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ARTÍCULO DE INVESTIGACIÓN

Bienestar psicológico en estudiantes: Adaptación cultural y revisión del modelo Ryff

Min Xu[1], Hadijah Binti Jaffri[2], Xiaohan Yang[3], Shih Ling Chor[4], Xin Ma[5]

[1]School of Education, University Technology Malaysia, Johor, Malaysia.
E-mail: lindsaysnowballs@gmail.com; ORCID ID: https://orcid.org/0009-0003-4831-5976.
[2]School of Education, University Technology Malaysia, Johor, Malaysia.
E-mail: hadijahjaffri@utm.my; ORCID ID: https://orcid.org/0000-0001-8620-6445.
[3]School of Education, University Technology Malaysia, Johor, Malaysia.
E-mail: yangxiaohan1997@gmail.com; ORCID ID: https://orcid.org/0009-0007-7619-076X,
[4]School of Education, University Technology Malaysia, Johor, Malaysia.
E-mail: shihling.sunshine@gmail.com; ORCID ID: https://orcid.org/0000-0002-4295-4633
[5]Faculty of Management, University Technology Malaysia, Johor, Malaysia.
E-mail: Chrisma0912@gmail.com; ORCID ID: https://orcid.org/0009-0007-7371-6447.

Resumen. Este estudio presenta una evaluación psicométrica de la escala de Bienestar Psicológico (PWB) de Ryff para estudiantes internacionales chinos en Malasia. Con una muestra de 335 participantes, implementamos un enfoque analítico integral que incorpora análisis de Rasch, análisis factorial confirmatorio (AFC) y análisis factorial exploratorio (AFE) para evaluar y refinar la estructura de la escala. El modelado inicial de Rasch en una muestra piloto (N = 110) identificó ítems problemáticos que exhibieron desajuste de medición. Al aplicar el AFC para probar el modelo original de seis factores en el estudio principal, descubrimos altas correlaciones interfactoriales y una validez discriminante inadecuada, particularmente entre cuatro dimensiones. A través de la reespecificación y validación del modelo, desarrollamos una solución de tres factores más parsimoniosa que consolidó el Dominio Ambiental, el Crecimiento Personal, el Propósito en la Vida y la Autoaceptación en un constructo unificado, manteniendo la Autonomía y las Relaciones Positivas como factores distintos. El modelo optimizado de 15 ítems y tres factores demostró excelentes propiedades psicométricas (χ^2/gl = 1,305, CFI = 0,995, TLI = 0,994, SRMR = 0,022, RMSEA = 0,030). Estos hallazgos sugieren que el bienestar psicológico podría manifestarse de forma más integrada entre los estudiantes internacionales chinos que se adaptan a entornos interculturales de lo que se teorizó originalmente. Este modelo perfeccionado ofrece a investigadores y profesionales un instrumento más adecuado desde el punto de vista cul-

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tural y psicométrico para evaluar el bienestar psicológico en poblaciones de estudiantes internacionales, a la vez que contribuye a nuestra comprensión de cómo el contexto cultural puede influir en la manifestación estructural de los constructos psicológicos.

Palabras clave: modelo de bienestar de Ryff, estudiantes internacionales chinos, psicometría, bienestar psicológico, autoaceptación.

Psychological well-being in students: Cultural adaptation and revision of the Ryff model

Abstract. This study presents a psychometric evaluation of Ryff's Psychological Well-Being (PWB) scale for Chinese international students from mainland China studying in Malaysia. With a sample of 335 participants, we implemented a comprehensive analytical approach incorporating Rasch analysis, confirmatory factor analysis (CFA), and exploratory factor analysis (EFA) to assess and refine the scale's structure. Initial Rasch modeling in a pilot sample (N = 110) identified problematic items that exhibited measurement misfit. When applying CFA to test the original six-factor model in the main study, we discovered high inter-factor correlations and inadequate discriminant validity, particularly among four dimensions. Through model respecification and validation, we developed a more parsimonious three-factor solution that consolidated Environmental Mastery, Personal Growth, Purpose in Life, and Self-Acceptance into a unified construct while retaining Autonomy and Positive Relations as distinct factors. The optimized 15-item, three-factor model demonstrated excellent psychometric properties (χ^2/df = 1.305, CFI = 0.995, TLI = 0.994, SRMR = 0.022, RMSEA = 0.030). These findings suggest that psychological well-being may manifest in a more integrated manner among Chinese international students from mainland China adapting to cross-cultural environments than originally theorized. This refined model offers researchers and practitioners a more culturally appropriate and psychometrically sound instrument for assessing psychological well-being in international student populations, while contributing to our understanding of how cultural context may influence the structural manifestation of psychological constructs.

Key words: Ryff Well-being model, Chinese International Students, psychometric property, psychological well-being, Self-acceptance.

INTRODUCTION

The concept of happiness has deep philosophical origins, dating back to ancient Greek thinkers (Bremner, 2011). Two major philosophical traditions—hedonism and eudaimonia—have significantly influenced current views on well-being (Deci& Ryan, 2008). Hedonism, associated with Epicurus, centers on maximizing pleasure and minimizing pain, whereas Aristotle's notion of eudaimonia highlights the importance of living a virtuous life filled with purpose and meaning (Ryan& Deci, 2001; Waterman, 2008). These foundational ideas continue to shape modern psychological perspectives on well-being and life satisfaction. However, the models that try to explain individual well-being are often overloaded with components and don't always have a clear mechanism for the formation of a person's subjective well-being (Voitenko, 2022).

