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Analysis of the contribution of critical thinking and psychological well-being to academic performance

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This study examines the influence of critical thinking and psychological well-being on the academic performance of first-year college students. It emphasizes the importance of a model of psychological well-being focused on self-acceptance, environmental mastery and purpose in life, along with a critical thinking approach oriented to problem solving and decision making. A total of 128 first-year psychology students from a Spanish public university participated, assessed by means of Ryff's psychological well-being scale (PWBS) and the PENCRISAL critical thinking test, complemented with grades obtained in a critical thinking course. The results show positive correlations between psychological well-being, critical thinking and academic performance, with a stronger relationship between critical thinking and academic performance. However, psychological well-being also plays a significant role in academic performance. The findings highlight the need for holistic pedagogical approaches that combine cognitive skills and personal development to enhance first-year students' learning.

KEYWORDS

critical thinking, psychological well-being, academic performance, higher education, assessment

1 Introduction

In the context of the increasing demands of contemporary societies, in this study we address how critical thinking (CT) and psychological well-being (PWB) influence academic performance within the university setting. Upon entering university, first-year students are faced with the challenge of adapting to new academic dynamics and demands, which they must balance with the pursuit of personal satisfaction (Acee et al., 2012; Casanova et al., 2018). The adaptation process, which involves the achievement of academic goals and the projection of long-term life objectives, is fundamental to academic performance, considered a key indicator of successful adaptation and a reflection of the competencies required in the professional environment (Alonso-Borrego and Romero-Medina, 2016; Frick and Maihaus, 2016).

The goal of this research is to show the link between CT, which is characterized by analyzing and evaluating information, making evidence-based inferences, and reflecting on one's own thought process for decision making and problem solving (Bailin et al., 1999; Ennis,

2015; Jahn and Kenner, 2018; Saiz, 2020; Halpern and Dunn, 2023), and the PWB, which focuses on personal development (Ryff, 1989, 2013; Ryff and Keyes, 1995); and analyze how both contribute to academic performance. Despite the complexity of the factors that can influence academic performance, in this study we want to combine cognitive and socio-affective variables to better understand these dynamics. Based on The Ryff Psychological Well-Being Scale (PWBS), we examine how well-being, especially through self-acceptance, environmental mastery, and purpose in life impacts academic performance. As a starting point we recognize that CT may have an even greater effect on academic performance. This holistic approach seeks to contribute to the debate on the competencies needed for the 21st century through the relevance of CT and PWB in university education and their role in the formation of individuals capable of coping with contemporary demands.

1.1 Contextualization and characterization of academic performance

In the university context, academic performance is influenced by a series of factors ranging from pedagogical practices and student satisfaction with them to more personal and intrinsic elements. These include the student's motivation and emotional state, academic background, IQ, personality traits and level of psychological maturity. This multi-layered approach focuses the complexity underlying academic performance and emphasizes the interaction between the educational environment and the individual qualities of each student.

A study by Oliván Blázquez et al. (2019) highlights the flipped classroom (FC) method in comparison to traditional lecture-based learning (LB) and shows that FC not only improves students' grades, but also maintains their satisfaction with learning without increasing their perceived workload. Although FC was initially perceived as more difficult, this did not have a negative impact on satisfaction or long-term learning, underscoring the importance of student perceptions and involvement in the learning process. These results support the introduction of FC in higher education and point to the need for continuous adjustments based on student feedback to maximize academic performance and develop critical and practical skills.

Beyond educational practices, Gilar-Corbi et al. (2020) investigated how motivational and emotional factors and prior academic performance influence college students' success. The study used the Motivated Strategies Learning Questionnaire (MSLQ) and the Trait Meta-Mood Scale (TMMS) to measure motivational learning strategies and emotional intelligence. The findings show that scores obtained in the diagnostic tests have a strong influence on academic performance, while emotional attention has a minor influence. The study points out that prior performance, together with self-efficacy and appropriate emotional regulation, plays a crucial role in predicting academic success. Thus, the authors suggest that interventions focused on improving self-efficacy and emotional intelligence may be key to optimizing students' academic outcomes.

In the same context, this time with more variables, Morales-Vives et al. (2020) investigate the influence of intelligence, psychological maturity and personality traits on the academic performance of adolescents, and find that these factors combined explain about 30% of their variability. Intelligence, especially in reasoning and numerical aptitude, emerges as the most significant predictor, while psychological

maturity, reflected in work orientation, and traits such as conscientiousness and openness to experience, have an indirect influence. These findings show that, although intelligence plays a decisive role, maturity and personality are in a lesser proportion.

These conclusions and the recommendations derived from them resemble recent advances in academic research. One example is the work of Mammadov (2022), which draws attention to cognitive ability as the main predictor of academic performance, but also points to the relevance of conscientiousness, a personality trait associated with self-discipline and organization, which explains a significant part of the variability in academic performance. Mammadov also suggests that the influence of personality on performance varies by educational level, showing the dynamics between a student's personality and his or her educational context. These findings demonstrate the need for educational strategies that promote both cognitive development and the reinforcement of positive personality traits.

Recent research on academic performance shows two consensuses. First, there is a growing understanding of the influence of the interaction between intrinsic and extrinsic factors, including pedagogical methods and motivational, emotional and cognitive elements, in improving the performance and satisfaction of students in higher education. The studies reviewed highlight the relevance of cognitive ability and personality traits such as conscientiousness, and promote a holistic educational approach that integrates the development of cognitive and personality dimensions. Second, academic achievement is recognized as a multidimensional construct, objectively assessed through quantitative indicators such as grade point average (GPA) and standardized assessment scores. These reflect the attainment of educational objectives and the accumulation of knowledge and skills over time.

