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Abbreviated version of the Attitudes Towards Research Scale-Revised (ATRS-R): Psychometric properties in Peruvian students

Sergio Dominguez-Lara, Manuel Fernández-Arata, Rosa Seperak-Viera, Rony Prada-Chapoñan, Maite Díaz-Peñaloza, Gloria Marlen Aldana de Becerra

Abstract

Attitudes towards research are understood as a cognitive, persistent and acquired organization of beliefs, feelings and predispositions to action, product of experience, values and perceptions about scientific research, which is important because it is associated with progress in all areas of life, society and the economy. Therefore, the aim of this work was to provide evidence of the validity and reliability of the Attitudes Towards Research Scale-Revised (ATRS-R) in a sample of Peruvian undergraduate university students. A total of 666 students (74.9% women) between 19 and 55 years old (M = 23.086) participated. The ATRS-R and the Research Self-Efficacy Scale were used. The results indicate that the ATRS-R shows evidence of content validity. At a structural level, it is a one-dimensional measure, with adequate score and construct reliability, and is directly associated with research self-efficacy. It is concluded that this brief version of ATRS-R presents adequate psychometric properties.

Keywords

Attitudes towards research; psychometric properties; reliability; validity; university students.

Versión abreviada de la Escala de actitudes hacia la investigación-Revisada (EACIN-R): Propiedades psicométricas en estudiantes peruanos

Resumen

Las actitudes hacia la investigación se entienden como una organización cognitiva, persistente y adquirida de creencias, sentimientos y predisposiciones a la acción, producto de la experiencia, de valores y percepciones acerca de la investigación científica, la cual es importante porque se asocia con los avances en todos los ámbitos de la vida, la sociedad y la economía. El objetivo de este trabajo es brindar las evidencias de validez y fiabilidad de la Escala de Actitudes hacia la Investigación-Revisada (EACIN-R) en una muestra de estudiantes universitarios peruanos de pregrado. Participaron 666 estudiantes (74.9% mujeres) entre 19 y 55 años de edad (M_{edad} = 23.086). Se utilizaron EACIN -R y la Escala de Autoeficacia para Investigar. Los resultados indican que EACIN -R presenta evidencias de validez de contenido. A nivel estructural, es una medida unidimensional con una adecuada fiabilidad de las puntuaciones y del constructo, y se asocia directamente con la autoeficacia para investigar. Se concluye que esta versión breve de la EACIN -R presenta unas adecuadas propiedades psicométricas.

Palabras clave

Actitudes hacia la investigación, propiedades psicométricas, fiabilidad, validez, estudiantes universitarios

Versió abreujada de l'Escala d'Actitud vers la Investigació-Revisada (EACIN-R): propietats psicomètriques en estudiants peruans

Resum

Les actituds vers la investigació s'entenen com una organització cognitiva, persistent i adquirida de creences, sentiments i predisposicions a l'acció, producte de la experiència, de valors i percepcions sobre de la investigació científica, la qual és important perquè s'associa amb els avenços en tots els àmbits de la vida, la societat i l'economia. L'objectiu d'aquest treball és oferir les evidències de validesa i fiabilitat de l'Escala d'Actituds vers la Investigació-Revisada (EACIN-R) en una mostra d'estudiants universitaris peruans de pregrau. Hi van participar 666 estudiants (74.9% dones) entre 19 i 55 an i s (M_{edat} = 23.086). Es van utilitzar EACIN-R i l'Escala d'Autoeficàcia per a Investigar. Els resultats indiquen que EACIN-R presenta evidències de validesa de contingut. A nivell estructural, és una mesura unidimensional amb una adequada fiabilitat de les puntuacions i del constructe, i s'associa directament amb l'autoeficiència per investigar. Es conclou que aquesta versió breu de l'EACIN-R presenta unes propietats psicomètriques adequades.

Paraules clau

Actituds vers la investigació, propietats psicomètriques, fiabilitat, validesa, estudiants universitaris

INTRODUCTION

Scientific research is associated with advances in all areas of life, society and the economy. For this reason, it is considered a fundamental factor in the educational field, especially in higher education, and consequently it is included in the study plans of academic programs at universities due to the increase of opportunities for integrating academic and professional goals (Niemi & Nevgi, 2014).

However, and despite the fact that one of the objectives of universities is to create the habit and culture of research in professional life (Castro Rodriguez et al., 2018) to face the challenges of a changing society (Aguilar-Esteva et al., 2021; Colás-Bravo & Hernández de la Rosa, 2023), professionals do not always have the investigative skills or necessary attitudes to venture into it, either as a producer of knowledge or beneficiary of research results, to apply them in their professional field.

In Peru, scientific production remains behind and with a low presence in Latin American rankings and in countries with developed economies (Consejo Nacional de Ciencia, Tecnología e Innovación Tecnológica [National Council of Science, Technology and Technological Innovation] [CONCYTEC], 2017), despite the significant improvement resulting from the new University Law (El Peruano, 2014). In addition, the National Census of Research and Development in the Research Center shows that Peru spends four times less on research and development than the average of the Pacific Alliance countries and 20 times less than the OECD countries (CONCYTEC, 2016), due to the lack of financial resources and qualified personnel, and as a consequence no Peruvian university appears in the Academic Ranking of World Universities, published annually by the 500 best universities.

Despite these limitations, Peruvian scientific production increased between 2010 and 2015 from 927 to 1610 documents. However, Colombia and Chile produced 7,000 and 10,000 documents respectively in the same period (Superintendencia Nacional de Educación Superior Universitaria [National Superintendency of Higher University Education] [SUNEDU], 2018), where it is highlighted that the specialties of medicine, agriculture and social sciences are the ones that produce papers of excellence. Subsequently, a significant improvement in Peruvian pro-

duction was observed in the 2019–2020 biennium, but it continues to remain behind in scientific production and private universities continue to be the ones with the highest publications in indexed journals, mainly in natural sciences and health sciences. Moreover, 55% of the scientific publications come from five universities in the capital (SUNEDU, 2021).

It is necessary to highlight the role that universities have in the dynamics of this situation. Although the new University Law (El Peruano, 2014) establishes that both academic degrees and professional degrees are obtained through the preparation, development and support of research work, among which university theses stand out, universities used other modalities for a long time.

