CULTURAL ADAPTATION AND VALIDITY EVIDENCE OF THE IMAGINATION, CREATIVITY, AND INNOVATION (ICI) SCALE FOR USE IN BRAZILIAN PORTUGUESE - – VERSION FOR TEACHERS

ADAPTAÇÃO CULTURAL E EVIDÊNCIAS DE VALIDADE DA ESCALA IMAGINATION, CREATIVITY AND INNOVATION (ICI) PARA USO NA LÍNGUA PORTUGUESA DO BRASIL – VERSION FOR TEACHERS

ADAPTACIÓN CULTURAL Y EVIDENCIAS DE VALIDEZ DE LA ESCALA IMAGINATION, CREATIVITY AND INNOVATION (ICI) PARA SU USO EN EL IDIOMA PORTUGUÉS DE BRASIL - VERSIÓN PARA PROFESORES

Alzira Luciana FERRAZ DE SOUZA[1]
e-mail: alziraluciana.ferraz@gmail.com

Helena BRANDÃO VIANA[2]
e-mail: hbviana2@gmail.com

Alceli RIBEIRO ALVES[3]
e-mail: alceli.ribeiro@gmail.com

Dayse NERI DE SOUZA[4]
e-mail: dayse.neri.souza@gmail.com

How to reference this paper:

FERRAZ DE SOUZA, A. L.; BRANDÃO VIANA, H.; RIBEIRO ALVES, A.; NERI DE SOUZA, D. Cultural adaptation and validity evidence of the imagination, creativity, and innovation (ICI) scale for use in Brazilian Portuguese – version for teachers. **Nuances: Estudos sobre Educação**, Presidente Prudente, v. 36, n. 00, e025003, 2025. e-ISSN: 2236-0441. DOI: 10.32930/nuances.v36i00.10881.

| **Submitted**: 01/12/2024
| **Revisions required**: 06/01/2025
| **Approved**: 12/02/2025
| **Published**: 17/03/2025

Editors: Prof. Dr. Rosiane de Fátima Ponce
Prof. Dr. Paulo César de Almeida Raboni
Deputy Executive Editor: Prof. Dr. José Anderson Santos Cruz

[1] Brazilian Adventist Central Institution for Education and Social Assistance (APLAC), Brasília - Distrito Federal (DF) - Brazil. Director of Education.
[2] Brazil Adventist University (UNASP), Engenheiro Coelho - São Paulo (SP) - Brazil. Lecturer in the Professional Master's Program in Education.
[3] International University Center (UNINTER), Curitiba - Paraná (PR) - Brazil. Lecturer in the Stricto Sensu Postgraduate Program in Education and New Technologies-PPGENT.
[4] Brazil Adventist University (UNASP), Engenheiro Coelho - São Paulo (SP) - Brazil. Lecturer in the Professional Master's Program in Education.

ABSTRACT: This study aimed to perform the cultural adaptation and validation of the Imagination, Creativity, and Innovation (ICI) scale for use in Brazilian Portuguese. The cultural adaptation process followed the COSMIN methodology, which includes five steps: 1) translation of the original instrument into Portuguese; 2) synthesis of the translations; 3) back-translation into the original language; 4) formation of a committee composed of translators, linguists, and experts in the field to produce the pre-final version of the instrument; 5) application of the final version of the inventory to a sample of 191 teachers. The version showed satisfactory reliability values, with a Cronbach's Alpha of 0.886 and McDonald's Omega of 0.882. The items demonstrated acceptable factor loadings in the confirmatory factor analysis (CFA). Therefore, the Brazilian version of the ICI for teachers constitutes a relevant and reliable tool for analyzing creativity, imagination, and innovation in the school environment.

KEYWORDS: Cultural Adaptation. Creativity. Imagination. Innovation. Teachers.