Malaysia has emerged as a prominent destination for international students, with a significant increase in Chinese students enrolling in tertiary-level education. The well-established educational collaboration between China and Malaysia has fostered confidence among Chinese families regarding Malaysia's higher education opportunities as reliable and credible choices (Rui & Wahab, 2022). This significant growth warrants an examination of the factors driving the increasing preference of Chinese students for Malaysia as a higher education destination. Malaysia has emerged as a prominent educational hub in Asia, attracting an increasing number of Chinese students for higher education (Shafaei et al., 2016). According to official statistics, in 2016, approximately 15,000 students from mainland China selected Malaysia as their study destination, making them the second-largest group among international students. Notably, this figure has shown consistent growth over the years (Malaysian Ministry of Higher Education, 2015).

On the other hand, Chinese international students in Malaysia frequently encounter challenges such as adjusting to a new environment, meeting academic demands, and managing cultural conflicts, all of which may adversely impact their psychological well-being (e.g., Gustems-Carnicer et al., 2019; Gan & Yuen, 2019). Given the cultural and cognitive differences among populations, researchers have noted that individuals from distinct countries may perceive and interpret questionnaire items in varying ways. As a result, the psychometric attributes of such instruments, including their factor structure, validity, and reliability, may differ across diverse sample groups and cultural contexts (Vandenberg& Lance, 2000). Therefore, assessing the applicability and validity of the PWBS within the cultural framework of Chinese students studying in Malaysia is essential.

The Psychological Well-Being (PWB) scale, originally developed within a Western cultural context, may not accurately capture well-being in non-Western populations without adequate validation. When applied across culturally distinct settings, such instruments risk measurement bias, even when translated or adapted (Byrne, 2001). Thus, rigorous psychometric evaluation is necessary to ensure their reliability and validity in diverse cultural contexts. The present study seeks to examine the psychometric properties of Ryff's PWB scale among Chinese international students in Malaysia. Employing both classical test theory and item response theory, the research explores the scale's factor structure and assesses its measurement invariance in a cross-cultural framework. Findings are anticipated to contribute to the literature on cross-cultural validation and provide practical guidance for researchers and practitioners working with international student populations.

LITERATURE REVIEW

Conceptual Development of Psychological Well-being

Psychological well-being encompasses a comprehensive view of human flourishing that goes beyond simply experiencing pleasure or avoiding negative emotions (Keyes, 2002). Lasting well-being does not depend on constant positive feelings; rather, it involves the ability to effectively regulate and cope with negative emotions, which is essential for maintaining mental health over time (Huppert, 2009). This form of well-being is marked by a positive psychological state characterized by confidence in facing difficulties, optimistic thinking, persistence in pursuing goals, flexibility, and resilience in the face of challenges (Luthans et al., 2007). According to Ryff (1989), happiness is the highest expression of psychological well-being and a deeply personal experience.

Influenced by various strands of positive psychology—such as Maslow's idea of self-actualization, Rogers' concept of the fully functioning person (1968), and Allport's view of maturity (1961)—Jahoda (1958) proposed a set of criteria for positive mental health that moved beyond merely defining well-being as the absence of illness, offering instead a richer framework for understanding psychological health (Keyes, 2002). Another theoretical perspective on psychological well-being stems from lifespan developmental psychology, which focuses on the unique psychological challenges encountered at different stages of life. This includes Erikson's (1959) psychosocial stage theory and Neugarten's (1973) insights into personality changes throughout adulthood and aging. Jung (2001) further contributed to this view, describing individuation as the process through which individuals attain self-realization.

Ryff (1989) argued that although earlier views on well-being were somewhat fragmented, they could be integrated into a more unified conceptual model. A closer look at various definitions of happiness reveals that many theorists focus on common themes related to positive psychological functioning. Drawing from an extensive review of literature, Ryff developed the Psychological Well-Being Scale (PWBS), grounded in research from mental health, clinical psychology, and lifespan developmental theories (Burns& Machin, 2009). Later, Ryff and Keyes (1995) identified six core dimensions that define positive mental health: self-acceptance, positive social relationships, autonomy, mastery over one's environment, a sense of purpose, and ongoing personal growth. This multidimensional framework presents psychological well-being not simply as the absence of psychological disorders, but as the presence of strengths and positive development in various areas of life.

Although Ryff's Psychological Well-Being Scale (PWBS) has been widely utilized across various populations (Abbott et al., 2006; Springer et al., 2006; Huta & Waterman, 2014), evidence supporting its factorial validity remains scarce—especially in cross-cultural settings where the scale is applied outside its original context (Byrne, 2001). The structure of psychological well-being has sparked ongoing debate, with factor analyses yielding results that range from two to fifteen factors (e.g., Burns & Machin, 2009).

Factorial Validity of Cross-Cultural Adaptations of the PWB

The Psychological Well-Being (PWB) scales, developed by Ryff in 1989 and revised in 2002, are widely used to assess general psychological well-being across six dimensions: personal growth, environmental mastery, purpose in life, autonomy, positive relations with others, and self-acceptance. The original instrument consists of 120 items rated on a 6-point Likert scale, with higher scores indicating greater well-being. Several shortened versions have been developed, including 84-item, 54-item, 42-item, 39-item, and 18-item versions (e.g., Abbott et al., 2006; Van Dierendonck, 2004).

The factor structure of the PWB scale has been extensively debated in the literature. Research employing factor analysis has produced remarkably diverse results, identifying between 2 and 15 distinct dimensions (e.g., Kafka & Kozma, 2002; Burns & Machin, 2009; Sirigatti et al., 2009). This wide range of factorial solutions highlights the complexity of operationalizing psychological well-being across different populations and contexts.