1.2 Contextualization and characterization of critical thinking

Halpern (1998) argues that intrinsic effort and a willingness to analyze and solve complex problems are key competencies for learning and adapting to a constantly changing environment. According to Halpern (1998) CT transcends the mere acquisition of analytical skills and requires the development of an active predisposition to question assumptions, consider diverse perspectives, and persist in cognitive effort. This disposition is by no means innate, but can be cultivated through a pedagogy that explicitly integrates the teaching of critical skills such as logical analysis, argument evaluation, and information synthesis, and that emphasizes problem structuring to facilitate skill transfer and metacognitive self-regulation. Halpern proposes an educational framework that promotes the acquisition of these skills and encourages reflection on the thinking process so that students are able to apply CT effectively in diverse contexts and continuously improve. This methodical and structured approach characterizes CT as a set of advanced cognitive skills and an exercise of conscious judgment that is essential for informed, evidence-based decision making, which integrates non-cognitive elements (Halpern and Dunn, 2023).

Throughout the development of the discourse on CT, various theories and their empirical foundations have evolved into meaningful educational practices, recognized in diverse academic settings. Meta-analyses, particularly those by Abrami et al. (2008, 2015) have

contributed significantly to the understanding of effective teaching of CT and have emphasized the need for specific and tailored teaching strategies that incorporate clear CT objectives into educational programs. These studies demonstrate that CT, defined as a process of intentional, self-regulated judgment that includes interpretation, analysis, evaluation, and inference, is increasingly recognized as essential in the knowledge era. [Abrami et al. \(2008\)](#) note that critical skills and dispositions are developed through explicit pedagogical interventions, as opposed to spontaneous acquisition, which challenges traditional pedagogical paradigms and fosters a shift towards intentional educational practices, placing students at the center of learning.

In addition, a more detailed analysis by [Abrami et al. \(2015\)](#) identifies that strategies that encourage interactive dialogue, confrontation with real problems, and individual tutorials are particularly effective. This suggests that active and meaningful learning outperforms traditional methods in the development of critical skills. This approach not only enhances students' analytical and synthesis skills, but also facilitates the transfer of knowledge to new contexts, a key skill for the 21st century. The research reinforces the view that CT is a cross-cutting competency, crucial for navigating the complexity of contemporary challenges, and argues for an education that integrates these skills into all areas of learning.

Despite in-depth analyses of the need for CT, the growing discrepancy between rapid progress, the availability of information and the ability to critically analyze it poses a major challenge. [Dwyer et al. \(2014\)](#) point out that the exponential increase in global information has outpaced the ability of traditional education systems to teach effective CT skills, creating a gap that may inadequately prepare students for the challenges of today's world. The authors argue that the ability to critically evaluate, synthesize, and apply knowledge is crucial for academic success and survival in the 21st century. This approach highlights how CT, by fostering analytical and reflective skills, transcends academia to positively impact individual and collective well-being, and argues for educational strategies that bridge the gap between information acquisition and critical analytical skills.

Recent research on this topic points to the indisputable relevance of CT as an essential component of academic performance and points to its role as a key predictor of success in educational processes. [Rivas et al. \(2023\)](#) show that CT transcends conventional cognitive skills. This is because CT is characterized as a rigorous practice that fosters in-depth analysis, critical evaluation and synthesis of information oriented to decision making and problem solving, fundamental skills to understand and apply knowledge in complex contexts. Research shows that CT skills not only maintain a positive correlation with academic performance, but can be significantly improved through targeted educational programs. For this reason, the authors advocate their integration into curricula and educational assessment systems to prepare students for the challenges of the 21st century, especially when phenomena such as artificial intelligence acquire greater prominence in social and professional dynamics ([Saiz and Rivas, 2023](#)).

The literature on CT identifies two fundamental consensuses: first, it defines it as an intentional and deep process, oriented to problem solving and decision making, based on meticulous analysis that goes beyond logical reasoning to include a critical evaluation of the basis for judgments. In addition, it involves detailed scrutiny and integration of new information in changing contexts, as well as metacognition, i.e., conscious self-regulation of thinking that facilitates adaptation

and continuous improvement of cognitive strategies in accordance with the major demands and obstacles of our first half century ([Dwyer, 2023](#)). In its practical application, CT enables daily challenges to be met through informed judgments and a willingness to question and adjust perspectives in response to new information. Characterized by curiosity and adaptability, CT is essential for making responsible decisions and achieving successful outcomes, underscoring its practical value in both personal and professional settings.

Second, CT, beyond its theoretical value, can be conceived as a key theory of action for academic performance and PWB ([Saiz, 2020](#); [Saiz and Rivas, 2023](#)), by enhancing in individuals the ability to face and solve problems in an effective and grounded manner. CT involves crucial skills such as analysis, evaluation and synthesis, indispensable for acquiring and retaining knowledge, and also for applying it in new contexts, which improves academic performance and has, in principle, positive effects on quality of life. Thus, CT emerges as an academic competence and an essential tool for everyday life ([Dumitru and Halpern, 2023](#); [Guamanga et al., 2023](#)). Therefore, to synthesize theoretical paths with a practical function, we understand that "to think critically is to arrive at the best explanation of a fact, phenomenon or problem in order to know how to solve it effectively" ([Saiz, 2024](#), p. 19).