Furthermore, while research is rewarding, it is a complex process and requires specific personal and academic qualities: subject and methodological knowledge, discipline, resistance to frustration, individual and collective work capacity, ethics and permanent learning. In this way, those who produce knowledge in an original way contribute significantly to their professional training, although the advantage is not always visible (Alarco et al., 2017), among which the creation of knowledge from an evidence-based critical approach stands out (Drennan & Clarke, 2009), optimizing analytical thinking in the discussion of vocational and professional issues as well as contributing to enhancing metacognitive capacity (Perines & Murillo, 2017) and increasing personal prestige (Alarco et al., 2017)

Despite the advantages of research, this sometimes cannot materialize if the training provided in universities is deficient (Castro Rodriguez, 2019), among other reasons, because a significant number of first-year students do not have enough basic skills related to research, such as reading, writing, and mathematical calculation (Hacieminoglu, 2016; May & Hong, 2015; Osman, 2016; Van Aalderen-Smeets et al., 2017; Verkade & Hoon, 2016). Most of the time, theoretical knowledge is acquired without contexts for application to develop problem-solving skills (Edvardsson et al., 2010). Few critical skills are achieved (Beach, 2011), partly because the professors/advisors do not have the necessary experience in scientific production that supports their activity (Mamani-Benito et al., 2019). All these factors cause inadequate research teaching and learning processes.

These limitations could be overcome by optimizing training mechanisms throughout the university community, mainly among professors (Perines & Murillo, 2017), and making research part of the curricular objectives in a transversal way (Nobigrot-Kleinman et al., 1995), and not just a formal requirement to obtain an academic degree or professional degree, and thus scientific research would become a priority for professionals from various disciplines (Castro-Rodriguez, 2019; De la Cruz-Vargas et al., 2019). Nevertheless, it is necessary to indicate that a favorable attitude towards research is needed to acquire the conditions and venture into this process.

In this sense, attitudes are defined as the usual response predispositions of a subject towards an event, where three interrelated factors intervene: affective, cognitive, and behavioral factors (Barragán-Velásquez, 2009; Veliz-Manrique, 2017). The affective one is what the subject feels, the emotions that generate and mediate their judgment; the cognitive one is what the person knows or thinks they know (it includes concepts and opinions), and the behavioral one refers to the actions that they perform or are willing to perform.

Attitudes towards research are understood as a cognitive, persistent and acquired organization of beliefs, feelings and predispositions to action, product of experience, values and perceptions about scientific research. In this way, by knowing the attitudes of a person or group, it is possible to infer their behavior (Aldana et al., 2016; Rojas et al., 2012), with which it is possible to undertake strategies in this regard, since if they are favorable, interest and self-confidence can be generated in relation to this activity; on the contrary, if they are unfavorable, anxiety, a low level of self-efficacy and a perception of little usefulness of research for practical life may occur (Bilasa & Taşpınar 2019; De las Salas et al., 2014). The prediction and change of attitudes will depend on their evaluation (Arellano Torres et al., 2019; Ortega-Carrasco et al., 2018).

In the academic field there is a particular situation whereby although students recognize the importance and contribution of research for professional practice (Ortega-Carrasco et al., 2018), they have unfavorable attitudes or reflect indifference. In the Peruvian context, this situation is present in undergraduate (Camacho et al., 2022) and postgraduate students (Berrocal et al., 2022; Díaz & Cardoza, 2021; Garay-Argandona et al., 2021), mainly in university degree courses such as psychology (Hernández et al., 2022), although health science students have more favorable attitudes (Alarco et al., 2017; Castro-Rodríguez et al., 2018).

In any case, attitudes towards research facilitate the definition of a professional experience, the selection of the specialty, and increase the possibility of continuing with postgraduate academic activities (Chang et al., 2015). In addition, they foster a greater commitment to research by facilitating evidence-based professional practices (Akerjordet et al., 2012). In this way, involvement with research allows the professional to systematically examine their beliefs, understand their practices and continue learning from their experience. Moreover, it fosters a critical attitude and enables the identification of useful ideas in the literature consulted for their work practice (Kostoulas et al., 2019).

Currently, there are more professionals who show their responsibility in carrying out their work practice based on the best available evidence. Evidence-based professional practice arises in the health context, and is essential for high-quality, safe and effective health care. In addition, it enables improving results for personnel and organizations (Bahtsevani et al., 2004), and due to its rele-

vance, it has been extended to various disciplines (Kagan, 2022; Pizard et al., 2023).

Therefore, and due to the future implications of attitudes towards research, it is necessary to measure them because of their predictive nature, their relationship with teaching/learning, and because they help to identify favorable contexts or difficulties towards this process in order to intervene preventively (Arellano-Torres et al., 2019; Cota-Valenzuela et al., 2018; Papanastasiou & Schumacker, 2014).

In this sense, in Latin America there are different instruments, such as the Scale of Attitudes towards Learning Research Methodologies and the Production of Knowledge for students of Graphic Design (Chamosa-Sandoval, 2022), and the Questionnaire Attitude towards research (Barrios & Delgado, 2020), both created in Mexico. However, one of the studies only reported validity evidence based on content (Chamosa-Sandoval, 2022), while in another it was not clear which procedure linked to the factor analysis was executed to provide validity evidence based on internal structure (Barrios & Delgado, 2020).

In Peru there is the Scale of Attitudes towards Scientific Research (Portocarrero & De La Cruz, 2006), and although it was used in empirical studies (e.g., De la Cruz, 2013), this instrument does not have sufficient validity evidence based on internal structure given that a psychometric study analyzed the internal structure with the Little Jiffy approach (Ramos-Vargas, 2019). Moreover, the items do not focus on the student but on the environment, and while this is important, attitudes are personal aspects. In addition to this, there are already scales that assess the influence of external factors on attitudes towards scientific research (González-Rivera et al., 2021). In addition to the aforementioned scale, there are other Peruvian instruments, but they do not have validity evidence (Díaz-Vélez et al., 2008; Hernández et al., 2022; Mercado, 2017).