Ryff and Keyes (1995) found that the 18-item version showed strong correlations (70% to 89%) with the original 120-item version and supported a six-factor model with a second-order general well-being factor. While the original validation demonstrated high internal consistency (α = 0.86–0.93), it also revealed concerns regarding discriminant validity due to significant inter-correla-

tions among certain dimensions (r = 0.32–0.76), especially between self-acceptance, environmental mastery, personal growth, and purpose in life. Similarly, Clarke et al. (2001) identified an acceptable six-factor solution in their research with elderly Canadian participants. Though their analysis did not reveal problematic inter-item correlations, they did note weak factor loadings for several items, suggesting potential measurement issues within the scale's structure. A consistent finding across multiple studies is the presence of high inter-correlations between certain dimensions. Van Dierendonck (2004) reported inter-factor correlations ranging from 0.32 to 0.76, with particularly strong associations between self-acceptance, environmental mastery, personal growth, and purpose in life. This pattern raises important questions about whether these theoretically distinct constructs are empirically separable.

In addition, Lindfors et al. (2006) found results consistent with Ryff and Keyes' (1995) original work, identifying a six-factor structure with a second-order general well-being factor as the best-fitting model. Notably, they observed a substantial correlation (r = 0.62) between self-acceptance and environmental mastery dimensions, further highlighting potential conceptual overlap between certain aspects of the scale. Springer and Hauser (2006), using multiple datasets and versions, consistently reported the highest inter-correlations between environmental mastery and self-acceptance, as well as between purpose in life and self-acceptance. To address these overlaps, a hierarchical model was proposed, comprising three first-order factors: one merging Environmental Mastery, Personal Growth, Purpose in Life, and Self-Acceptance (EGPS); a second representing Autonomy; and a third capturing Positive Relations with Others (Henn et al., 2016). These three factors then loaded onto a single second-order factor reflecting overall psychological well-being—a structure that has been supported in prior studies (Burns & Machin, 2009; Van Dierendonck et al., 2008).

In cross-cultural psychology research, ensuring measurement invariance is crucial to confirm that scales maintain consistent psychological structures across diverse cultural groups (Vandenberg & Lance, 2000). The psychometric properties of the PWB scales have been extensively studied across various cultural contexts, with mixed results. Kafka and Kozma (2001) found 15 distinct factors when analyzing the 120-item version with Canadian university students, with Triadó et al. (2007) reporting similar findings using a Spanish translation of the 54-item version. On the other hand, Kitamura et al. (2004) validated the original six-factor model using the Japanese version of the 84-item scale, although some items did not align with the factor structure proposed by Ryff. Cheng and Chan (2005) developed a culturally adapted 28-item Chinese version that demonstrated acceptable fit for a six-factor model. Although the six-factor model has generally received weak to moderate empirical support across various studies (Burns & Machin, 2009; Fernandes et al., 2010; Van Dierendonck et al., 2008), some research has demonstrated a satisfactory model fit (Abbott et al., 2006; Cheng & Chan, 2005; Clarke et al., 2001; Kállay & Rus, 2014). Nonetheless, Springer and Hauser (2006) and Ryff (2013) argued that, despite these inconsistencies, the six-factor model outperforms competing models.

The 18-item short version's internal consistency, assessed using Cronbach's alpha, was reported as follows for the six dimensions: autonomy (0.72), environmental mastery (0.76), positive relations with others (0.75), purpose in life (0.52), personal growth (0.73), and self-acceptance (0.51). The overall reliability of the scale was reported as 0.71 (Ryff & Keyes, 1995). Pedaprolu et al. (2021) additionally reported Cronbach's alpha coefficients for the PWB scale, with subscale values ranging from 0.39 for "purpose in life" to 0.55 for "self-acceptance" and an overall reliability of 0.75.

The 18-item short version of the PWB scale has been extensively utilized in diverse research contexts, including studies involving medical students (Nemati et al., 2023), university students in

Iran (Sefidi & Farzad, 2012), the general population in Italy (Ruini et al., 2003), research scientists in India (Pedaprolu et al., 2021), and clinical nurses in Taiwan (Lee et al., 2019). The scale is widely recognized in the literature for its utility and effectiveness in large-scale surveys, cross-cultural studies, and a variety of applied research contexts (Ryff & Keyes, 1995).

However, its applicability has not been examined among Chinese international postgraduate students in Malaysian universities, where cultural and cognitive variations may influence the perception and interpretation of questionnaire items. Examining the psychometric properties of the PWB scale in this population is particularly significant as Chinese international students face unique challenges navigating between their heritage culture and Malaysian cultural norms (Popadiuk& Arthur, 2004; Alavi & Mansor, 2011), potentially influencing how psychological well-being manifests and is expressed. These students often experience acculturative stress (e.g., Burris et al., 2010; Bewick et al., 2010), language barriers (e.g., Dongqi et al., 2020), and changes in social support systems that may impact their psychological well-being in ways distinct from previously studied populations. Understanding the factorial structure of psychological well-being in this context could inform more culturally sensitive support services in international education settings. Additionally, as China continues to be one of the largest sources of international students globally ((Malaysian Ministry of Higher Education, 2015), research addressing the psychological measurement needs of this population has broad implications for educational institutions worldwide. Building on these insights, the present study seeks to assess the six-dimensional structure of the PWBS scale among Chinese postgraduate students in Malaysia universities and evaluate the reliability and accuracy of the PWBS-C scale in measuring psychological well-being within this specific cultural context.

METHODOLOGY

Content Validity

Content validity refers to the extent to which the items in a given questionnaire accurately capture and represent the constructs being measured (Polit & Beck, 2006). It is closely linked to construct validity, as the process requires an initial definition of the content domain followed by an evaluation of whether the measurement scale appropriately represents that domain (Gould, 1994). According to Polit and Beck (2006), content validity relies on the scope of the measure, ensuring that the instrument includes a sufficient and representative set of items reflecting the underlying concept. Mohajan (2017) emphasizes that content validity ensures all critical aspects and dimensions of the concept under investigation are addressed. Typically, this form of validity is assessed by experts who determine whether the instrument's questions or items adequately cover the intended concept (Bannigan & Watson, 2009). In the present study, two experts from the Faculty of Education at UTM will evaluate the questionnaire's content validity prior to the formal study. Both experts possess extensive experience in teaching psychology and conducting research in the field of social science.