1.3 Contextualization and characterization of psychological well-being

The task of relating concepts that are difficult to operationalize, such as well-being, is a major challenge; but it is necessary to approach it, more within a framework of CT understood as a means to achieve broad objectives than as an end in itself. Thinking critically transcends the mere application of skills or the accumulation of goal-oriented knowledge. In fact, it requires a detailed examination of the effect that such management has on the environment and how the satisfaction derived from reaching certain achievements is related to subjective aspects.

CT by its very deliberative and goal-oriented nature goes beyond the search for how to reach effective solutions and addresses a wider range of human and social consequences resulting from these actions ([Facione, 1990](#); [Elder, 1997](#); [Jahn, 2019](#)). The idea is to involve non-cognitive aspects that occupy a central place in academia, and that are crucial in the interaction between specific knowledge and skills, elements widely explored in the discourse of CT. In this sense, PWB has been selected as the focus of study, recognizing it as a desirable attribute in educational processes. The challenges this poses are not lost sight of, especially when it comes to quantifying transient, subjective and normatively mediated judgments about what states or conditions are considered good, healthy or desirable in the complexity of human experience, as detailed by [Flanagan et al. \(2023\)](#).

[Ryff \(1989, 2013\)](#), [Ryff and Keyes \(1995\)](#) contribution to the conceptual understanding and dissemination of PWB is notorious and highly valued in different fields of knowledge ([Van Dierendonck and Lam, 2023](#)). The imprint of his research has been marked by criticism of a reductionist conception of PWB that simplifies well-being to the presence of positive affective states ([Ryff, 1989](#)). Consequently, [Ryff](#) defends a much more complex multidimensional concept that seeks to attune the attainment of goals with the development of potentialities. [Ryff's](#) thesis is that PWB is a multidimensional construct

that transcends happiness or mere life satisfaction (Ryff and Keyes, 1995).

Carol Ryff's theory of PWB, based on humanistic, clinical and developmental psychology, as well as Aristotelian eudaimonia, focuses on self-actualization, the search for meaning and purpose in life as the core of well-being. As detailed in the text *Happiness is everything, or is it? Explorations on the meaning of psychological well-being* (Ryff, 1989) the model consists of six dimensions that converge in personal development: autonomy, environmental mastery, personal growth, positive relations with others, purpose in life, and self-acceptance.

The first dimension, self-acceptance, implies a positive attitude towards oneself and an acceptance of all aspects of one's identity, including both positive and negative qualities. As for positive relationships with others, Ryff states that these are interpersonal relationships characterized by warmth, trust and genuine concern for the well-being of others; this dimension is dominated by the value of empathy in human well-being. Autonomy is defined by an individual's capacity to maintain independence and resist social pressures in order to regulate their behavior according to internal personal norms. This dimension emphasizes self-determination as a compass for the pursuit of well-being. On the other hand, environmental mastery emphasizes the ability to effectively manage and control the external environment, which implies a feeling of competence and control over personal and professional life. Finally, purpose in life and personal growth refer to the possession of goals, direction and a sense of development and fulfillment of one's potential. These dimensions reflect the search for meaning and continuous personal evolution as fundamental components of PWB.

Ryff's PWBS has established itself as a key instrument in positive psychology. Research after 1989 (Ryff and Keyes, 1995; Ryff, 2013) has explored the variability of these dimensions with age and across genders. These studies showed the influence of sociodemographic factors on well-being, so the model has been extended to consider the development of PWB across the lifespan and determined by more contextual factors such as health. The approach enriches the understanding of PWB and denotes the practical relevance of the construct in fields such as mental health and social policy. Ryff's work has inspired other researchers to discuss and extend its principles (Van Dierendonck and Lam, 2023). For example, Huppert (2009) complements Ryff's dimensions by emphasizing the management of negative emotions and resilience as key components of sustainable well-being; Huppert aligns this view with the World Health Organization (WHO) definition of health and adds a dynamic dimension on overcoming adversity. This theoretical and practical deepening demonstrates the robustness and adaptability of Ryff's model. The synthesis of these contributions confirms the value and applicability of Ryff's PWBS; they reveal how the eudaemonic model not only reinforces an academic discourse, but also guides practices that promote well-being in different contexts and consolidates itself as a vital field in human development.

However, due to the same complexity and extension of the PWB construct, Ryff's PWBS has different observations that question its theoretical and statistical foundations. On the first aspect, the work of Disabato et al. (2016), by examining the distinction between hedonic and eudaimonic well-being, problematizes the theoretical basis of this dichotomy. Through an analysis incorporating data from 7,617 individuals from 109 countries, the authors find that there is no clear distinction between hedonic well-being experiences, focused on

pleasure, and eudaimonic ones, related to personal fulfillment. The results indicate a high correlation between the two types of well-being ($r=0.96$). This suggests that people do not significantly differentiate between pleasure seeking and self-fulfillment in their perception of well-being. This implies that the hedonic-eudaimonic dichotomy may not hold empirically and, therefore, a unified model of well-being that reflects the current behavioral dynamics should be sought.

From a statistical perspective, Ryff and Keyes (1995) analyses show that the PWBS, composed of 18 items, meets psychometric criteria and shows strong internal and moderate correlations among different scales. Correlations between dimensions range from low to modest (0.13 to 0.46), suggesting that each dimension addresses unique aspects of well-being. From the theoretical model, this diversity underscores that, although interrelated, the dimensions represent unique aspects of psychological well-being. In terms of specific results, studies indicate that with age the dimensions of environmental mastery and autonomy increase, while purpose in life and personal growth tend to decrease, with no significant changes in self-acceptance and positive relationships with others. Women outperform men on positive relationships with others and personal growth, suggesting that changes in these dimensions reflect evolving priorities and perceptions of personal development across the life span (Ryff and Keyes, 1995).