RESUMO*: Esta pesquisa teve como objetivo realizar a adaptação cultural e a validação da escala Imagination, Creativity and Innovation (ICI) para uso na língua portuguesa do Brasil. O processo de adaptação cultural seguiu a metodologia Cosmin, que abrange cinco etapas: 1) tradução do instrumento original para a língua portuguesa; 2) síntese das traduções; 3) retrotradução para a língua original; 4) formação de um comitê composto por tradutores, linguistas e especialistas na área para a produção da versão pré-final do instrumento; 5) aplicação da versão definitiva do inventário em uma amostra de 191 professores. A versão apresentou valores de confiabilidade satisfatórios, com Alpha de Cronbach de 0,886 e Ômega de McDonald de 0,882. Na AFC, os itens apresentaram cargas fatoriais aceitáveis. Portanto, a versão brasileira da ICI para professores constitui uma ferramenta relevante e confiável para analisar a criatividade, imaginação e inovação no ambiente escolar.*

PALAVRAS-CHAVE*: Adaptação Cultural. Criatividade. Imaginação. Inovação. Professores.*

RESUMEN*: Esta investigación tuvo como objetivo realizar la adaptación cultural y la validación de la escala Imagination, Creativity and Innovation (ICI) para su uso en el idioma portugués de Brasil. El proceso de adaptación cultural siguió la metodología COSMIN, que incluye cinco etapas: 1) traducción del instrumento original al portugués; 2) síntesis de las traducciones; 3) retrotraducción al idioma original; 4) formación de un comité compuesto por traductores, lingüistas y especialistas en el área para elaborar la versión preliminar del instrumento; 5) aplicación de la versión definitiva del inventario en una muestra de 191 profesores. La versión mostró valores satisfactorios de confiabilidad, con un Alfa de Cronbach de 0,886 y un Omega de McDonald de 0,882. En el análisis factorial confirmatorio (AFC), los ítems presentaron cargas factoriales aceptables. Por lo tanto, la versión brasileña de la escala ICI para profesores constituye una herramienta relevante y confiable para analizar la creatividad, la imaginación y la innovación en el entorno escolar.*

PALABRAS CLAVE*: Adaptación Cultural. Creatividad. Imaginación. Innovación. Profesores.*

Introduction

The world is constantly changing. It can be seen in many areas, including education. Technological, scientific, and industrial development presents environmental, health, and social disorganization problems, among others, which require creativity in the search for solutions (Oliveira, 2010).

As population growth, disease, conflict, pollution, and hunger intensify, both locally and globally, it is clear that creative solutions are urgently needed to tackle these and other challenges (Renzulli, 2014).

The job market demands people who know how to innovate and act quickly, creatively, and competently, going beyond the competition. It's important that the school sees creativity as a means of delighting students and stimulating and developing the creative potential that exists in everyone. The great challenge to be overcome is to banish from school the barriers that prevent creative expression. In this way, it will be possible to see creativity as a means of engaging students, making lessons more enjoyable, and stimulating the development of creative potential through the proposed activities. We need to optimize the search for every form of creative expression, making it an element that trains innovative citizens for this complex and ever-changing world.

Creativity is a research topic that has developed significantly in recent decades. It has always been of interest, especially to psychologists, but nowadays, it has received attention from various areas of knowledge (Nakano, 2009). The first efforts in creativity research show that this area has unlimited potential for development, especially as the current context reaffirms the need to prepare people to overcome challenges.

In addition, one of the aims of the school is to prepare these young people to "[...] take on future responsibilities and enable people to understand the world around them and their talents so that they can become full, active, and caring citizens" (Robinson; Aronica, 2019, our translation). It is important to emphasize that the mere reproduction of knowledge and content no longer meets society's demands. It is necessary to develop individuals who know how to solve problems and think differently, so that they can innovate in the face of the possibilities presented to them.

For this reason, there is a need to develop creativity, which still doesn't have a well-defined concept and carries myths in its definition, but is fundamental today. It must be emphasized that it is not only related to the artistic aspect or to performance in the areas in which it is traditionally known. According to Alencar and Fleith (2003, p. 1, our translation), "[...] creative production cannot be attributed exclusively to a set of skills and personality traits of the creator", as it was defined in the past, but can also be determined by the influence of elements of the environment in which this individual is inserted, causing transformations. Therefore, creativity not only changes the world but can also be a differentiator for success in an individual's social, professional, and academic life(Nakano; Fusaro; Batagin, 2020, our translation).

According to Torrance (1976, p. 240, our translation), "[...] we must recognize that the future of our civilization and our very survival depends on the creative quality of the next generation." Maybe that's the generation we're living in. So, instead of trying to fill children's minds with facts and formatted content, it would be interesting to assess what kind of children and young people we are training and how they can make a difference, contributing productively to our society.

In this sense, Nóvoa (2022) points out that our school model still follows the patterns of the last 150 years. This model has served education well in the last century, but today, we need to change the way we teach and see the future that lies ahead of us. He says that chalk, blackboards, notebooks, mimeographs, and overhead projectors were elements that met the needs of the time, but that, given the current reality, we wonder if they are adequate for the moment in which the school is inserted.