Two educational psychology experts evaluated the questionnaire, verifying its construct validity and suggesting minor wording refinements to enhance clarity. Following translation into Chinese, linguistic specialists conducted additional validation to ensure both measurement accuracy and cultural relevance. The instrument utilizes a seven-point Likert format, recognized for optimal psychometric properties and consistent with the original PWB structure. Content validity assess-

ment employed the Content Validation Index (CVI), with both experts rating all items as content valid (scores of 3-4), yielding a perfect CVI of 1.0 that substantially exceeds the 0.8 threshold required for adequate content validity.

TABLE 1. CVI for Adapted PWB

Measurement scale	Total number	Expert 1			Expert 2			Overall CVI
		Valid items	Invalid items	CVI	Valid items	Invalid items	CVI	1
Adapted PWB	16	16	0	1	16	0	1	1

Pilot Study

The pilot study employed Theory (IRT), the Rasch model, to evaluate the psychometric properties of the instrument (Wright& Masters, 1982). This approach converts ordinal data into interval-scale measurements expressed in logits, allowing for more precise assessment of item functioning and producing comparable measurements with defined units (Sondergeld & Johnson, 2014; Boone et al., 2011). Additionally, the Rasch model enables the removal of irrelevant items, identifies items with high accuracy, and detects potential item bias (Cooke & Michie, 1997). ConQuest version 2 software was utilized for the Rasch analysis due to its powerful capabilities in handling a wide range of measurement models and its ability to process both dichotomous and polytomous item responses efficiently. The software provides comprehensive item fit statistics and allows for clear interpretation of results through well-structured output formats. ConQuest is particularly effective for educational and psychological measurement applications, making it suitable for analyzing instruments such as the one examined in this study (Koyuncu& Şata, 2023).

Data from 110 Chinese postgraduate students at Universiti Teknologi Malaysia were analyzed using ConQuest version 2. This sample size aligns with established guidelines for polytomous Rasch models, which recommend approximately 100-200 participants to achieve stable item parameter estimates due to the increased complexity of item scoring with multiple response categories (Briggs& Wilson, M. (2003). The sample size of 110 participants was determined to be sufficient for obtaining meaningful results in this pilot phase while maintaining adequate statistical power.

To evaluate item fit, Mean Square (MNSQ) values were examined, with acceptable ranges between 0.6 and 1.4 (Bond & Fox, 2007), and T statistics, with values between ±2.0 indicating acceptable fit (Linacre, 1994). These criteria help identify items that may not be functioning as expected within the measurement model. Item 3 was removed from the final scale due to statistical misfit based on Rasch analysis (See Table 2). The item demonstrated significant deviation from the measurement model expectations with weighted MNSQ of 1.23 and a T value of 2.2, exceeding the recommended threshold of ±2.0. This elevated T statistic indicates the item exhibited more unpredictable response patterns than the model predicts, suggesting it may be measuring a different construct or contains confusing wording that introduces construct-irrelevant variance. Removal of this item improves the overall psychometric integrity of the scale while maintaining sufficient content coverage of the underlying construct.

TABLE 2. Item Parameter Estimates of PWB

PWB			Unweighted Fit			Weighted Fit		
Item	Estimate	error	MNSQ	CI	T	MNSQ	CI	T
1	-0.064	0.07	0.92	(0.73, 1.27)	-0.6	0.9	(0.74, 1.26)	-0.8
2	0.013	0.069	1.01	(0.73, 1.27)	0.1	1.01	(0.74, 1.26)	0.1
3	-0.212	0.041	1.27	(0.73, 1.27)	1.9	1.23	(0.81, 1.19)	2.2
4	0.197	0.077	1.21	(0.74, 1.26)	1.5	1.17	(0.73, 1.27)	1.2
5	0.051*	0.098	1.15	(0.74, 1.26)	1.1	1.17	(0.74, 1.26)	1.2
6	-0.139	0.058	1.16	(0.74, 1.26)	1.2	1.12	(0.74, 1.26)	0.9
7	0.291	0.043	0.94	(0.74, 1.26)	-0.4	0.94	(0.80, 1.20)	-0.6
8	-0.368	0.077	0.76	(0.74, 1.26)	-1.9	0.77	(0.73, 1.27)	-1.8
9	0.171*	0.109	0.96	(0.74, 1.26)	-0.2	0.95	(0.73, 1.27)	-0.3
10	-0.079*	0.059	1.03	(0.74, 1.26)	0.3	1.01	(0.76, 1.24)	0.1
11	0.271	0.066	0.79	(0.74, 1.26)	-1.6	0.86	(0.71, 1.29)	-1
12	0.089	0.064	1.03	(0.74, 1.26)	0.3	1.06	(0.72, 1.28)	0.5
13	0.053	0.06	1.16	(0.74, 1.26)	1.1	1.16	(0.74, 1.26)	1.1
14	-0.360*	0.092	1.16	(0.74, 1.26)	1.2	1.2	(0.72, 1.28)	1.4
15	0.24	0.074	1.2	(0.74, 1.26)	1.5	1.15	(0.74, 1.26)	1.1
16	0.086*	0.084	1.01	(0.74, 1.26)	0.1	1.03	(0.71, 1.29)	0.3
17	0.1	0.076	0.95	(0.74, 1.26)	-0.3	0.96	(0.73, 1.27)	-0.2
18	-0.340*	0.106	0.92	(0.74, 1.26)	-0.6	0.97	(0.74, 1.26)	-0.2

The analysis of the 18-item instrument revealed that most items demonstrated acceptable fit to the Rasch model, with one item (Item 3) showing potential misfit with a weighted MNSQ of 1.23 and a T value of 2.2, exceeding the recommended threshold. As the purpose of the pilot was to refine the instrument, this item was removed to improve the overall measurement properties of the scale before proceeding to the main study.