On the number of dimensions of PWBS, Blasco-Belled and Alsinet (2022) note that the six-dimensional theoretical model has generated debate even among experts in the field. Some suggest that a four-dimensional model-environmental mastery, personal growth, purpose in life, and self-acceptance-might represent a second-order PWB factor, indicating a possible conceptual overlap between Ryff's original dimensions; others exclude positive relationships with others and autonomy from the model. The study of Ryff's PWBS by network analysis conducted by Blasco-Belled and Alsinet (2022) shows four different dimensions, in one of these, the most important node of the network, self-acceptance, purpose in life and environmental mastery are grouped, with special emphasis on self-acceptance because of its centrality in the network at the item level.

In the Spanish-speaking context, Nogueira et al. (2023) identified three main factors: autonomy, positive relationships with others, and competence. This suggests that PWBS may vary according to cultural and contextual factors. Furthermore, although it is not a study analyzing the dimensions of Ryff's PWBS, the study by Páez-Gallego et al. (2020) applied the PWBS to Spanish adolescent students and found a strong positive correlation with the use of adaptive decision-making strategies. Specifically, the findings show that the adaptive approach is significantly associated with improvements in self-acceptance, environmental mastery, and purpose in life. In contrast, maladaptive strategies characterized by impulsivity and avoidance are associated with lower PWB. From this we infer that fostering effective decision-making skills is important for well-being and, in particular, we identify from empirical studies the dimensions of PWBS that correlate with post decisional skills.

Taken together, these findings suggest that Ryff's PWBS, although pioneering and widely used, could benefit from revision to more accurately reflect the structure of PWB and its application in diverse cultural and educational contexts. The convergence of evidence from factorial and network analysis perspectives points to the need for a more integrated and adaptive model capable of capturing the complexity and dynamics of the underlying constructs.

This underscores the continuing interest in PWB in research and practice. It is also an indication of the ongoing scholarly debate about its conceptualization and measurement. The recurrence of dimensions such as self-acceptance, environmental mastery, and purpose in life across analyses suggests a common core of PWB. This raises the question of whether these dimensions can be conceptually aligned with academic achievement and CT. In addition, questioning the boundaries between hedonic and eudaimonic raises the issue of whether a broader construct is needed to analyze well-being in educational settings. In this context, we start from the premise that self-acceptance, environmental mastery, and purpose in life are sufficient to explore college students' PWB. These dimensions reflect students' ability to recognize their strengths and weaknesses, set goals, and navigate effectively in their educational environment, aspects that could be considered part of the dispositional component necessary for the development of higher-level competencies such as those of the CT.

The research brings to empirical analysis the complex interplay between CT, PWB, and academic performance in the university context. We seek to answer how CT skills and PWB influence college students' academic performance; and, how CT practices can be aligned with PWB to improve academic performance. We propose that the study variables converge in both a theoretical and an empirical model. The argumentative strategy consists of analyzing the direct impact of CT on academic performance, assessing whether PWB correlates with better academic outcomes, examining in detail the predictive factor of the relationship between CT and PWB on academic performance, and finally, according to the data obtained, proposing some dialogic bridges between cognitive and non-cognitive aspects of CT.

2 Methodology

2.1 Participants

The study involved 128 first-year psychology students from a Spanish public university. The vast majority were women (83.1%), with only 16.9% men, which is usual in social sciences and humanities degrees. Age ranged from 18 to 33 years, with a mean of 19.28 ($SD = 1.73$). The sample was essentially composed of students who had completed secondary education (75.3% of the students were 19 years old). Between the ages of the students according to sex — females ($M = 19.09$, $SD = 0.814$) and males ($M = 20.20$, $SD = 3.78$) — there were no statistical differences, but the age of the males was not only higher, but also more dispersed.

2.2 Instruments

The instruments applied were Ryff's PWBS in its Spanish adaptation (Díaz et al., 2006) and the PENCRISAL critical thinking test (Saiz and Rivas, 2008; Rivas and Saiz, 2012). For academic performance, the academic records of the students participating in the critical thinking course in the first year of the psychology graduation were collected. The grades have an ascending interval from 1 to 10.

Ryff's PWBS as mentioned in the previous discussion has different models. This instrument aims to measure psychological well-being, focusing on students' own evaluations of their situations and perceived success in various aspects of life and personal development. It explores

well-being through six main dimensions, self-acceptance ($\alpha: 0.83$), positive relationships with others ($\alpha: 0.81$), environmental mastery ($\alpha: 0.71$), autonomy ($\alpha: 0.73$), purpose in life ($\alpha: 0.83$) and personal growth ($\alpha: 0.68$). The questionnaire consists of 39 items, presented in a Likert scale format ranging from 1 (strongly disagree) to 6 (strongly agree) (Díaz et al., 2006).

Consistent with the complexity of the scale and some data in common with other studies, we have chosen to consider only self-acceptance, environmental mastery and purpose in life. In support of this methodological decision, we have performed with our sample an exploratory factor analysis (principal components method) to see if these three dimensions converge in the same factor. The data confirm this convergence and show that this single factor has an eigenvalue of 2.43 and explains a very high value of the variance of its results (81.1%).

