online role-playing game

MMORPG games showing higher item intercepts than those who did not. All scalar invariance models showed comparable model fit indices ( $\Delta RMSEA$ ,  $\Delta CFI$ , and  $\Delta SRMR < 0.01$ ) and lower BIC than the configural invariance models. These results support the invariance of factor structure, item loadings, and item intercepts of the Hexad-12 across all subgroups.

As shown in Table 5, there were no significant latent mean differences in the Hexad-12 factors across the two subsamples. Compared to females, males showed significantly higher levels in Socializer, Achiever, and Disruptor. Adolescents reported significantly higher levels in Socializer and Disruptor than young adults. Respondents who played MOBA games showed significantly higher levels in Socializer and Disruptor but lower levels in Free Spirit than those who did not; Respondents who played MMORPG showed significantly higher levels in Disruptor but lower levels in Free Spirit and Player than those who did not.

### Gamification User Types Distribution

Table 6 shows the descriptive statistics of the Hexad-12 factors scores. Disruptor showed the lowest score and Player showed the highest score than the other types. For the distribution of the main user type, Player showed the highest prevalence (33.9%) in the sample, followed by Free-Spirit (19.7%), and these were especially true among females. The Disruptor type was the least common type (7.5%).

### Convergent Validity

Table 7 displays the partial correlations between the Hexad-12 factors, gaming characteristics, and psychosocial variables in the sample. Disruptor was negatively associated with social support from family but positively associated with exposure to violent contents in games, intent to become an eSports player, social support from netizens, IGD symptoms, depressive symptoms. The other five factors were positively associated with helping others in games, social support from family and friends and negatively associated with depressive symptoms. Philanthropist, Socializer, Free-Spirit, and Achiever showed positive associations with meaning in life. Free Spirit and Achiever showed negative and weak correlations with IGD symptoms. Respondents with hikikomori showed higher levels in Disruptor but lower levels in Achiever, and respondents with suicidal ideation showed higher levels in Disruptor but lower levels in other five factors.

### Discussion

The present study examined the psychometric properties of the Hexad scale in a sample of young gamers in Hong Kong. Comparing to previous validation studies on the Hexad-24 (Krath & von Korflesch, 2021; Krath et al., 2023; Ooge et al., 2020; Tondello et al., 2019), we found consistent results indicating that the 6-factor CFA model did not adequately fit the Hexad-24. The lack of fit was likely due to items with low factor loadings and double loadings. The removal of these problematic items led to improved model fit for the Hexad-12. A recent study (Krath et al., 2023) in the Western context also found a superior model fit for the Hexad-12 over the original Hexad-24. Besides, 10 of our Hexad-12 items matched with the existing Hexad-12, suggesting future possibilities to compare the Hexad-12 user types across cultural contexts. The marginal to acceptable levels of reliability for the Hexad-12 were attributable to the ultra-short length (two items) of the factors. The

**Table 5** Comparison of latent means of Hexad-12 factors across demographic subgroups, game genre, and mental health outcomes

Subgroups	Philanthropist Δ (SE)	Socializer Δ (SE)	Free-spirit Δ (SE)	Achiever Δ (SE)	Disruptor Δ (SE)	Player Δ (SE)
Across subsamples (Reference = subsample 1 [N=805]):						
Subsample 2 (N=805)	-0.01 (0.07)	-0.02 (0.06)	0.08 (0.07)	-0.06 (0.06)	-0.06 (0.07)	0.02 (0.06)
Across gender (Reference = females [N=723]):						
Males (N=887)	0.14 (0.06)	0.21 (0.06)*	0.04 (0.07)	0.23 (0.06)*	0.26 (0.06)*	-0.02 (0.06)
Across age group (Reference = young adults [N=1260]):						
Adolescents (N=350)	0.10 (0.08)	0.16 (0.06)*	-0.01 (0.09)	0.13 (0.07)	0.28 (0.07)*	0.02 (0.07)
Across game genre:						
Played MOBA (N=779)	0.08 (0.07)	0.29 (0.07)*	-0.23 (0.07)*	0.01 (0.06)	0.37 (0.07)*	-0.12 (0.06)
Played MMORPG (N=612)	0.02 (0.07)	0.02 (0.06)	-0.40 (0.07)*	-0.10 (0.06)	0.38 (0.07)*	-0.22 (0.06)*
Across mental health outcomes:						
Hikikomori (N=153)	0.07 (0.12)	-0.20 (0.09)	-0.29 (0.12)	-0.25 (0.10)*	0.70 (0.14)*	-0.18 (0.10)
Suicidal ideation (N=448)	-0.23 (0.08)*	-0.35 (0.07)*	-0.24 (0.07)*	-0.27 (0.06)*	0.55 (0.10)*	-0.29 (0.06)*

\*  $p < .01$ ; Hexad-12 = 12-item Gamification User Type Hexad Scale; Δ = standardized mean difference; SE = standard error; MOBA = multiplayer online battle arena game; MMORPG = massive multiplayer online role-playing game