Participants and procedure

The main study sampled 335 Chinese international postgraduate students from a Malaysian university, exceeding the minimum required sample size (160) based on the 1:10 item-to-sample ratio for SEM. From 366 initial questionnaires, 31 were eliminated through systematic outlier detection using Mahalanobis distance analysis ($p<.001$) (Mahalanobis, 2018; Hair, 2011), standard de-

viation review, boxplot visualization, and screening for straight-lining patterns (Reuning& Plutzer, 2020). Data collection followed formal institutional protocols with official authorization from the Faculty of Educational Sciences and Technology, adhered to methodological guidelines (Sng et al., 2016), and maintained ethical standards including informed consent and participant rights protection (Felzmann, 2009). All participants provided informed consent voluntarily and were fully aware of their involvement in the research process (Felzmann, 2009; Ederio et al., 2023). The consent form ensured participants' rights to withdraw at any point, guaranteed complete anonymity for privacy protection, and mitigated the risk of deception (Sil & Das, 2017).

Data Analysis Procedure

Mplus software was selected for this analysis due to its effectiveness in handling categorical data through the integration of the WLSMV estimator (Harrington, 2009). As the instruments in this study utilized a seven-point Likert scale—an ordinal measurement format—factor analysis was conducted using Mplus version 8 with the WLSMV estimation approach. Therefore, Mplus 8 (v1.6.1) is employed for confirmatory factor analysis (CFA) testing the models, and SmartPLS 4 (v4.1.0.9) is to test the inner model fit: evaluating reliability, convergent validity, and discriminant validity of the adapted PWB.

Findings

Goodness-of-fit for measurement model

Multiple fit indices were examined to evaluate model adequacy. The Standardized Root Mean Square Residual (SRMR), an absolute fit index, was assessed with values between 0.05-0.10 considered acceptable and values below 0.05 indicating good fit (Schermelleh-Engel et al., 2003). For incremental fit measures, the Comparative Fit Index (CFI) values exceeding 0.95 represent good fit, while values above 0.90 are deemed acceptable (Byrne, 2013; Hair et al., 2019). Similarly, the Tucker-Lewis Index (TLI), a non-normed fit index, values greater than 0.90 indicate good fit (Whittaker & Schumacker, 2022). Additionally, the Root Mean Square Error of Approximation (RMSEA) values below 0.08 and normed chi-square (χ^2/df) between 1.0-5.0 are considered satisfactory thresholds for model evaluation (Hair et al., 2011).

TABLE 3. Goodness-of-fit for measurement model PWB

Model	χ2	df	χ2/df	P-Value	CFI	TLI	SRMR	RMSEA		
								Estimate	90 Percent C.I.	Probability RMSEA <= .05
M1	628.655	119	5.283	0.0000	0.870	0.852	0.067	0.146	0.135 0.157	0.000
M2	132.684	104	1.276	0.0303	0.993	0.990	0.021	0.037	0.012 0.055	0.879
M3	139.848	116	1.206	0.0652	0.994	0.993	0.022	0.032	0.000 0.050	0.952
M4	113.545	87	1.305	0.0296	0.995	0.994	0.022	0.030	0.010 0.045	0.990

The analysis began with an evaluation of Ryff's original six-factor Psychological Well-Being (PWB) scale. Through rigorous Confirmatory Factor Analysis (CFA), the structural validity of the model was examined. The results demonstrated exceptional model fit, with highly favorable overall fit indices: Root Mean Square Error of Approximation (RMSEA) of 0.037 (90% Confidence Interval [0.012, 0.055]), Comparative Fit Index (CFI) of 0.993, Tucker-Lewis Index (TLI) of 0.990, and Standardized Root Mean Square Residual (SRMR) of 0.021. These metrics provide strong empirical support for the six-factor structure, indicating that the model effectively represents the underlying psychological construct of well-being.

Nevertheless, further examination revealed significant discriminant validity concerns. The Heterotrait-Monotrait ratio (HTMT) analysis showed extremely high correlations between Environmental Mastery (EM), Personal Growth (PG), Purpose in Life (PL), and Self-Acceptance (SA), with HTMT values approaching or exceeding 1.0 (ranging from 0.999 to 1.009) (Sarstedt et al., 2021). Such high values indicate these four dimensions are statistically almost indistinguishable, despite their conceptual differences.

Addressing persistent discriminant validity challenges highlighted in previous research and the current investigation, an alternative three-factor model was proposed. This model combined four highly correlated dimensions—Environmental Mastery (EM), Personal Growth (PG), Purpose in Life (PL), and Self-Acceptance (SA)—into a single composite factor labeled as *Merged Four*, while maintaining Autonomy (AU) and Positive Relations (PR) as distinct factors.

As a result, M3(merged) shows comparable excellence with a slightly better χ^2/df ratio of 1.206 (χ^2 = 139.848, df = 116), non-significant p-value (0.0652), marginally higher incremental indices (CFI = 0.994, TLI = 0.993), and slightly improved residual indices (SRMR = 0.022, RMSEA = 0.032, 90% CI [0.000-0.050], probability RMSEA ≤ .05 = 0.952) than M2. While M3(merged) demonstrates slight statistical advantages across several indices, particularly in its non-significant p-value and higher probability of close fit, the differences between the models are minor, suggesting that both adequately represent the underlying structure of the data.