In the case of the PENCRISAL, the full version was applied, and the score was taken for each of the five dimensions and the total score. The PENCRISAL was applied to measure CT skills. This test consists of 35 problem situations that participants answer in an open-response format. The test is organized into five key areas: deductive reasoning, inductive reasoning, practical reasoning, decision making and problem solving.

The deductive and inductive component tests different forms of reasoning, such as propositional, categorical, causal, analogical and hypothetical. Decision-making measures the ability to make probabilistic judgments and to effectively use heuristics to identify potential biases. The problem-solving section poses participants with general and specific problems that require appropriate solution strategies. These sections are intended to encourage the application of strategies necessary for effective problem planning. The open-ended question format encourages participants to justify their answers, which are evaluated using a scoring system that rates the quality of their responses on a scale of 0 to 2. Responses are converted into numerical scores using item-specific criteria. These are used to describe and identify the thinking mechanisms underlying each response. A score of 0 indicates that the answer is incorrect, 1 indicates that the answer is correct but no or inadequate justification is provided, and 2 indicates that the answer is correct and adequate justification is provided. The PENCRISAL yields an overall score of the CT ranging between 0 and 70 and between 0 and 14 for each dimension. Reliability assessments show satisfactory accuracy, with a minimum Cronbach's Alpha of 0.632 and a test-retest reliability of 0.786 (Rivas and Saiz, 2012). The test is administered online through the SelectSurvey.NET V5 platform.

2.3 Procedures

Students gave their free and informed consent to participate in the study. The PWBS was carried out at the beginning of the semester of the CT course. The PENCRISAL test was taken at the beginning and at the end of the academic period. Only the results of students who completed both instruments are considered. Academic performance is represented by the grade obtained by students at the end of the course. Statistical analyses were performed with IBM/SPSS version 29.0. After performing the descriptive statistics, we proceeded to a correlation analysis and, finally, we evaluated the impact of the PWBS and the CT on the variance of academic performance by performing a regression analysis.

3 Results

Table 1 presents the descriptive data of the students' scores on the two instruments applied, and the measure of academic performance. In addition to the minimum and maximum values, the mean, standard deviation and indicators of skewness and kurtosis of the distribution of the results are presented.

Observing the results, we can see a distribution with a slight tendency towards values above the mean ($m = 79.80$) for the PWBS, which is reflected in a negative skewness (-0.437). With respect to the five dimensions of CT, it can be stated globally that the mean value of DR, IR and PS is moving away from the maximum value observed and towards the minimum value, which represents a positive symmetry. The opposite situation occurs with the RP dimension. Regarding the TCT, the data show a tendency to scores around the mean ($m = 37.21$), as can be deduced from the residual values of skewness and kurtosis. Regarding the AP, the data suggest a balanced distribution of academic scores around an intermediate value between 3.66 and 9.01 as scores at the lower and upper extremes ($m = 6.10$), with very low skewness and kurtosis.

In general, the results show good variability or dispersion, since the mean of each variable is located in the center of the data interval, which is desirable in research to adequately represent the population studied. Skewness and kurtosis indices close to zero for academic achievement are especially indicative of a normal or Gaussian distribution of values. The slightly higher kurtosis in the IR dimension of CT (2.248) is still acceptable.

Table 2 shows the correlations between the variables in this study. Since these were interval metric variables, Pearson's product x moment method was used to calculate the correlations. For statistical significance, the two-tailed test was used and $p < 0.05$ was set as the limit of significance.

According to the data, the highest correlation is found between TCT and AP, with the lowest correlation being between CT and PWBS measurement (no correlation). At an intermediate level is the correlation between PWBS and AP. Likewise, all the dimensions of the CT correlate with the AP with values between 0.183 (PS) and 0.337 (PR). As can be seen, there are variations in the correlations among the five dimensions of the CT, but all have high correlations with the total score (between 0.502 and 0.668). In this sense, only the TCT score is used for the regression statistical analysis.

In summary, the data suggest that there is a significant and positive relationship between PWBS and AP, as well as an even stronger and more significant relationship between TCT and AP. There is no evidence of a significant relationship between PWBS and TCT. To further explore the relationships between cognitive and noncognitive variables in AP, we turned to a regression analysis. We opted for a linear regression with PWBS and TCT as predictors and AP as the criterion or dependent variable. **Table 3** presents the regression values obtained.

The regression model was found to be statistically significant, with an F -value $(2, 88) = 18.571$, $p < 0.001$. This indicates that, collectively, PWBS and TCT provide significant prediction of AP. The coefficient of determination (R^2 adj.) is 0.285, which means that approximately 30% of the variability in AP can be explained by the independent

TABLE 1 Descriptive statistics for the measures used ($n = 128$).

Variables	Minimum	Maximum	Mean	Standard deviation	Skewness	Kurtosis
PWBS	39	103	79.80	13.41	-0.437	0.076
DR	1	14	5.56	2.59	0.395	0.173
IR	2	16	6.36	2.10	0.858	2.248
PR	2	14	10.20	2.41	-1.002	1.338
DM	4	13	8.52	1.83	0.080	0.031
PS	2	16	6.87	2.32	0.409	0.797
TCT	19	56	37.21	7.17	-0.012	-0.293
AP	3.66	9.01	6.10	1.05	0.204	-0.155

Psychological well-being scale (PWBS), deductive reasoning (DR), inductive reasoning (IR), practical reasoning (PR), decision making (DM), problem solving (PS), critical thinking total (TCT), academic performance (AP).