**Table 6** Descriptive statistics of the Hexad-12 factors and distribution of the main Hexad user type in the sample

User type	Mean	SD	Skewness	Kurtosis	Prevalence as main user type		
					Overall sample ( <i>N</i> = 1610)	Males ( <i>N</i> = 887)	Females ( <i>N</i> = 723)
Philanthropist	4.94	1.13	-0.54	0.42	11.2%	11.8%	10.6%
Socializer	4.91	1.20	-0.69	0.52	13.2%	13.9%	12.4%
Free-Spirit	5.20	1.03	-0.63	0.67	19.7%	18.3%	21.5%
Achiever	5.04	1.18	-0.77	0.72	14.3%	16.2%	12.1%
Disruptor	3.90	1.38	-0.01	-0.45	7.5%	8.9%	5.9%
Player	5.44	1.14	-0.93	1.10	33.9%	31.0%	37.6%

Hexad-12 = 12-item Gamification User Type Hexad Scale; Score for each user type ranges from 1 to 7

present findings suggest the use of Hexad-12 as a valid and brief measure of gamification user types to facilitate quick screening and early identification of problem gamers with heightened IGD risks.

It is important to evaluate the measurement invariance of the Hexad-12 to ensure that the measurement tool is valid and comparable across different subgroups. Previous studies have found gender invariance for the Hexad-24 in the Turkish and Brazilian contexts (Manzano-León et al., 2020; Santos et al., 2022). The present study contributes to the literature by demonstrating scalar measurement invariance for the Hexad-12 across gender, age groups (adolescents and young adults), and mental distress subgroups (hikikomori and suicidal ideation). This implies meaningful and unbiased comparisons of the Hexad gamification user types across these subgroups. The present study found evidence for non-invariant intercepts in the two Disruptor items across game genres. The measurement non-invariance may be attributed to the respondents' gaming preferences, indicating that gamers who played MOBA or MMORPG games were inherently more rebellious and disobedient. The non-invariance in the item intercepts could bias meaningful interpretation of the latent mean differences in the Disruptor factor across game genres. Further studies are needed to elucidate potential measurement non-invariance of the Hexad-12 factors, particularly the Disruptor factor, across other game genres such as first-person shooting, sports, and strategy games.

Adolescents reported higher levels in Socializer and Disruptor than young adults. Internet gaming could play a greater role in the socialization process of adolescents to develop friendships during school life (Kowert et al., 2014; Torres-Rodríguez et al., 2018). The higher levels of Disruptor could be attributed to the rebellious personality and risk-taking tendencies during adolescence (Gullone & Moore, 2000). Males showed higher levels in Socializer, Achiever, and Disruptor than females. This gender discrepancy suggests higher levels of gaming motivations and is in line with higher IGD risks in males (Su et al., 2020). Both MOBA and MMORPG were associated with lower levels in Free Spirit and higher levels in Disruptor. Our results contributed to the existing literature on gaming motivations and game genre (Brandtner et al., 2022; Laconi et al., 2017). MOBA game players showed stronger gaming motivation to socially interact with others (Bonny & Castaneda, 2022).

Previous studies (Krath & von Korfflesch, 2021; Senocak et al., 2021; Tondello et al., 2016) has shown satisfactory convergent validity for the Hexad-24 with the Big Five personality traits and game design elements and preferences. The present study elucidated the associations between Hexad user types and gamers' psychosocial well-being. Philanthropist

**Table 7** Partial correlations between Hexad-12 factors, gaming characteristics, and psychosocial variables

Study variables	Philanthropist	Socializer	Free-spirit	Achiever	Disruptor	Player
Gaming hour (per week)	.05 (-.04 – .14)	.03 (-.06 – .12)	.09 (-.01 – .18)	.08 (-.01 – .17)	-.01 (-.11 – .08)	.09 (-.01 – .19)
Intent to join eSports	.07 (-.03 – .16)	.03 (-.06 – .12)	-.15 (-.25 – -.05)*	.00 (-.08 – .09)	.26 (.17 – .35)*	-.06 (-.15 – .03)
Help others in games	.34 (.25 – .43)*	.38 (.30 – .46)*	.18 (.09 – .28)*	.26 (.18 – .35)*	.03 (-.06 – .12)	.19 (.10 – .27)*
Violent contents in games	.10 (-.01 – .19)	.05 (-.03 – .14)	.04 (-.05 – .14)	.07 (-.02 – .15)	.25 (.16 – .33)*	.04 (-.04 – .12)
IGD symptoms	.01 (-.08 – .11)	-.03 (-.12 – .05)	-.19 (-.28 – -.09)*	-.11 (-.19 – -.02)*	.47 (.39 – .55)*	-.06 (-.15 – .02)
Depressive symptoms	-.19 (-.28 – -.09)*	-.24 (-.32 – -.15)*	-.20 (-.30 – -.10)*	-.23 (-.31 – -.15)*	.31 (.23 – .40)*	-.14 (-.23 – -.06)*
Social support – family	.35 (.25 – .44)*	.32 (.23 – .40)*	.22 (.12 – .32)*	.27 (.19 – .36)*	-.16 (-.26 – -.06)*	.20 (.12 – .29)*
Social support – friends	.50 (.40 – .59)*	.46 (.38 – .54)*	.47 (.37 – .57)*	.42 (.34 – .51)*	-.02 (-.12 – .08)	.36 (.27 – .46)*
Social support – netizens	.29 (.20 – .38)*	.27 (.19 – .35)*	.08 (-.02 – .17)	.19 (.11 – .27)*	.18 (.08 – .27)*	.07 (-.01 – .15)
Presence of meaning in life	.31 (.22 – .40)*	.29 (.21 – .38)*	.20 (.11 – .29)*	.28 (.20 – .36)*	-.09 (-.18 – .01)	.09 (.01 – .17)*