Construct reliability and validity

To ensure methodological rigor in our measurement models, a comprehensive approach was implemented to evaluate convergent validity and reliability, following the established guidelines of Hair et al. (2019). The assessment centered on four critical statistical parameters: 1) item factor loadings, 2) Cronbach's alpha, 3) composite reliability, and 4) average variance extracted (AVE). Stringent criteria were applied throughout the validation process. Specifically, factor loadings were required to exceed 0.60 to establish item validity (Hair et al., 2019). Internal consistency was rigorously examined through both Cronbach's alpha and composite reliability, with threshold values set above 0.70 to confirm satisfactory reliability (Fornell & Larcker, 1981; Hair et al., 2019). Additionally, AVE was incorporated as a complementary validity indicator, with values of at least 0.50 considered sufficient to demonstrate convergent validity, in accordance with Hair et al. (2019). To address potential statistical complications, variance inflation factor (VIF) values were also scrutinized. VIF values below 5 were deemed to represent acceptable multicollinearity levels, while values exceeding 10 indicated significant multicollinearity issues (Hair et al., 2019; Becker et al., 2015).

TABLE 4. Construct reliability and validity and collinearity (VIF)

PWB	Items	Outer Loading	Cronbach's alpha	Composite Reliability	AVE	VIF
	Autonomy		0.912	0.944	0.85	
	AU1	0.920				2.902
	AU2	0.921				3.268
	AU3	0.925				3.439
	Merged Four		0.978	0.980	0.817	
	SA1	0.907				4.629
	SA2	0.907				4.662
	SA3	0.902				4.479
	EM1	0.892				4.031
	EM2	0.913				5.125
	EM3	0.898				4.213
	PG1	0.920				5.493
	PG2	0.904				4.522
	PG3	0.904				4.589
	PL2	0.904				4.650
	PL3	0.892				4.062
	Personal relationship		0.926	0.953	0.871	
	PR1	0.938				4.161
	PR2	0.931				3.834
	PR3	0.931				3.365

Despite the strong overall performance of the three-factor model (M3), minor multicollinearity issues persisted for items EM2 (VIF = 5.125) and PG1 (VIF = 5.403) (Hair et al., 2019; Becker et al., 2015) (see Table 4). Consequently, these items were removed to improve model fit, resulting in the refined M4 model. The fit indices for M4 indicate excellent structural validity: χ^2 = 113.545 with 87 degrees of freedom (χ^2/df = 1.305), CFI = 0.995, TLI = 0.994, SRMR = 0.022, and RMSEA = 0.030 (90% CI [0.010, 0.045]). The probability of RMSEA ≤ 0.05 is notably high at 0.990, suggesting strong model fit.

In addition, the psychometric assessment of the three-factor Psychological Well-Being (PWB) scale demonstrates excellent measurement properties across all dimensions. The Autonomy factor (three items: AU1-AU3) exhibits high outer loadings (0.920-0.925), strong reliability (Cronbach's alpha = 0.912, composite reliability = 0.944), robust convergent validity (AVE = 0.85), and acceptable multicollinearity levels (VIF = 2.902-3.439). Similarly, the Personal Relationship factor (three items: PR1-PR3) shows very high loadings (0.931-0.938), excellent reliability (Cronbach's alpha = 0.926, composite reliability = 0.953), strong convergent validity (AVE = 0.871), and acceptable multicollinearity (VIF = 3.365-4.161). The Merged Four factor, consolidating items from Self-Acceptance, Environmental Mastery, Personal Growth, and Purpose in Life dimensions, demonstrates consistently high loadings (0.892-0.920), outstanding reliability (Cronbach's alpha = 0.978, composite reliability = 0.980), and robust convergent validity (AVE = 0.817).

Comparative analysis between M3 and M4 reveals subtle improvements in the refined model. While both demonstrate strong fit statistics, M4 shows marginally better performance across key indicators, including lower RMSEA (0.030 vs. 0.032), higher CFI (0.995 vs. 0.994), and higher TLI (0.994 vs. 0.993). The most notable improvement appears in the probability value of RMSEA ≤ 0.05 (0.990 vs. 0.952), indicating M4's stronger confidence of good fit. Additionally, M4's more parsimonious structure is reflected in its reduced degrees of freedom (87 vs. 116), suggesting a more efficient measurement model while maintaining excellent psychometric properties.

Discriminant validity

Discriminant validity refers to the extent to which constructs in a measurement model are empirically distinct from one another (Fornell& Larcker, 1981). It is a critical methodological requirement for accurately analyzing relationships among latent variables (Hair et al., 2019). According to established criteria, discriminant validity is confirmed only when a latent construct explains more variance in its own indicators than it shares with other constructs within the model (Hair et al., 2019).

In this study, discriminant validity was assessed using multiple complementary approaches. First, the Heterotrait-Monotrait Ratio (HTMT) of correlations was employed, which is considered a more reliable criterion than the traditional Fornell-Larcker method (see Table. 5). Based on Henseler et al.'s (2015) guidelines, HTMT values below 0.85 indicate strong discriminant validity, while values below 0.90 are deemed acceptable. Second, the Fornell-Larcker criterion was applied, which requires that the square root of the average variance extracted (AVE) for each construct should exceed its correlation with any other construct in the model (Haji-Othman& Yusuff, 2022). Finally, the cross-loadings of all indicators across constructs were examined to verify that each indicator loaded highest on its intended construct with substantially lower loadings on all other constructs (Henseler et la., 2015), confirming that items were appropriately assigned to their respective latent variables (Chin, 1998). The results from all three approaches consistently demonstrated adequate discriminant validity among the study's constructs.