TABLE 2 Correlations between study variables.

Variables	PWBS	DR	IR	PR	DM	PS	TCT	AP
PWBS	-	-0.082	-0.167	-0.041	-0.132	0.040	0.039	0.336**
DR	-0.082	-	0.450***	0.271	0.227**	0.118	0.589***	0.211*
IR	-0.167	0.450***	-	0.362***	0.218*	0.129	0.622***	0.205*
PR	-0.041	0.669***	0.362***	-	0.381***	0.132	0.668***	0.337***
DM	-0.132	0.593***	0.218*	0.381***	-	0.295**	0.593***	0.217*
PS	0.040	0.502***	0.129	0.132	0.295**	-	0.502***	0.183*
TCT	0.039	0.589***	0.622***	0.668***	0.593***	0.502***	-	0.514***
AP	0.336**	0.211*	0.205*	0.337***	0.217*	0.183*	0.514***	-

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$ (two-tailed).

variables in the model. As can be seen from the *t*-values and significance, both variables have a significant impact on AP, although TCT has a greater impact.

In a complementary manner, with the objective of enriching the analysis of the influence of the CT on the PA, we have included additional measures to the grade obtained by the students in the course (NCT), such as the selectivity grade with which they entered the university (NEBAU), the average grade of the transcript (NMEXP), that is, the grades of the other courses that the students must take, and the pretest results obtained with the PENCRISAL (PCT). The data obtained are recorded in Table 4.

Table 4 shows that the relationship between PWBS and NMEXP has a Pearson correlation of 0.075, with a *p*-value of 0.372. This low correlation indicates that the connection is minimal. In contrast, the relationship between TCT and NMEXP shows a stronger correlation of 0.464**, suggesting a moderate positive association. The significance of this correlation, less than 0.001, indicates a statistically significant relationship, which implies that this result is not likely to be a coincidence. A similar case occurs with the relationship between NEBAU and NMEXP.

Given this context, if we perform a multiple linear regression analysis with NMEXP as the dependent variable and PWBS and TCT as independent variables, we would expect TCT to have a more significant impact on NMEXP. This projection is based on the statistically significant correlation of these variables. On the other hand, NEBAU has a slightly lower correlation with NMEXP compared to TCT (0.455 vs. 0.464), but the difference is very small, indicating that both have similar impact capacity for NMEXP in terms of linear correlation.

Confirmation of these hypotheses by appropriate regression analysis will provide a more detailed and accurate understanding of how PWBS and TCT individually contribute to the prediction of NMEXP, considering the influence of interrelated variables. However, in performing this procedure, a reduction in sample size to only 64 cases were observed. This increases the risk of failing to detect significant differences or could lead to unstable effect estimates.

TABLE 3 Impact of psychological well-being and critical thinking on academic performance.

		B	Error	Beta	<i>t</i>	Prob.
1	(Constant)	1.653	0.793		2.085	0.041
	PWBS	0.022	0.007	0.271	3.004	<0.01
	TCT	0.074	0.014	0.473	5.252	<0.001

TABLE 4 Correlations between study variables and complementary measures.

Variables	PCT	TCT	NCT	NMEXP	NEBAU	PWBS
PCT	–	0.477***	0.196*	0.271***	0.089	–0.142
TCT	0.477***	–	0.512***	0.464***	0.177*	–0.128
NCT	0.196*	0.512***	–	0.642***	0.288**	0.194*
NMEXP	0.271**	0.464***	0.642***	–	0.455***	0.075
NEBAU	0.089	0.177*	0.288***	0.455***	–	0.008
PWBS	–0.142	–0.128	0.194*	0.075	0.008	–

* *p* < 0.05; ** *p* < 0.01; *** *p* < 0.001 (two-tailed). PCT, PENCRISAL total PRE; TCT, total of PENCRISAL POST; NCT, critical thinking course note; NMEXP, grade point average; NEBAU, selectivity score; PWBS, Psychological Well-Being Scale.

4 Discussion and conclusions

The CT seeks to understand and effectively solve problems, through a correct approach, the generation of solution alternatives filtered by the mechanism of explanation and the selection of a solution, all with the aim of achieving a desired change. The PENCRISAL test is based on this defining framework of the CT (Saiz and Rivas, 2008; Rivas and Saiz, 2012). Therefore, if we start from this concept and look at the data, we can conclude that the CT is a good predictor of academic performance.

Table 2 shows a positive and moderate correlation (0.514) between the CT and academic performance, suggesting that an increase in the CT is associated with an improvement in academic performance. Meanwhile, Table 3 shows — with a B coefficient of 0.074 and a Beta of 0.473 — that CT has a stronger relationship with academic performance compared to PWBS. This means that for every unit increase in CT, academic performance increases on average 0.074 units, and this effect is considerably significant in the model. The robust correlation and the impact indicated as a dependent variable highlight that the CT is a determinant competence of academic performance and is suggested as a relevant diagnostic and formative tool in the educational field. Although it is not the only factor that influences academic performance, the CT is presented as a significant predictor and one that can be worked on or trained in the classroom.

Declaratively, the current study coincides with other results obtained and recorded in Rivas et al. (2023). On that occasion, the authors found that CT is a predictor of academic performance and that the benefits of instruction can be sustained over time. The study showed a correlation between CT and academic performance of 0.32. The main difference between these two studies concerns the objectives. The previous study did not attend to the explicit discussion of how CT could influence well-being, or vice versa. The current work recovers this line and incorporates non-cognitive variables in the analysis framework to account for well-being, under the assumption that this construct should have a significant impact on academic performance.