For this reason, it is necessary to evaluate alternative instruments to measure the construct, which is why the Attitudes Towards Research Scale-Revised (ATRS-R; Aldana et al., 2016, 2020) was chosen, prepared for Colombian university students, and consisting of three dimensions. The first dimension is the vocation for research, defined as a call to investigative activity, taking into account scientific rigor, which demands innate and permanently acquired skills to interact in academic and scientific communities (Perales et al., 2013; Rios, 2007). The second one is the assessment of research, which refers to the recognition of research as a basic factor for the advancement of knowledge and for problem-solving (De las Salas et al., 2014; Martínez-Rodríguez & Márquez-Delgado, 2014). Finally, there is interest in research, which is defined as having a disposition towards the elements and procedures that concern the research process.

The choice of the ATRS-R was based on the fact that this instrument went through different stages for its development and validation, and because it focuses on the attitude's subject, and not on other components such as the institutional profile or the incidence of professors, which although they are related to the attitudes of students towards research, it is not exactly the measurement object.

Regarding the psychometric analysis, the revised version of the ATRS (Aldana et al., 2016) provided validity evidence based on content obtained through the assessment of expert judges, as well as the estimation of reliability through Cronbach's alpha, although normative data is not supported in relation to the internal structure, which was not analyzed. Subsequently, the ATRS was analyzed from a perspective of an exploratory factor analysis (EFA; Aldana et al., 2020): the number of necessary factors was estimated using Horn's parallel analysis (Lloret-Segura et al., 2014), the principal component analysis (PCA), and promax rotation. In this case, adequate reliability coefficients were obtained in each of the dimensions ($\alpha_{disinterest}$ = .87; $\alpha_{vocation}$ = .87; $\alpha_{assessment}$ = .77), as well as the calculation of total reliability (α_{total} = .87), with two relatively low inter-factor correlations (< .20), and a moderate one (.510).

In addition, its psychometric properties were evaluated in Mexico (Cota-Valenzuela et al., 2019) from an EFA with PCA and varimax rotation, and a confirmatory factor analysis (CFA). After the first analysis, a two-component solution was obtained with four items each that together explained 56.43% of the variance of the items, and this structure obtained favorable evidence under a confirmatory approach, and a moderate total reliability (α_{total} = .81) and a moderate inter-factor correlation (.43) were also reported. Another study carried out in Mexico (Quezada-Berumen et al., 2019) obtained a three-dimensional factorial structure through an EFA, and although it seems a stable structure, the factor loadings are not reported in order to analyze whether there are complex items (with significant factor loading in more than one factor) as the inter-factor correlations are moderate (> .50). A CFA was also reported, but having as input the same sample as the EFA, the results are questionable because the execution of EFA and CFA with the same group is not recommended (Pérez-Gil et al., 2000). In the same way, a study developed in the Peruvian population (Hidalgo et al., 2023) was also found, which used both EFA (PCA and promax rotation) and AFC, reporting that the three-factor structure receives empirical support, which included high inter-factor correlations (.71, .73 and .85).

Despite the fact that the studies provide a favorable outlook, it is necessary to mention that the PCA used in most ATRS psychometric studies is not the most recommended for exploring the internal structure of self-reports in psychology, since it does not separate the true variance from the residual variance and, consequently, it is highly probable that the magnitudes of the factor loadings increase artificially (Lloret-Segura et al., 2014). On the other hand, the Horn's parallel analysis is used to determine how many factors will be extracted, not to confirm a multidimensional model or the number of items of each dimension as indicated in the Peruvian validation

(Hidalgo et al., 2023). Moreover, although the score reliability (coefficient α) is reported, information on the construct reliability (coefficient ω) is not provided, which is more compatible with the approaches used in this study. Additionally, the relevance of a general factor (GF) was not evaluated through a bifactor modeling (Rodríguez et al., 2016) due to the high inter-factor correlation found, since this situation could suggest the presence of a GF that explains more variance of the items. Finally, none of the psychometric reports subsequent to the Colombian version (Cota-Valenzuela et al., 2019; Hidalgo et al., 2023) provided validity evidence based on content nor validity evidence based on relations to other variables, such as some behaviors or beliefs linked to the investigative process, such as research self-efficacy.

Research self-efficacy is defined as the degree to which the person thinks they have the ability to adequately perform various research tasks, such as information search, scientific writing, among others (Dominguez-Lara, 2017), and previous evidence indicates a direct association with attitudes towards research (Wajid & Jami, 2020). In effect, as students are convinced of their skills, anxiety decreases (Gredig et al., 2022), and their attitudes towards research are more favorable (van Der Linden et al., 2015), given that self-efficacy contributes to the participation of students in research activities (Jacobs & Kane, 2021). This is explained because the first satisfactory experiences in research strengthen self-efficacy, mainly when they occur in a context of teamwork, the role of the professor and classmates being important (Kakupa & Xue, 2019; Pasetto et al., 2021).

The present study

The objective of this work was to provide validity and reliability evidence for the ATRS-R in a sample of Peruvian undergraduate university students, given the need for an instrument to assess attitudes towards scientific research in an agile and linguistically appropriate way.

The adaptation of the instrument to a different context could make its measurement or understanding more precise in the target audience, potentially changing its internal structure in the process (Lara et al., 2021; Sánchez-Villena et al., 2021), since the use of a scale without solid psychometric evidence could lead to erroneous conclusions. Therefore, the study is justified due to both the importance of science in the development of societies, and the need to know the valuation of research by university students, as research is a skill required to practice any profession and provide scientific knowledge to society. Furthermore, the study is useful to the extent that it will provide relevant information on the configuration of a construct that is not yet fully addressed in Peru, i.e., having more than one source of validity, in addition to the internal structure, which is most typical. This could provide information on the most relevant manifestations for the purpose of approaching the topic at training level (e.g., introductory research courses) and executive level (e.g., thesis consultancies)—since there is evidence that attitudes can improve with training (Aguilera & Perales-Palacios, 2020)—and for this it is necessary to have a measure with psychometric evidence. Additionally, the association with research self-efficacy broadens the background on its relationship with constructs involved in the teaching-learning processes of subjects related to research tasks. Finally, due to the limitations in previous studies (e.g., principal components analysis) regarding the analyses carried out, methodological improvements were implemented regarding the factor-analytic approach used, which allowed obtaining a more functional and brief version with greater practical usefulness in studies that address more than two variables, as well as a complete reliability report.