*N* = 1610; \* *p* < .01; Hexad-12 = 12-item Gamification User Type Hexad Scale; IGD = internet gaming disorder; 99% confidence intervals are shown in parenthesis. All coefficients are controlled for age, gender, education, game genre, and household income

and Socializer were positively associated with social support from all three sources (family, friends, and netizens), which indicates that these two user types are oriented towards social interaction and interpersonal relationships. Free Spirit and Achiever could potentially be protective factors of IGD given their negative correlations with IGD symptoms. These four intrinsically motivated user types were associated with higher meaning in life and fewer depressive symptoms and suicidal ideation. In contrast, Player was extrinsically motivated by rewards and this user type showed weaker associations with the psychosocial variables. Our results add to the growing evidence base on the theoretical framework of SDT (Gillison et al., 2019; Krath et al., 2021), where intrinsic motivation plays a greater role than extrinsic motivation in promoting positive affect, motivation, and behavior change (Ryan & Deci, 2020; Taylor et al., 2014). A recent study found network linkages between IGD, social withdrawal, and depressive symptoms (Fong et al., 2024). Given the positive associations with IGD and depressive symptoms, the Disruptor user type could be a potential risk factor of IGD and psychological distress that warrants more investigation in future studies.

Previous studies (Krath et al., 2023; Manzano-León et al., 2020; Santos et al., 2022; Tondello et al., 2016, 2019) have found higher Hexad scores for Philanthropist, Free Spirit, and Achiever than other types. In contrast, our sample showed the highest Hexad score in Player, accounting for one-third of the sample as the main user type compared to only 10%–12% in previous studies (Santos et al., 2022; Tondello et al., 2016). The discrepancy suggests that the gaming behaviors of our sample were driven by extrinsic rewards rather than intrinsic motivations. In the present sample, the Disruptor user type showed a higher prevalence (7.5%) than those (1%) reported in previous studies. A recent systematic review has found that design choices for one's avatar may represent markers of mental health conditions (Szolin et al., 2022). Given the applications of gamification approach in non-gamified contexts such as work and education (Mitchell et al., 2020; Sailer & Homner, 2020), future studies should evaluate the utility of the Hexad-12 in assessing Hexad user types in these contexts.

## Study Limitations

The present study had several limitations. Firstly, this cross-sectional study could not examine the test–retest reliability and longitudinal invariance of the Hexad-12. Longitudinal studies are needed to examine the changes in Hexad user types and temporal relationships with IGD (Jeong et al., 2021) and suicidal ideation (Fong et al., 2021). Secondly, this study did not investigate the criterion validity of the Hexad-12. Future studies should incorporate measures on gaming motivation such as Gaming Motivation Inventory (Király et al., 2022) and Motives for Online Gaming Questionnaire (Wu et al., 2016) to examine the associations between the Hexad user types and gaming motivation. Third, the non-random sampling design implies potential non-response bias in the sample, and the present sample could be over-represented by university students and active users of social media. Caution is warranted in generalizing the results to other populations and further studies could attempt to recruit more adolescents via middle school settings.

Fourth, the present study did not distinguish between gamers with multiple dominant user types and different user types could have interactive effects on gamers' psychosocial well-being. Further studies should conduct finite mixture modeling to explore the latent heterogeneity of gamification user types in gamers. Fifth, the present study did not investigate the cognitive and behavioral mechanism of developing IGD (Wang et al., 2023). Further studies could assess the relationships between Hexad user types

and other factors such as impulsivity trait, lifestyle factors, and resilience (Gao et al., 2022; Matias et al., 2023; Tsui & Cheng, 2021). Sixth, the present study only tested the measurement invariance of the Hexad-12 across basic demographics (gender and age groups). Future research should evaluate its measurement invariance across other relevant variables such as skill levels (professional versus amateur levels) and time spent gaming (frequent gamers versus occasional gamers). To account for non-invariance in the measurement structure, future studies could consider alternative modeling approach such as partial invariance approach, Bayesian approximate measurement invariance approach (Fong & Ho, 2015), or alignment approach (Munck et al., 2018).

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**Data Availability** The data analysed in the present study are available from the first author upon request.

## Declarations

**Ethics Approval** Ethics approval was obtained from the Human Research Ethics Committee of the University of Hong Kong (HREC Number=EA220044). The authors assert that all procedures contributing to this work comply with the ethical standards of the Declaration of Helsinki in 1975, as revised in 2008.

**Informed Consent** All participants provided informed consent, and participation was voluntary. They understood that they could withdraw from the study anytime.

**Conflict of Interest** The authors declare no competing interests.

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