More generally, if we consider that, although the construct intelligence is not the same as CT, they do have several points of convergence (Butler et al., 2017), then we can establish a dialogue with other studies on the factors that influence academic performance. Intelligence represents the intrinsic capacity to learn, understand, reason, and meet challenges through problem solving to adapt to the environment (Sternberg, 1985). This cognitive potentiality manifests itself in various ways, being the CT one of its most relevant

expressions, particularly in situations that demand deep analysis, evaluation, and decisions based on logical reasoning (Saiz, 2024). The CT, therefore, acts as an essential tool that intelligence employs to effectively navigate through complex and challenging real-world situations (Halpern and Butler, 2018).

In this conceptual line, the current results partially coincide with studies that have shown that the best predictors of academic performance are cognitive components, such as measures of general intelligence, analogical reasoning, fluid intelligence, logical, verbal and quantitative reasoning (Morales-Vives et al., 2020; Mammadov, 2022); as well as scores on the diagnostic and university entrance test (Gilar-Corbi et al., 2020).

In our study the other factor of analysis was the PWB. Although due to its non-cognitive nature it would be *per se* at a disadvantage compared to cognitive factors, the data also show that its inclusion in educational research, especially to account for academic performance, is significant. In Table 2, the analysis of the correlation between PWBS and academic performance reveals a positive relationship with a correlation coefficient of 0.336. Although the correlation is moderate and not as strong as that observed between CT and academic performance, it is still significant and should not be ignored in the pursuit of improving students' academic performance. Table 3 shows that PWBS has a positive and significant influence on the dependent variable. The standardized coefficient (Beta) of 0.271 indicates that there is a positive relationship between PWBS and academic achievement. The unstandardized coefficient (B) shows that, holding all other variables constant, for each unit increase in PWBS, academic performance increases on average 0.022 units. This relationship, supported by a low standard error of 0.007, points to a moderate but significant contribution of PWBS compared to other variables.

These findings show that the integration of some aspects of PWBS could be an effective strategy to improve academic performance, evidencing a beneficial and significant relationship between both aspects. PWB can influence academic performance through non-cognitive conditions or factors involved in learning, such as motivation, academic satisfaction, effective coping with stress or anxiety, and the acceptance and management of limitations related to the process of appropriation and adaptation to one's own identity.

However, it is important to emphasize that the PWB is a construct that requires careful theoretical and empirical review in the educational context, as the Ryff scale has open debates and the lack of uniqueness of criteria on the number of dimensions influences these results. To cite just one case, we have used three dimensions out of six, with statistical and literature support, but the data may be different with a different selection approach. This finding highlights the importance of students' PWB as part of a comprehensive educational strategy, but also shows that the direct impact of PWB on academic performance may be less pronounced than the impact of cognitive skills, and that due to its very multidimensional and complex nature, it is not easy to converge in an instructional design. Despite this, higher education institutions can take care of the institutional and relational climate so that students feel good and take advantage of the formative and educational opportunities of the academic environment. In the case of CT, there are concrete and validated training strategies that make it possible to improve skills such as argumentation, explanation,

problem solving and decision making (Guamanga et al., 2023; Saiz, 2024). On the PWB side, the same cannot be said due to the lack of empirical support; however, some studies have proposed a path that incorporates socio-emotional competences in the training of CT, a proposal characterized by the cognitive-emotional methodology, with interesting results that still need to be explored and debated (Hanna, 2013).

Table 2 shows low and non-significant correlations between PWBS and the different forms of reasoning (deductive, inductive and practical), as well as with decision making and problem solving. For example, the correlation between PWBS and deductive reasoning is -0.082 , which is not only low, but also lacks statistical significance. Additionally, the correlation between PWBS and decision making is -0.132 , which is also a low correlation and not significant. Although there is a positive correlation between PWBS and problem solving (0.040), it is very low and not statistically significant, so there is not enough evidence to claim a positive relationship between these variables. This reinforces the idea that there is not a direct and significant relationship between how a student feels psychologically and CT skills or, nuanced is not supported by the data from this sample. It is possible that there are unexamined mediating factors that influence these relationships or that the relationship exists in a different context or with different measures.

The results of the present study do not coincide with other research that has shown positive relationships between decision-making and PWBS, especially with self-acceptance, environmental mastery, and purpose in life. The study by Páez-Gallego et al. (2020) addresses this issue by exploring how the PWBS of adolescents in Madrid, Spain, is linked to their decision-making methods. The research concludes that there is a positive correlation between the use of adaptive decision-making strategies and PWBS. Adolescents who opt for a rational and systematic evaluation of available options report higher levels of well-being. Specifically, adaptive decision-making style correlates significantly with overall well-being (0.544) and with aspects such as self-acceptance (0.485), positive relationships with others (0.242), environmental mastery (0.472), autonomy (0.359), purpose in life (0.473), and personal growth (0.346). In contrast, those who resort to maladaptive strategies, marked by impulsivity or avoidance, show reduced PWBS (-0.458).