MATERIAL AND METHODS

Design

This research corresponds to an instrumental design (Ato et al., 2013) oriented towards the psychometric analysis of the Attitudes Towards Research Scale-Revised (ATRS-R).

Participants

A total of 666 university students (74.9% women) between 19 and 55 years old (M = 23.086; SD = 5.217), with 83.954% (n = 559) below 26 years old, mostly single (89.9%), who resided in the regions of Lima (28.5%), Arequipa (30.8%), and Lambayeque (40.7%) were evaluated. Of the total, 40.1% worked, 37.1% only studied, and 22.8% were looking for a job.

The participants were studying between the 6th and 9th academic cycle (semester) in private institutions, and at the time of responding they were enrolled in courses associated with scientific research. Finally, 64% would choose the thesis as the means of graduation.

Instruments

Attitudes Towards Research Scale-Revised (ATRS-R)

The ATRS-R (Aldana et al., 2020) is a scale created in Colombia for high school students, university students, teachers and university administrators to assess attitudes towards research considering three dimensions: vocation (e.g., *I am interested in attending face-to-face or virtual research events (conferences, seminars, among others)*), assessment of research (e.g., *Working as a team in research helps to achieve better results*), and interest in research (e.g., *Research should not be taught in the university*), through 28 items scaled in Likert format with five response options ranging from strongly disagree (0) to strongly agree (4).

The version reviewed by the expert judges was applied to the participants.

Research Self-Efficacy Scale (RSES)

The RSES (Dominguez-Lara, 2017) was developed in Peru for university students and evaluates four dimensions of self-efficacy to research, through 25 items with five response options ranging from *I can't do it* (1) to *I'm sure I can do it* (5). With the data from this study, adequate reliability coefficients were found in all dimensions: information management (α = .905; r_{ij} = .761), analysis and synthesis capacity (α = .956; r_{ij} = .707), scientific writing (α = .954; r_{ij} = .722), and data analysis and interpretation of results (α = .928; r_{ij} = .721).

Procedure

Informed consent and self-reports were presented using Google forms, and the responses were collected by sharing the link during the classes. The informed consent contains the aims of the study, as well as indicating the voluntary nature of the study, and that the information provided will be anonymous. The research was conducted and based on the ethical guidelines of the Helsinki Declaration (Asociación Médica Mundial, 1964) and the College of Psychologists of Peru Code of Ethics (2017).

Data analysis

Estimation and software

Measurement models were estimated using the weighted least square mean and variance adjusted (WLSMV) and the polychoric correlation matrix method. The WLSMV was chosen because it is an efficient estimator when ordinal variables are used (Li, 2016a, 2016b), and the polychoric correlation matrix for the same reason. These models were run with the Mplus v. 7 software (Muthén & Muthén, 1998–2015). In the same way, the indices of the bifactor models were obtained with a specific module (Dominguez-Lara & Rodriguez, 2017), and for the misspecifications a specific module (Dominguez-Lara, & Merino-Soto, 2018) was used as well, and the correlations were executed with the SPSS v21 program.

Validity evidence based on content

The validity evidence based on item content was obtained by evaluating a group of expert judges made up of professors of research methodology who have publications in indexed journals. In this sense, they were consulted regarding representativeness (if they are representative of the construct to be evaluated) and clarity (or if they are univocally understandable), evaluated on a scale from *not at all* (1) to *completely* (5). Subsequently, the quantification of the agreement was carried out with Aiken's V and its confidence interval (CI; Merino-Soto & Livia-Segovia, 2009), expecting values greater than .50 for the lower

limit of the CIs (Dominguez- Lara, 2017). Furthermore, based on the comments, the original items were modified to maximize comprehension in the target group.

Validity evidence based on internal structure

Preliminary analysis. The approximation to univariate normality was evaluated by the magnitude of the skewness (< 2; Finney & DiStefano, 2006) and kurtosis (< 7; Finney & DiStefano, 2006). Regarding multivariate normality, the Mardia multivariate kurtosis coefficient (G2) was used (< 70; Rodríguez & Ruiz, 2008).

Measurement models. Three measurement models were analyzed: original model (oblique three-factor model), which represents the original model; a bifactor model (three specific factors and a GF), because the high inter-factor correlation would suggest the presence of a GF with greater explanatory power on the items; and a unidimensional model, as a potential structure based on the results of the bifactor modeling.

Model evaluation. The measurement models were evaluated according to general and specific criteria. Regarding the general ones, the magnitude of the fit indices such as the CFI (> .90; McDonald & Ho, 2002), the RMSEA at point level (< .08; Browne & Cudeck, 1993) and expecting the upper limit of its confidence interval to be less than .10 (West et al., 2012), and the WRMR (< 1; DiStefano et al., 2018) was considered. The second general criterion was the magnitude of the factor loadings (> .50; Dominguez-Lara, 2018). Specifically, in the oblique model, the magnitude of the inter-factor correlations (ϕ) was considered, since values greater than .80 indicate that two factors are redundant (Brown, 2015). Furthermore, the presence of misspecifications associated with the correlation between residuals was determined in the unidimensional model, that is, relationships that must be modeled to improve the fit of the model and the structure to have greater solidity. Thus, a method was used that simultaneously analyzes the statistically significant modification indices (MI) (χ^2 > 10) with the expected unstandardized parameter change (EPC; Saris et al., 2009).

Finally, regarding the bifactor model, the strength of the GF was determined according to the magnitude of the omega hierarchical (ω_H; Zinbarg et al., 2006) and the explained common variance (ECV; Sijtsma, 2009), which are greater than .70 and .60, respectively (Rodríguez et al., 2016; Flores-Kanter et al., 2018).

Reliability

Reliability was estimated at the point level using the α coefficient (> .70; Ponterotto & Charter, 2009) to assess precision of the scores, as well as at the construct level with the ω coefficient (> .70; Hunsley & Marsh, 2008). In the same way, CIs were calculated with the bias-corrected bootstrap method (Asparouhov & Muthén, 2021).

Subsequently, the coefficients α and ω were corrected due to the presence of correlated residuals in the final model (Dominguez-Lara & Merino-Soto, 2017; Raykov, 2001).