Given this scenario, there is no doubt that the role of the teacher is decisive in promoting or repressing the development of creativity in the school context. In addition, since teachers are an essential instrument in influencing creativity in the classroom, various studies have been carried out with the aim of developing skills in these professionals that enable and favor the establishment of a creative environment in their teaching practices. However, such opportunities will only be possible if the teacher is aware of their importance in this process, so that they are prepared to offer and allow conditions that enable the development of creativity in the classroom, avoiding the model perpetuated in most schools, which emphasizes memorization, conformism and passivity (Nakano, 2009).

It is, therefore, essential to make lessons more interesting. After all, seeing the student as the protagonist of learning and preparing them for the professions of the future, many of which haven't even been created yet, are challenges present in everyday school life. It is up to the teacher, as well as the whole team, to create the conditions for learning to take place (Nóvoa, 2022). In this way, the student will be better prepared for future challenges. Thus, the manifestations of creative thinking at each educational level will be fundamental for society to have the greatest possible diversity of talents and, consequently, find solutions to the problems that arise.

Therefore, defining the concept of creativity, taking into account the main theorists who have written on the subject, is fundamental so that, based on these concepts, the myths related to creativity are minimized, and it is possible to reaffirm that this is a necessary competence that can be developed in students. In addition, cultural adaptation is relevant because it will contribute to the creation of a scale that can be used to assess whether the strategies adopted by the teacher stimulate creative thinking and thus favor innovation and imagination.

Therefore, the general objective of this research was to carry out the cultural adaptation of the ICI. In Brazil, there is still little research on creativity that proposes specific tools for assessing it. This highlights the need for in-depth studies in this area, considering its importance for personal and professional development. In addition, it is crucial to recognize the fundamental role of the teacher in this process, as well as to ensure the validation and cultural adaptation of these tools to the Portuguese language in the Brazilian context.

Method

The process of cultural adaptation of this instrument was divided into two stages. The first, carried out with students, focused on validation and adaptation, contributing to the implementation and practice of activities that enable the development of creativity (Santos *et al.*, 2024). The second stage involved basic education teachers, validating the scale for teachers and helping to analyze the profile of creative teachers and their teaching practices.

The ICI scale is made up of 18 questions, 15 of which are closed and 3 open, in which the participant could interrupt the process at any time if they felt tired or uncomfortable and even choose not to continue taking part in the research. The risks of this research can be

considered to be minimal, as it does not involve public exposure of the subjects, but only the completion of the questionnaire, with the guarantee that they could stop participating at any time if they felt uncomfortable with any question. Participants were invited, and those who accepted the invitation took an average of 10 minutes to complete the questionnaire. The benefits of the research are direct and indirect for the subjects involved. The direct benefits include not only a reflection on the importance of working on imagination, creativity, and innovation, but also the personal development of the participants. The indirect benefits refer to the contribution to researchers by providing an instrument for assessing creativity in Brazil, filling a gap in the educational sector, and facilitating research on this very relevant subject.

Characterization of the participants

The ICI was applied *online,* using *Google Forms*, with basic education teachers from an educational network in Brazil. A total of 191 teachers answered the questions on the questionnaire, 153 of whom were female and 38 male, with degrees in various areas. Table 1 below shows the characterization of the participants in the final test.

Table 1 - Training of participants

Formation	**Quantity**
Pedagogy	105
Degree	75
Bachelor	08
Fine Arts	01
Chemical Engineering	01
Psychopedagogy	01
Total	**191**

Source: prepared by the authors.