The initial HTMT assessment of the proposed three-factor psychological well-being model (M3)—in which the four related dimensions of Environmental Mastery, Personal Growth, Purpose in Life, and Self-Acceptance were consolidated into a single "Merged four" construct—indicated acceptable though borderline discriminant validity between certain constructs. Most notably, the HTMT coefficient between Autonomy (AU) and the Merged four reached 0.879, approaching the upper acceptable limit of 0.90. Other relationships demonstrated more comfortable values: 0.591 between AU and Positive Relations (PR), and 0.721 between PR and Merged four. Though these findings generally supported acceptable discriminant validity, the relatively high AU–Merged four correlation suggested possible theoretical overlap between these constructs, indicating the need for additional model refinement to strengthen construct distinctiveness.

HTMT analysis of the refined M4 model demonstrated notable improvements in discriminant validity measures: the AU–Merged four coefficient reduced considerably from 0.879 to 0.779, the PR–Merged four value decreased from 0.721 to 0.691, and the AU–PR relationship improved slightly from 0.591 to 0.574. The most significant enhancement occurred in the previously problematic AU–Merged four relationship, which shifted from borderline acceptable to comfortably within the recommended threshold (below 0.85), providing strong evidence of improved construct separation and theoretical distinctiveness.

The observed improvements—evidenced by reductions in HTMT ratios and enhanced model fit indices—offer strong support for the refined three-factor model (M4) as a more statistically sound and conceptually parsimonious representation of psychological well-being. Table 5 provides a comparative overview of HTMT coefficients before and after item removal (M3 vs. M4), where values outside parentheses correspond to the refined model (M4), and those within parentheses reflect the original estimates from M3. Following the exclusion of two items with VIF values slightly exceeding 5, both the HTMT analysis and model fit metrics demonstrated marked enhancement. These results collectively validate the item removal as a judicious and efficient refinement of the measurement model.

TABLE 5. HTMT Results for PWB

	HTMT Results		
	AU	PR	Merged four
AU			
PR	0.574 (0.591)		
Merged four	0.779 (0.879)	0.691(0.721)	

The Fornell-Larcker section confirms this with square roots of AVE (diagonal values: AU=0.922, PR=0.933, Merged four=0.903) exceeding inter-construct correlations in their respective rows and columns ((Fornell & Larcker, 1981). The Fornell-Larcker criterion results for the three-factor Psychological Well-Being (PWB) model demonstrate strong discriminant validity among the constructs (see Table 6). Each construct has stronger correlations with its own indicators than with those of other constructs, indicating that it shares more variance with its associated measures than with unrelated ones in the model. Specifically, the correlation between AU and PR is 0.544, between AU and Merged four is 0.734, and between PR and Merged four is 0.685. The highest correlation (0.734 between AU and Merged four) remains below the square root of AVE for both constructs, further supporting discriminant validity. These findings provide statistical evidence that the three PWB dimensions are empirically distinct from one another, despite their conceptual relationships, reinforcing the structural validity of the three-factor model.

TABLE 6. Fornell-Lacker Criterion for PWB

Fornell- Lacker Criterion		
AU	PR	Merged four
0.922		
0.544	**0.933**	
0.734	0.685	**0.903**

As shown in Table 6, the cross-loading matrix confirms that each item predominantly loads on its theoretically assigned factor. Items measuring Autonomy exhibit high loadings on their intended construct (0.920–0.925), with only moderate cross-loadings on unrelated factors. Positive Relations

items similarly show strong primary loadings (0.931–0.938), while the indicators from the merged dimensions—Environmental Mastery, Personal Growth, Purpose in Life, and Self-Acceptance—demonstrate consistently substantial loadings (0.894–0.907) on the combined "*Merged four*" factor. These results collectively affirm that the revised 15-item, three-factor model successfully addresses the discriminant validity limitations of both the original six-factor structure and the earlier 17-item three-factor model, while retaining solid psychometric robustness.

TABLE 7. Cross loading for PWB

	AU	PR	merged 4
AU1	0.920	0.502	0.728
AU1	0.920	0.502	0.728
AU2	0.921	0.509	0.642
AU2	0.921	0.509	0.642
AU3	0.925	0.494	0.655
AU3	0.925	0.494	0.655
EM1	0.652	0.637	0.894
EM1	0.652	0.637	0.894
EM3	0.661	0.599	0.899
EM3	0.661	0.599	0.899
PG2	0.656	0.609	0.907
PG2	0.656	0.609	0.907
PG3	0.662	0.627	0.906
PG3	0.662	0.627	0.906
PL2	0.659	0.623	0.906
PL2	0.659	0.623	0.906
PL3	0.664	0.594	0.896
PL3	0.664	0.594	0.896
PR1	0.517	0.938	0.632
PR1	0.517	0.938	0.632
PR2	0.476	0.931	0.608
PR2	0.476	0.931	0.608
PR3	0.528	0.931	0.676
PR3	0.528	0.931	0.676
SA1	0.666	0.614	0.905
SA1	0.666	0.614	0.905
SA2	0.667	0.634	0.907
SA2	0.667	0.634	0.907
SA3	0.673	0.628	0.906
SA3	0.673	0.628	0.906

DISCUSSION

This study provides important insights into the psychometric properties of the Psychological Well-Being (PWB) scale when applied to Chinese international students studying in Malaysia. Our findings raise significant questions about the empirical distinctiveness of Ryff's theoretical six-factor structure, particularly in light of the substantial overlap observed between certain dimensions when used with this specific cross-cultural population.

The high inter-factor correlations revealed through our HTMT analysis between Environmental Mastery, Personal Growth, Purpose in Life, and Self-Acceptance (with values approaching or exceeding 1.0) suggest these dimensions are statistically nearly indistinguishable in our sample of Chinese international students, despite their conceptual differences. This finding aligns with previous research that has questioned the distinctiveness of these dimensions. Van Dierendonck (2004) similarly reported high inter-factor correlations, particularly among these same four dimensions. While Clarke et al. (2001) and Lindfors et al. (2006) found support for the six-factor structure, they too observed substantial correlations between certain dimensions, notably Self-Acceptance and Environmental Mastery.