Validity evidence based on relations to other variables

The relationship between attitudes towards research and research self-efficacy was assessed with the Pearson correlation coefficient according to the following criteria: less than .20, insignificant; between .20 and .50, low; between .50 and .80, moderate; above .80, high (Ferguson, 2009).

RESULTS

Validity evidence based on content

Nine expert psychologists participated in the review of the scale. There were five women, with an average age of 35.111 years (SD = 6.451), with almost 10 years of experience teaching courses associated with research methodology (M = 9.111; SD = 5.578). Although a relevant percentage of items reached adequate magnitudes regarding representativeness and clarity (table 1), the expert judges made recommendations to modify the writing in order to make them more understandable for the Peruvian population. Likewise, in some items the orientation was changed from a more everyday theme to one more focused on science (item 8) and words that reflect frequency were eliminated in order to not interfere with the response options (item 15). In the review process, a dimension change was proposed because, in the opinion of the judges, the content they evaluated was not related to the original dimension. Finally, they advised eliminating five items (9, 13, 18, 26 and 28) since, in their opinion, they had redundant content with others. Instead, they proposed six new items: four of them represented positive wording of some items that were retained (2, 3, 5, and 25), because inverse items are often problematic, and two additional items replaced those that were removed (18 and 26).

Finally, at the suggestion of the experts, some items were removed due to a lack of relevance to the scientific field (*Daily activities do not inspire in me anything new*; *I am the last to know about current affairs*) or having content redundant with other original items (*I almost always put off anything to do with research*; *I find scientific conversations boring*; *My research activities are a mess*).

On the other hand, new items were proposed for the dimension vocation for research (*I pay attention to scientific conversations*; *It is difficult for me to organize my research activities*), interest in research (*In the university research courses should be strengthened*; *I would be interested in receiving more courses on research*), and research assessment (*I am encouraged by thinking about research activities*; *Looking up scientific information is interesting*).

Validity evidence based on internal structure

Preliminary analysis

Generally, the approximation of the items to univariate normality is adequate according to skewness and kurtosis (table 2), although the picture is different for multivariate normality (G2 = 298.873). In general, the inter-item correlation is adequate (appendix 1).

Model evaluation

The oblique three-factor model obtained unfavorable fit indices (CFI = .817; RMSEA = .157, CI 90% .154, .161; WRMR = 3.427) as well as high inter-factor correlations (> .80), and also some reversed items presented factor loadings of low magnitude. Subsequently, the reversed items were eliminated and the fit indices continued without a substantial improvement (CFI = .872; RMSEA = .152, CI 90% .148, .156; WRMR = 2.892), although the high inter-factor correlation was kept (> .80).

Based on these results, a bifactor modeling was performed without the reversed items, evidencing a more favorable fit than the previous ones (CFI = .904; RMSEA = .137, CI 90% .133, .142; WRMR = 2.268), and with indicators that endorse the strength of the GF (ω_H = .968; ECV = .862), compared to what was found in the dimensions vocation for research (ω_H = .002), interest in research (ω_H = .001) and research assessment (ω_H = .223).

Then, since the data is oriented to unidimensionality, this model was evaluated, and in view of the fit indices (CFI = .863; RMSEA = .156, CI 90% .152, .160; WRMR = 3.007), progressive analyzes were performed to purify the structure factor, and thus eliminate some items, until reaching a version of 13 items (table 3; appendix 2) that have three pairs of correlated residuals: items 15 (*I look up scientific information on topics of interest*) and 16 (*Research is one of the things that arouses my interest*) (χ^2 = 661.473; EPC > 1; ϕ = .666); 22 (*Looking up scientific information is interesting*) and 23 (*I take advantage of any opportunity to participate in research activities or events*) (χ^2 = 145.321; EPC = .538; ϕ = .444); y 11 (*I like to get trained to acquire investigative skills*) and 23 (*I take advantage of any opportunity to participate in research activities or events*.) (χ^2 = 30.711; EPC = -.341; ϕ = -.358). After that, the fit improved (CFI = .979; RMSEA = .100, CI 90% .091, .108; WRMR = 1.280).

Reliability

Regarding the score reliability, the α coefficient obtained acceptable magnitude and CI (.956; CI 95% .950–.961), and in relation to the construct reliability, the ω coefficient was also adequate (.965; CI 95% .961–.966). Subsequently, after correction due to the presence of correlated residuals, the ω coefficient did not have a significant reduction (.957; CI 95% .950–.961), although this reduction was slightly greater in the α coefficient (.846; CI 95% .830–.857), without considering a drastic decrease in reliability.

Table 1: Validity evidence based on item content.

Vocation for research	Representativeness		Clarity		
Original version	V	CI 95%	V	CI 95%	Amended version
1 In research events (congresses, meetings) I interact with people.	.704	.515 - .841	.741	.553 - .868	I am interested in attending face-to-face or virtual research events (conferences, seminars, among others).
3 One of the things I like the most are scientific conversations.	1.000	.875 - .1000	.756	.569 - .879	I like conversations related to science or research.
6 I consider that I am patient enough to research.	.963	.817 - .993	.963	.817 - .993	I have the necessary enthusiasm to research.
8 Most things make me curious.	.778	.592 - .894	.756	.569 - .879	I am curious to learn more about topics of my interest.
10 I am aware of hearing about current affairs.	.593	.407 - .755	.63	.442 - .785	I am aware of current scientific issues.
11 I like to get trained to acquire investigative skills.	1.000	.875 - .1000	1.000	.875 - .1000	[Unchanged].
12 I believe that persistence contributes to the achievement of goals.	.481	.307 - .660	.704	.515 - .841	Being persistent contributes to the achievement of my goals in the research process.
14 I usually write to delve into topics of interest.	.852	.675 - .941	.778	.592 - .894	I usually read to delve into topics of interest.
15 I frequently find myself looking up scientific information.	1.000	.875 - .1000	1.000	.875 - .1000	I look up scientific information on topics of interest.
17 I am tidy in my research activities.	1.000	.875 - .1000	1.000	.875 - .1000	I am tidy in research-related activities.
20 I come up with innovative ideas about everyday problems.	.741	.553 - .868	.852	.675 - .941	I have innovative ideas about everyday problems.
23 I take advantage of any opportunity to publicize my work.	.963	.817 - .993	.963	.817 - .993	I take advantage of any opportunity to participate in research activities or events.
24 I like to expedite research-related work.	.963	.817 - .993	.926	.766 - .979	I prioritize research-related activities.
25 To me, in research it is important to strengthen the ability to listen.	.852	.675 - .941	.756	.569 - .879	Analytical ability is important during the research process.
Interest in research					
2 In my opinion, the university should not teach research.	.963	.817 - .993	.815	.633 - .918	Research should not be taught at the university.
4 Taking refresher courses is not for me.	.704	.515 - .841	.704	.515 - .841	I am not interested in taking research courses.
5 I think that looking up scientific information is a waste of time.	1.000	.875 - .1000	1.000	.875 - .1000	Looking up scientific information is a waste of time.
16 Research is one of the things that arouses my interest.	.963	.817 - .993	.963	.817 - .993	[Unchanged].
26 Thinking about starting to research breeds discouragement.	1.000	.875 - .1000	1.000	.875 - .1000	I get discouraged when thinking about research.
Assessment of research					
7 All professionals should learn to research.	1.000	.875 - .1000	1.000	.875 - .1000	[Unchanged].
19 Working with others on research helps us achieve better results.	1.000	.875 - .1000	.963	.817 - .993	Working as a team in research helps to achieve better results.
21 I consider that research helps detect errors in science.	1.000	.875 - .1000	1.000	.875 - .1000	Research helps detect errors in science.
27 In my opinion, research contributes to the resolution of social problems.	1.000	.875 - .1000	1.000	.875 - .1000	Research contributes to the resolution of social problems.