Instrument

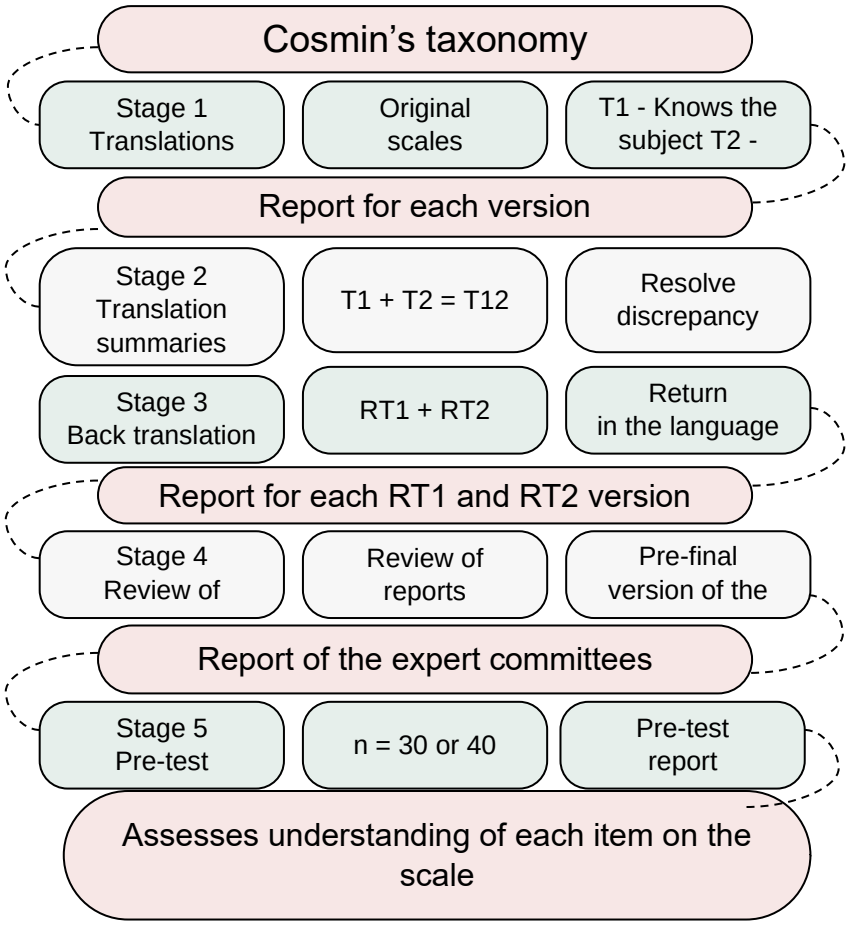
The ICI Scale was developed by researchers Joseph Renzulli, Ronald Beghetto, and Laurel Brandon, from the University of Connecticut in the United States, and Maciej Karwowski from the University of Wroclaw, in Poland, with the aim of measuring the opportunities for teachers to work with imagination, creativity and innovation(Renzulli *et al.*,

2022). The ICI has two parts: one for students and one for teachers. The part aimed at students consists of 17 questions, 15 of which are closed and two are discursive, and was validated in Brazil by Santos *et al*. (2024). The validation of the teachers' part, which is presented in this paper, is made up of 18 questions, 15 of which are closed and 3 open. The purpose of this study is to adapt and culturally validate the ICI Scale from its original language into Brazilian Portuguese, with a view to using it with Brazilian teachers.

Methodological procedures

The methodology chosen for this cultural adaptation was Cosmin's Taxonomy (Mokkink *et al*., 2012), shown in Figure 1, because its process of analyzing and measuring information brings reliability to the procedure of obtaining, analyzing, and interpreting the results in its application, and it was used throughout the study process.

Figure 1 - Stages of cultural adaptation according to Cosmin's Taxonomy



Source: adapted by the author.

Stage 1 - Translation of the instrument into Portuguese

Initially, two native Portuguese-speaking bilingual translators with fluency in English were chosen. Following the procedures that govern the quality and reliability aspects for the validity of this research, according to Cosmin's Taxonomy (Mokkink *et al.*, 2012), the two translators received the original instrument for translation from English into the native Portuguese language, being considered at this point as instruments T1 and T2, or translation 1 and translation 2.

Stage 2 - Synthesis of translations T1 and T2 = T12

In order to develop T12, which is the synthesis of the T1 and T2 translations, the differences between the two documents were observed, which led to the creation of T12, compiling the partial information produced by the two translators. After summarizing the

translations, the first version of the Equivalence Assessment document was developed and sent to the committee of experts. This review of the adapted instrument was completed by a bilingual teacher who was familiar with the cultural adaptation process.

Stage 3 - Back translation

For the back-translation, document T12, created from the first translations T1 and T2, was sent to two native English-speaking translators living in Brazil who are fluent in Portuguese. The aim of back-translating these instruments, now in Portuguese, was to translate the scale back into the original language, thus creating the RT1 and RT2 versions. Once this was done, the RT12 version was drawn up and then sent to the equivalence assessment committee for the instrument to be translated from the original version into Portuguese.