The discrepancy in results with this study could be due to the difference between the instruments used to assess decision making. While Páez-Gallego et al. (2020) used the *Flinders Adolescent Decision Making Questionnaire* (FADMQ), which focuses on personal perceptions and experiences of decision making, our study uses the PENCRIASAL, which although not limited to decision making, does include this ability as an essential component of the CT. The latter measures the ability to identify, analyze and solve everyday problems through items that simulate real situations, assessing the ability to choose the best solution or action strategy. Because the PENCRIASAL responses are open-ended, it allows for a detailed assessment of how participants describe or explain their decisions. Ultimately, the fundamental difference between these two measures is that one is a self-report of perceptions and experiences, while the other is a set of problems to be solved correctly; in other words, one collects impressions of decision making and the other collects realized decision making. Therefore, although both studies applied Ryff's

PWBS, the differences between instruments and approach to decision making explain the variations in the results. This divergence evidences the relevance of considering the context and the specific instrument when interpreting the relationship between the PWBS and decision making.

Despite these findings, the need to further explore these interactions persists, especially given that the three selected dimensions—self-acceptance, environmental mastery, and life purpose—theoretically align with CT approaches focused on explanation and the development of post-decisional skills, such as decision making and problem solving (Guamanga et al., 2023). A CT approach that emphasizes the development of these skills must consider effects that transcend immediate or tangible outcomes. Therefore, it is crucial to understand how the concept of PWB, as examined above, relates to CT. Specifically, it must be determined whether some of these dimensions align directly to foster effective CT, or whether they instead lean more towards a conception of well-being in a more general sense, which could include hedonic aspects.

The emphasis on CT oriented to decision making and problem solving through the analysis of explanations and causalities should be evaluated for its pragmatic effects on PWB. At first glance this idea seems to confront parallel concepts paradoxically united by the same diachronic nature. In the case of the CT, this nature explains the high demands placed on it. For example, it is not enough to say that it contributes to tangible improvements in academic performance, but its usefulness is expected to transcend beyond academia and materialize in skills of interest to organizations in all sectors of the economy (Casner-Lotto and Barrington, 2006; Atanasiu, 2021). However, their practical impact still presents serious challenges, especially when students, as active subjects of learning, face limitations in anticipating the usefulness and applicability of these critical skills for the future. This is partly explained by the fact that the educational system prioritizes academic performance over the comprehensive development required later in the professional sphere (Saiz, 2020). Which means that the CT can be interpreted as an unfulfilled or partial promise. It is certainly a reading that omits the particular contexts, interests, motivations and concerns of students while they are part of these instructional programs and then the same factors analyzed by a student who knows that he or she must make the transition to the professional field.

A similar case happens with PWB as a diachronic phenomenon. An instant in time is not enough to understand and analyze students' PWB. It is necessary to focus on how it changes and evolves through different stages, including through feelings of achievement or frustration in the academic process. Thus, it is recognized that PWB is not static and, therefore, evolves through lived experiences, among them, those comprising the applicability of a series of learned skills. This implies that as diachronic phenomena they can evolve and influence each other over time. This approach requires longitudinal studies to follow the evolution of the impact of curricular interventions aimed at strengthening cognitive skills such as those of the CT, in order to understand how these may influence the PWB in the long term.

The limitations of this study, beyond having a small sample that prevents the generalization of the results or having examined only certain dimensions of the PWBS, added to the theoretical impossibility

of performing regression analyses with other performance measures, lie in the diachronic nature of the constructs studied. This characteristic makes it difficult, as has been argued, to give a definitive answer on the relationship.

Within the framework of the PWBS triad model we are analyzing, it is possible to theoretically group several key concepts. The development of the CT involves a process of self-acceptance, which is crucial given our inherent tendency for error. This process allows us, through a reflective evaluation of our past and present, to recognize and accept beliefs that we have discarded as erroneous. This self-acceptance facilitates deeper introspection, allowing us to see these errors as essential learning opportunities in our lives. On the other hand, any model that emphasizes post-decisional skills must also consider the non-linear complexity of our reality, and provide solid criteria for problem solving and decision making to master our environment more effectively. This is what allows us to adapt better, both biologically and socially. Finally, this approach to TC inevitably values purpose in life by seeking to ensure that it is in part determined by integrating the best tools of science, philosophy and education for a more effective life orientation, grounded in the principles of rationality. The importance of setting clear goals, recognizing that their achievement requires effort, discipline and determination, is essential to being an effective critical thinker.

Therefore, although each dimension proposed by Ryff's PWBS possesses a conceptual richness that requires empirical validation, the dimensions selected for this study are aligned with a model of CT focused on problem solving and real-world decision making. Although we aspired to discover stronger links between PWB and CT, and to deepen their interrelationship, the theoretical parallelism analyzed is also reflected in the empirical results. Moreover, PWB as an operational concept, due to its complexity and multidimensionality, is subject to continuous revisions or possible unifications into a broader notion of well-being.

In future research on this topic, it is essential to include a broader set of variables predictive of academic performance. This includes, but is not limited to, students' selectivity record and cumulative grades in other subjects. In addition, a more solid and theoretically robust concept of well-being must be adopted, one that fits contemporary educational and professional demands. This concept must transcend the simple distinction between eudaemonic and hedonic well-being, and address its diachronic nature. It is important to explore how these dimensions of well-being are interrelated, either as cause or effect; and to examine whether CT fosters a virtuous circle with well-being.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material; further inquiries can be directed to the corresponding author.

Ethics statement

Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

MG: Writing – original draft, Conceptualization, Investigation, Methodology, Writing – review & editing. CS: Investigation, Methodology, Project administration, Validation, Writing – original draft. SR: Data curation, Investigation, Supervision, Validation, Writing – review & editing. LA: Formal analysis, Methodology, Validation, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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