Table 2: Descriptive statistics.

Items	M	SD	g1	g2	Response options				
					0	1	2	3	4
1	3.758	0.924	−0.763	0.569	2.402	6.907	22.523	48.799	19.369
2 (R)	1.949	1.139	1.185	0.535	45.345	31.982	9.61	8.559	4.505
3	3.560	0.896	−0.590	0.408	2.703	7.958	31.682	45.946	11.712
4 (R)	2.039	0.983	0.788	0.097	34.384	37.688	19.219	7.057	1.652
5 (R)	1.779	0.947	1.284	1.217	47.898	35.285	9.159	6.306	1.351
6	3.455	0.943	−0.544	0.329	4.354	7.958	36.486	40.24	10.961
7	4.167	0.910	−1.392	2.257	2.402	3.604	9.159	44.595	40.24
8	4.101	0.832	−1.275	2.532	1.802	3.153	9.76	53.754	31.532
9	3.989	0.951	−1.043	1.111	2.703	4.354	16.366	44.444	32.132
10	3.168	0.976	−0.244	−0.005	6.456	13.213	45.345	27.027	7.958
11	3.622	0.954	−0.632	0.402	3.604	6.456	30.48	43.093	16.366
12	4.003	0.858	−1.165	2.095	2.252	3.153	13.664	53.904	27.027
13	3.682	1.003	−0.784	0.433	4.354	6.907	24.324	45.045	19.369
14	3.853	0.867	−0.879	1.142	1.952	4.805	19.82	52.853	20.571
15	3.803	0.879	−0.941	1.363	2.703	4.204	21.471	53.303	18.318
16	3.360	0.982	−0.380	−0.044	4.805	11.261	37.988	34.985	10.961
17	3.369	1.000	−0.330	−0.165	4.655	12.012	37.387	33.634	12.312
18	3.252	0.999	−0.331	−0.218	5.706	14.414	37.688	33.333	8.859
19	3.895	0.961	−1.072	1.299	3.754	3.904	17.718	48.348	26.276
20	3.512	0.944	−0.460	0.089	3.153	9.309	33.934	40.39	13.213
21	3.992	0.873	−1.060	1.625	2.102	3.453	15.465	51.051	27.928
22	3.797	0.896	−0.925	1.225	2.853	4.505	21.622	52.102	18.919
23	3.108	1.013	−0.253	−0.215	7.958	15.165	42.342	27.177	7.357
24	3.090	0.992	−0.218	−0.184	7.357	16.216	43.243	26.426	6.757
25	4.011	0.880	−1.096	1.713	2.252	3.153	15.165	50.15	29.279
26 (R)	2.623	1.076	0.198	−0.588	16.817	28.829	34.084	15.766	4.505
27	4.018	0.881	−1.068	1.582	2.102	3.303	15.315	49.249	30.03
28	3.509	0.925	−0.570	0.278	3.303	9.009	32.432	43.994	11.261
29 (R)	3.074	1.049	−0.069	−0.536	7.057	21.772	36.486	26.126	8.559

Nota: R: Reversed items; M: Mean; SD: Standard deviation; g1: Skewness; g2: Kurtosis; 0: Strongly disagree; 1: Disagree; 2: Neither agree nor disagree; 3: Agree; 4: Strongly agree.

Validity evidence based on relations to other variables

A positive and significant association was observed with all the dimensions of research self-efficacy: information management (r = .370), analysis and synthesis capacity (r = .429), scientific writing (r = .385), and data analysis and interpretation of results (r = .395).

DISCUSSION

The objective of this research was to analyze the psychometric properties of the Attitudes Towards Research Scale-Revised (ATRS-R; Aldana et al., 2020) in Peruvian undergraduate students.

Regarding the validity evidence based on item content, this was obtained through the opinion of expert judges, which led to the adjustment of some items' writing, in or-

Table 3: Factor loadings of the brief version of ATRS-R.

	Item	Factor loadings
Item 3	I like conversations related to science or research.	.772
Item 6	I have the necessary enthusiasm to research.	.815
Item 9	In the university research courses should be strengthened.	.864
Item 11	I like to get trained to acquire investigative skills.	.759
Item 12	Being persistent contributes to the achievement of my goals in the research process.	.766
Item 13	I would be interested in receiving more courses on research.	.773
Item 15	I look up scientific information on topics of interest.	.750
Item 16	Research is one of the things that arouses my interest.	.772
Item 17	I am tidy in research-related activities.	.750
Item 18	I am encouraged by thinking about research activities.	.746
Item 22	Looking up scientific information is interesting.	.837
Item 23	I take advantage of any opportunity to participate in research activities or events.	.894
Item 28	I pay attention to scientific conversations	.835

der to avoid repeated items and/or that an item could cause confusion in the participant when responding, while reducing response bias due to inappropriate interpretation of the item. It should be noted that this does not disqualify the original version, but it is necessary to highlight that when an instrument is analyzed at a psychometric level in a context other than the original one, the items must linguistically adapt to this new environment regardless of whether they share a language or are neighboring countries (Aparicio et al., 2021; Miranda-Zapata et al., 2021; Sánchez-Villena et al., 2021). It is worth mentioning that although there is a recent Peruvian study that assesses the ATRS-R at a psychometric level (Hidalgo et al., 2023), there is no evidence of reviewing the content of the items.