Stage 4 - Reviewing the judges

With the creation of RT12 based on the activities carried out previously, the Equivalence Assessment document was developed and sent to the expert committee made up of a linguist, the two initial translators, professors, and doctors with experience in linguistics and cultural adaptation. This committee was created based on the needs visualized in the context of the reliability of the information for the research, so as soon as the Equivalence Assessment document was prepared, it was sent by e-mail to each of the 8 experts so that they could contribute their considerations. This committee analyzed all the questions, described points of discrepancy in the adaptation of the translation, and individually suggested their opinions on the questions applied in the instrument, improving the questionnaire based on the three evaluation criteria, namely Semantics and Idiomatics, Conceptualization, and Culture. Everyone participated dynamically, offering various suggestions so that the instrument would be suitable for later application. The suggestions proposed by the experts are shown in Chart 1, with the suggested changes to the writing in the ICI instrument, which also formed part of the pre-test questionnaire given to the students.

Stage 5 - Pre-testing the instrument

Following the recommendations for using Cosmin's Taxonomy (Mokkink *et al*., 2012), after the experts had validated the document, the pre-test was applied to a sample of 30

individuals, considering that the purpose was to check the teacher's understanding of the adapted inventory. In this case, basic education teachers from an educational network in the Federal District took part in the research.

In order to carry out the pre-test, the teachers were given a printed ICF to verify their participation in the study. After checking the signed terms, the instrument was handed over, and the researcher explained its objectives and clarified any doubts. The pre-test was not administered to all the teachers at the same time but in small groups of no more than four teachers so that the researcher could take note of any observations and suggestions that arose.

Throughout the application process, the researcher was available to answer any questions and provide clarifications that the teachers needed when filling in the questionnaire. At the end of the process and after receiving the completed questionnaires, with or without suggestions from the participants, the data underwent the first qualitative analysis of the inventory in the translation phase, using the *software* JASP®, version 17.1, for reliability analysis using MacDonald's omega test. The instrument was then sent back to the experts to check the teachers' suggestions and draw up the final version.

Stage 6 - Final application of the instrument

Once the committee's experts had confirmed the instrument, the final stage began with the choice of participants for the final phase. For this stage, at least 190 teachers of both genders had to take part. Therefore, at this stage of the process, basic education teachers from a private school network with units in several Brazilian states were chosen, and 191 teachers took part. The instrument was applied *online,* using a questionnaire on *Google Forms*. After receiving the data from the questions answered by the teachers, a confirmatory factor analysis was carried out to check whether the model fit the Brazilian version.

Data analysis methodology

The data was analyzed qualitatively in the translation phase by the expert committee and in the pre-test. After being applied to the final sample, the data was subjected to statistical analysis using *the software* JASP®, version 17.1, with reliability analysis using MacDonald's omega test and Confirmatory Factor Analysis.

Results

This section presents the results obtained during the research, organized into three main parts. Firstly, the analyses carried out by the expert committee are presented, followed by the results obtained in the pre-test of the instrument. Finally, the results of the final application of the ICI instrument are detailed. Each stage was carefully analyzed to ensure the accuracy and relevance of the data presented, making a significant contribution to the objectives of this study.

Analysis by the Committee of Experts on the T12 version

Below are the suggestions for changes proposed by the committee of experts, according to their analysis of the instrument.

Chart 1 - Equivalence assessment: questions that have changed as suggested by the Committee of Experts[5]