It is important to note that the original six-factor structure still demonstrated acceptable model fit indices in our study, confirming the overall value and validity of Ryff's theoretical framework. The six-factor conceptualization offers rich theoretical insights into the multidimensional nature of psychological well-being and has proven useful across numerous studies and diverse populations. Our findings do not invalidate this model but rather suggest that in the specific context of Chinese international students navigating cross-cultural adaptation in Malaysia, certain dimensions may be experienced in a more integrated manner.

The methodological approach employed in this study represents a significant strength. Beginning with Rasch analysis in the pilot phase allowed for early identification of problematic items (Frances& Solon, 2014), such as PL1, which demonstrated substantial misfit with the measurement model. It should be noted that our Rasch analysis was conducted using the original dimensional structure and focused primarily on item parameter estimation. The limited sample size in our pilot study (n=110) was insufficient for robust DIF analysis, which typically requires larger groups for meaningful comparisons across cultural or demographic categories. This integration of Item Response Theory with traditional factor analytic techniques provided a more comprehensive assessment of the scale's psychometric properties than either approach alone could offer.

CONCLUSION

This study presents a rigorous psychometric assessment of the Psychological Well-Being (PWB) scale through the integration of multiple analytical frameworks. In the preliminary pilot phase, Rasch analysis grounded in Item Response Theory (IRT) was employed to detect measurement anomalies. The exclusion of item PL1 was warranted due to its substantial misfit with the model (weighted MNSQ = 1.23, T = 2.2), suggesting that its response pattern was misaligned with the intended latent construct. The application of Rasch analysis at this early stage facilitated the detection of item-level irregularities that may not have been identifiable using traditional classical test theory alone. This Rasch-informed refinement laid a more psychometrically robust foundation for the subsequent main analysis.

The main study commenced with a traditional six-factor confirmatory factor analysis (CFA), which produced fit indices that, while within acceptable ranges, indicated less-than-optimal model performance and raised concerns regarding its structural validity. A closer inspection highlighted substantial issues with discriminant validity. Specifically, the Heterotrait-Monotrait (HTMT) ratio analysis revealed exceedingly high inter-factor correlations among Environmental Mastery (EM), Personal Growth (PG), Purpose in Life (PL), and Self-Acceptance (SA). These elevated values suggest that, despite their theoretical distinctiveness, the four dimensions were statistically indistinguishable within the measurement model.

In light of the observed discriminant validity issues, a revised three-factor model was proposed wherein the highly interrelated dimensions—Environmental Mastery, Personal Growth, Purpose in Life, and Self-Acceptance—were consolidated into a single latent construct labeled "Merged four," while Autonomy and Positive Relations were retained as separate factors. This restructured model (M3) yielded improved psychometric properties and model fit. Further refinement involved the removal of two items (PG1 and EM2) with variance inflation factors exceeding 5.0, culminating in the final model (M4), which comprises 15 items distributed across three latent variables. The optimized model demonstrated excellent fit indices ($\chi^2/df = 1.305$, CFI = 0.995, TLI = 0.994, SRMR = 0.022, RMSEA = 0.030), along with enhanced discriminant validity, as indicated by reduced HTMT values.

Limitations

Several limitations of this study should be acknowledged. The cross-sectional design limits our ability to assess the stability of the factor structure over time (e.g., Levin, 2006), particularly for international students whose psychological well-being may evolve throughout their cross-cultural adaptation process (Zhou et al., 2008). Additionally, our use of convenience sampling means that the findings may not fully represent the broader population of Chinese international students in Malaysia (e.g., Jager et al., 2017). The sample was also drawn from specific universities, potentially limiting the generalizability of our findings.

A methodological limitation of this study is that Rasch analysis was only employed during the pilot phase, whereas the main analyses relied exclusively on Classical Test Theory (CTT) approaches. Although the sample size in the main study (n = 335) would have been adequate for conducting Differential Item Functioning (DIF) analysis, the shift to CTT-based methods precluded further examination of measurement invariance across demographic subgroups. This decision was guided by the study's primary focus on factorial structure but reflects a trade-off between the depth of item-level diagnostics and the broader dimensional validation. Moreover, while the study identified structural inconsistencies in the PWB scale within this population, it did not investigate the underlying cultural or contextual factors that may account for the limited empirical distinctiveness of certain dimensions among Chinese international students in Malaysia.

Implications and Future Directions

These findings have important implications for how psychological well-being is conceptualized and measured in cross-cultural contexts, particularly for Chinese international students navigating adaptation to a foreign educational environment. Although Ryff's six dimensions may not demonstrate perfect distinctiveness in this population, with considerable overlap observed among certain aspects, this does not necessarily indicate a flaw in the theoretical framework. Rather, it suggests that

Chinese international students may experience psychological well-being in a more integrated manner than originally conceptualized, with specific components exhibiting stronger interconnections than anticipated in the original model.

The three-factor model identified in this study (Autonomy, Positive Relations, and the "Merged four" composite) may provide a more parsimonious and culturally appropriate framework for assessing psychological well-being among Chinese international students. This streamlined model could offer practitioners and researchers a more efficient tool for assessing well-being in this group. Future research should investigate whether similar patterns of dimensional overlap emerge in different international student populations, which could help determine whether our findings reflect characteristics specific to Chinese international students in Malaysia or more fundamental issues with the scale's structure in cross-cultural settings. Additionally, longitudinal studies examining how the factor structure might change throughout the cultural adaptation process would provide valuable insights into the dynamic nature of psychological well-being for international students. Future studies could benefit from integrating Rasch modeling, DIF testing, and qualitative approaches to more comprehensively explore how cultural variables shape both the experience and measurement of psychological well-being.

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