The internal structure was analyzed in detail, considering some indicators that, for various reasons, were not assessed in previous studies. Firstly, confirmation of the dimensionality of the scale was pending, as although theoretically it is multidimensional, empirical analysis sometimes determines a different picture (Dominguez-Lara et al., 2020). In this sense, the initial analyses based on the originally-proposed oblique model suggested a one-dimensional structure due to the high association between the original dimensions, which raised the possibility that there was an underlying GF for all the items. This assumption was corroborated by bifactor modeling (Rodríguez et al., 2016), i.e., that the attitudes towards scientific research construct is unidimensional, at least with the ATRS-R, although complex, considering the presence of specific dimensions that occur simultaneously in a continuum.

Regarding the correlation between residuals, although it is a procedure that could be inadequate (Dominguez-Lara, 2019), it would help to know some aspects related to the wording of the items involved with the aim of optimizing the scale in future studies (Lingán-Huamán et al., 2023; Pérez-Fuentes et al., 2020). For example, the residuals of two pairs of items (15 and 16; 22 and 23) could represent the specificity associated with *interest* in both items, while the other pair (11 and 23) would have a behavioral component (participation).

This situation contrasts with what was observed in other works, since although in the initial study (Aldana et al., 2020) the inter-factor correlations did not suggest overlapping between factors, in the other studies it was a probable situation considering the magnitudes of the inter-factor correlations (Hidalgo et al., 2023; Quezada-Berumen et al., 2019); therefore, it was necessary to evaluate the possible unidimensionality.

As a complementary aspect, it should be mentioned that the reversed items (when the most frequent response [e.g., *strongly agree*] indicates a more unfavorable attitude) did not perform well (e.g., low-magnitude factor loadings) from the initial stages of the process, and consequently they were eliminated. This reinforces the recommendations about avoiding this type of statement (Suárez et al., 2018), because, although it seeks to address a response bias such as acquiescence, the truth is that on many occasions they do not exceed the established quality criteria and are eliminated (e.g., Sánchez-Villena et al., 2021).

Similarly, this version has an adequate score reliability and construct reliability, with magnitudes similar to those of previous studies (Aldana, et al., 2020; Hidalgo et al., 2023). This characteristic allows it to be used later in both basic research and applied research (e.g., interventions) (Dominguez-Lara et al., 2023). This is supported by the fact that the sample size was significantly larger than that of previous studies (Aldana & Joya, 2011; Aldana et al., 2016; Aldana et al., 2020; Hidalgo, et al., 2023), an aspect associated to a tolerable amount of measurement error that allows for construct-focused interpretation.

On the other hand, the massive elimination of items is likely to generate concern, but it is a feasible situation within the psychometric analysis of an instrument in a different context (Lara et al., 2021). As such, the elimination of an item would indicate that it is not significantly influenced by the latent variable (construct). On the other hand, eliminating items to configure shorter versions of a scale is not a new procedure, since there are many examples of this (e.g., Campbell-Sills & Stein, 2007). This could question the breadth of the construct, but there would be greater collaboration of participants during evaluations linked to research that addresses a high number of variables (Dominguez-Lara et al., 2022; Rammstedt, 2007). In this way, they could be applied instead of extensive surveys that usually limit participation or the evocation of valid answers from those evaluated, either due to boredom or fatigue.

Furthermore, the direct association with the research self-efficacy dimensions is consistent with previous evidence (Jacobs & Kane, 2021; Wajid & Jami, 2020), providing further evidence of the strength of the abbreviated version of the ATRS-R.

Therefore, the abbreviated version of the ATRS-R to measure attitudes towards research has items with adequate factor loadings and a solid empirical representation of the construct, and excellent reliability, even after correction by correlated residuals, facts that make it an agile and easy-to-apply instrument.

Regarding the practical implications of the findings, it is known that the effective measurement of attitudes towards research is essential to understanding the predisposition of students towards this academic activity, especially during the first weeks of classes of the courses related to research. This information can allow the teachers to develop learning strategies oriented not only towards the knowledge of the research methodology, but also towards improving the attitudes, skills and behaviors of the students in the said activity (Papanastasiou, 2005). Likewise, the use of this scale will allow higher education institutions to adapt their academic programs by integrating research into the development of university degree courses. In this way, a timely intervention could be carried out, through strategies that arouse motivation and interest in research and scientific production (Camacho et al., 2022), with valuable information that the teachers can work with to improve students' appreciation and interest in research.

Similarly, the use of this scale can help universities adapt their academic programs such that research is integrated into the entire curriculum, with the possibility of consolidating more structured programs to guarantee an adequate teaching-learning process (Lateh et al., 2021). This is very important for university institutions, because in order to achieve quality certification, one of the basic requirements is the promotion of scientific research (Hernández et al., 2022). In this sense, training teachers to use pedagogical resources for teaching research methodology is suggested (Colás-Bravo & Hernández de la Rosa,

2023; Garay-Argandona et al., 2021), as well as encouraging research seedbed programs (training groups for interested students) that can favor student attitudes towards research (Castro-Rodríguez, 2022).

Despite the effort invested in this research process, it is necessary to mention some limitations in order to optimize future research. Firstly, and despite the effort of having a large sample of university students from three regions of Peru, which is even higher than previous studies, this is non-probabilistic; and its use limits generalization of the results. Another feasible aspect to optimize refers to data collection, which, being online, could make it difficult to handle extraneous variables, such as distraction with other stimuli on the device or environmental elements (e.g., noise). Secondly, the fact that more than half of the sample is interested in obtaining a thesis degree could bias the responses towards the positive side of the construct. Finally, it is likely that the predominantly female participation has biased the results, so it would be important to subsequently carry out a measurement invariance analysis according to sex.