Version T12	**Suggested changes**
Cabeçalho: Os itens a seguir descrevem diferentes maneiras pelas quais uma escola pode apoiar a imaginação, a criatividade e a inovação em seus alunos. *Para cada item, avalie o que você considera ser o grau ideal de ênfase, bem como o que você prevê que os alunos irão relatar como o grau de ênfase que a escola coloca em cada um.*	*Cabeçalho: Os itens a seguir descrevem diferentes maneiras como a escola pode apoiar a imaginação, a criatividade e a inovação de seus alunos.* *Para cada item, avalie o que você considera ser o grau ideal de destaque, bem como o que você pode prever que os alunos irão relatar como o grau de destaque que a escola coloca em cada um.*
Para cada item, a seguinte escala é fornecida: Nunca, Raramente, Às vezes, Na maioria das vezes, Quase Sempre.	*Para cada item, utilize a seguinte escala: Nunca, Raramente, Às vezes, Na maioria das vezes, Quase sempre.*
1) Incentiva os alunos a visualizar tópicos de várias perspectivas.	*Você incentiva os alunos a visualizar tópicos de várias perspectivas.*
2) Incentiva os alunos a apresentarem suas próprias ideias.	*Você Incentiva os alunos a terem as suas próprias ideias.*
3) Incentiva os alunos a considerar novas possibilidades.	*Você incentiva os alunos a considerar novas possibilidades.*
4) Incentiva os alunos a desenvolver suas próprias perspectivas.	*Você incentiva os alunos a desenvolver suas próprias ideias.*
5) Incentiva os alunos a usarem sua imaginação.	*Você incentiva os alunos a usar sua imaginação.*
6) Fornece tempo para os alunos desenvolverem suas ideias.	*Você fornece tempo para os alunos desenvolverem suas ideias.*
7) Fornece suporte para os alunos desenvolverem suas ideias em produtos (ou performances).	*Você fornece apoio para os alunos transformarem suas ideias em produtos (ou performances).*
8) Oferece oportunidades para os alunos receberem feedback sobre suas ideias.	*Você oferece oportunidades para os alunos receberem feedback sobre suas ideias.*
9) Oferece oportunidades para os alunos desenvolverem sua criatividade.	*Você proporciona momentos para os alunos desenvolverem sua criatividade.*
10) Proporciona oportunidades de expressão criativa.	*Você proporciona momentos para que o estudante expresse a criatividade.*
11) Espera que os alunos enviem seu trabalho para crítica externa.	*Você espera que os alunos submetam seus trabalhos para avaliação externa.*
12) Espera que os alunos exibam publicamente seu trabalho.	*Você espera que os alunos exibam publicamente seu trabalho.*
13) Espera que os alunos submetam seu trabalho a competições.	*Você espera que os alunos submetam seus trabalhos a competições.*
14) Espera que os alunos causem impacto com seu trabalho.	*Você espera que os alunos causem impacto com seus trabalhos.*
15) Espera que os alunos sejam inovadores (ou seja, contribuam com seu trabalho).	*Você espera que os alunos sejam inovadores (que seu trabalho gere uma contribuição).*
16) No quadrado abaixo, descreva um produto, desempenho ou serviço concluído pelos alunos da sua escola que seja motivo de orgulho. Você pode descrever mais de um produto.	*No quadrado abaixo, apresente um produto, desempenho ou serviço concluído pelos alunos da sua escola que seja motivo de orgulho. Você pode apresentar mais de um produto.*
17) No quadrado abaixo, descreva as formas de apoio que sua escola oferece para os alunos desenvolverem produtos, realizarem ações ou prestarem serviços a terceiros.	*No quadrado abaixo, apresente as formas de apoio que sua escola oferece para os alunos desenvolverem produtos, performances ou serviços a outros.*

[5] The chart hasn't been translated into English because the study talks about translations that have been made into Portuguese. We have, therefore, decided to keep it in Portuguese so that it does justice to the purpose of the text.

18) Insira quaisquer pensamentos ou comentários adicionais aqui.	*Você pode inserir quaisquer pensamentos ou comentários adicionais aqui.*

Source: prepared by the authors.

In all the questions that included the word "student," the experts suggested replacing it with "students" so that the articles "the" and "a" wouldn't have to be used in the questions. The words were therefore replaced, and Table 2 follows, with the final questionnaire for the pre-test.

Pre-test results

The pre-test was administered over a period of three days, taking into account the availability of respondents during class breaks. The teachers were invited to take part in the research, and when they accepted, they were directed to the teachers' room, reserved specifically for these moments. The researcher handed over the printed instrument, gave a brief explanation of the objectives of the research and the pre-test, and remained available for any questions or notes. Thirty teachers took part in this sample, four of whom were male and 26 female. After the explanation given by the researcher, they were able to read and sign the informed consent forms and again received a brief orientation from the researcher on the importance of the instrument for the educational process. The teachers then began the questionnaire, which was usually carried out in small groups of 4 teachers, with the possibility of not taking part in the survey at any time if they felt uncomfortable with the questions. Throughout the process of reading and answering the instrument, we had some questions about how to understand the questions, and these were noted down. After being analyzed, some changes were made.

Chart 2 shows the suggested changes after the pre-test was administered to all the participants.

Chart 2 - Questions with suggested changes

4. You encourage students to develop their own ideas. Putting it into practice...
7. You provide support for students to turn their ideas into products (or performances). Plays, artifacts, *software*.
11. You expect students to submit their work for external evaluation. From other people.