CONCLUSIONS AND RECOMMENDATIONS

It is concluded that this abbreviated version of the ATRS-R presents adequate psychometric properties: it is essentially a unidimensional scale, with high levels of reliability and a coherent association with research self-efficacy. These characteristics make it a suitable instrument for measuring attitudes towards research in Peruvian undergraduate university students.

It is recommended that in future research its psychometric properties be explored in other populations, such as postgraduate students of different university degree courses, as well as academic administrative actors, whose role is essential when establishing research-oriented university policies. Additionally, establishing whether the construct is invariant according to sex, university degree course, or region origin is pending in order to facilitate comparative research.

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APPENDIX 1

Table A: Polychoric correlations between items.

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Item 12	Item 13	Item 14	Item 15	Item 16	Item 17	Item 18	Item 19	Item 20	Item 21	Item 22	Item 23	Item 24	Item 25	Item 26	Item 27	Item 28	Ítem 29
Item 1	1																												
Item 2	.615	1																											
Item 3	.559	.667	1																										
Item 4	.492	.583	.561	1																									
Item 5	.454	.52	.552	.393	1																								
Item 6	.632	.656	.684	.57	.621	1																							
Item 7	.524	.563	.595	.605	.464	.714	1																						
Item 8	.47	.524	.567	.682	.485	.569	.623	1																					
Item 9	.499	.625	.613	.68	.59	.635	.584	.798	1																				
Item 10	.487	.524	.66	.434	.529	.658	.544	.508	.585	1																			
Item 11	.466	.516	.522	.446	.493	.548	.456	.558	.614	.53	1																		
Item 12	.548	.534	.604	.34	.573	.666	.443	.5	.554	.648	.536	1																	
Item 13	.515	.557	.639	.346	.598	.688	.471	.446	.549	.655	.498	.859	1																
Item 14	.359	.441	.436	.573	.321	.477	.618	.52	.544	.379	.41	.305	.348	1															
Item 15	.543	.67	.589	.525	.538	.588	.509	.511	.609	.518	.547	.592	.595	.463	1														
Item 16	−.046	.016	−.114	.086	.023	−.027	−.063	.062	.101	−.159	.065	−.013	−.009	.126	.151	1													
Item 17	−.151	−.121	−.181	−.2	−.044	−.019	−.209	−.063	−.067	−.068	−.002	.035	.006	−.242	−.082	.201	1												
Item 18	−.434	−.402	−.404	−.319	−.207	−.339	−.396	−.2	−.235	−.226	−.154	−.211	−.222	−.302	−.297	.264	.569	1											
Item 19	−.299	−.264	−.306	−.344	−.167	−.225	−.356	−.227	−.253	−.21	−.077	−.096	−.099	−.354	−.221	.278	.583	.722	1										
Item 20	.585	.612	.612	.641	.464	.654	.638	.551	.568	.515	.436	.486	.512	.538	.527	.009	−.335	−.459	−.399	1									
Item 21	.621	.636	.675	.559	.502	.753	.694	.578	.611	.616	.485	.636	.661	.533	.598	−.016	−.177	−.446	−.314	.786	1								
Item 22	.57	.688	.734	.551	.582	.771	.574	.62	.694	.721	.549	.704	.724	.419	.657	−.006	−.07	−.317	−.217	.617	.708	1							
Item 23	.54	.652	.729	.459	.59	.766	.536	.53	.614	.787	.586	.748	.785	.399	.629	−.075	−.034	−.283	−.166	.583	.686	.863	1						
Item 24	.554	.643	.675	.639	.511	.673	.628	.613	.686	.637	.574	.596	.584	.627	.674	−.029	−.25	−.407	−.397	.684	.709	.722	.688	1					
Item 25	−.31	−.226	−.344	−.154	−.126	−.275	−.22	−.128	−.158	−.261	−.097	−.192	−.22	−.106	−.146	.455	.376	.519	.436	−.239	−.309	−.284	−.284	−.297	1				
Item 26	.503	.547	.546	.646	.321	.546	.623	.503	.543	.461	.373	.331	.376	.638	.47	−.021	−.415	−.46	−.509	.727	.618	.514	.463	.641	−.226	1			
Item 27	.405	.443	.462	.47	.369	.487	.495	.46	.467	.475	.484	.428	.421	.506	.446	.099	−.149	−.226	−.21	.496	.538	.507	.519	.581	−.123	.483	1		
Item 28	.396	.476	.442	.628	.367	.471	.602	.548	.633	.423	.489	.362	.368	.7	.53	.095	−.28	−.3	−.354	.558	.532	.481	.428	.702	−.132	.627	.543	1	
Item 29	.395	.473	.428	.587	.297	.461	.595	.489	.481	.374	.382	.261	.313	.704	.504	.112	−.268	−.357	−.349	.562	.522	.448	.374	.607	−.136	.628	.491	.73	1

APPENDIX 2

Escala de actitudes hacia la investigación – Revisada (EACIN-R)
Versión peruana

A continuación, encontrará una serie de afirmaciones relacionadas con la investigación. Por favor, escoja la respuesta con la cual se sienta más identificado(a). No medite mucho su respuesta, no hay respuestas buenas ni malas. Las opciones son:

1. Muy en desacuerdo
2. En desacuerdo
3. Ni de acuerdo ni en desacuerdo
4. De acuerdo
5. Muy de acuerdo

1. Me agradan las conversaciones relacionadas con la ciencia o la investigación
2. Tengo el entusiasmo necesario para investigar
3. En la universidad se deberían fortalecer los cursos de investigación
4. Me gusta capacitarme para adquirir habilidades investigativas
5. Ser persistente contribuye a alcanzar mis metas en el proceso de investigación
6. Me interesaría recibir más cursos sobre investigación
7. Consulto información científica sobre temas de mi interés
8. La investigación es una de las cosas que me despierta interés.
9. Soy ordenado(a) en las actividades relacionadas con la investigación.
10. Me animo al pensar en actividades de investigación
11. Consultar información científica es interesante
12. Aprovecho cualquier oportunidad para participar en actividades o eventos de investigación.
13. Presto atención a las conversaciones científicas