Source: prepared by the authors.

After the teachers had participated, the data from the pre-test form was extracted into an Excel spreadsheet for qualitative analysis and verification of the statistical reliability of Cronbach's alpha and McDonald's omega values using the *software* JASP®, version 17.1. The information obtained is shown in Table 2 below.

Table 2 - McDonald's Omega values and Cronbach's Alpha obtained in the pre-test

Estimated	McDonald's ω	Cronbach's α
Average	0.831	0.851
95% CI lower limit	0.744	0.769
95% CI upper limit	0.905	0.923

Source: JASP, version 17.1. Prepared by the authors

The figures presented by Cronbach's Alpha analysis show that the values obtained from the data generated by the inventory applied in the pre-test are reliable. This is because, according to the objective of this coefficient, the reliability of the data should reach values close to 1, with a variance scale of 0 to 1, with accepted values above 0.70 for the reliability of the data. In this study, estimated statistical information above the required value for Cronbach's Alpha and McDonald's Omega is presented, considering a sample of 30 teachers in a pre-test.

Data analysis procedures

The adjusted version was applied to 191 individuals, and the answers were entered into *the software* JASP®, version 17.1, resulting in the reliability analysis, as shown in Table 3. Reliability was assessed by analyzing internal consistency using McDonald's ω coefficient. More recent studies indicate that this index is more sensitive than Cronbach's α coefficient in assessing the accuracy of the results between the (Şimşek; Noyan, 2013; Zinbarg *et al.*, 2006) factors. Values close to 1 indicate good internal consistency of the instrument (Gadermann *et al.*, 2012). The tolerance criteria of Nunnally and Bernstein (1994) were adopted for α coefficients ≥ 0.70, and those of Raykov and Hancock (2005) for McDonald ω coefficients ≥ 0.80.

Table 3 - Reliability

Estimated	McDonald's ω	Cronbach's α
Posterior Average	0.882	0.886
95% CI lower limit	0.857	0.861
95% CI upper limit	0.905	0.908

Source: JASP, version 17.1.

Confirmatory factor analysis

After assessing the reliability of the instrument, a confirmatory factor analysis was carried out in order to assess the plausibility of a three-dimensional structure for the ICI scale (Renzulli *et al*., 2022). The analysis was implemented using the *Robust Maximum Likelihood* (RML) estimation method, which is suitable for categorical data (DiStefano; Morgan, 2014; Li, 2016).

The fit indices used were: c2; c2/gl; *Comparative Fit Index* (CFI); *Tucker-Lewis Index* (TLI); *Standardized Root Mean Residual* (SRMR), and *Root Mean Square Error of Approximation* (RMSEA). Values of c2 should not be significant; the c2/gl ratio should be $\underline{<}$ 5 or preferably $\leq$ 3; CFI and TLI values should be $\geq$ 0.90 and preferably above 0.95; RMSEA values should be $\leq$ 0.08 or preferably $\leq$ 0.06, with a confidence interval (upper limit) $\leq$ 0.10 (Brown, 2015).

The three-dimensional structure showed very good fitting results. As can be seen in Table 4, the chi-squared values were not significant, and the chi-squared ratio per degree of freedom was adequate (2.36). The CFI, TLI, and SRMR indices supported the model. The RMSEA indices were also acceptable (Table 5).

Table 4 - Chi-squared values

Model	X^2	df	p
Reference model	1415.697	105	
Factor model	206.010	87	<.001

Source: JASP, version 17.1.
Note: df = degrees of freedom.

Table 5 - Fit indices of the three-dimensional ICI model

	χ2 (gl)	χ2/gl	CFI	TLI	SRMR	RMSEA (90% CI)
Original	186,639	2.17	0.923	0.906	0.073	0.078 (0.063 - 0.094)

Source: JASP, version 17.1.
Note: c^2 = chi-square; gl = degrees of freedom; CFI = *Comparative Fit Index*; TLI = *Tucker-Lewis Index*; SRMR = *Standardized Root Mean Square Residual*; RMSEA = *Root Mean Square Error of Approximation*; p < 0.001.

The factor loadings ranged from 0.35 to 0.83, and 5 items were below 0.50, but very close. The 15 items in the Brazilian version of the ICI were therefore maintained (Table 6).

Table 6 - Factor loadings for each item

Factor	Indicator	Symbol	Estimated	Error standard	z-value	p	95% CI		dp
							Lower	Upper	
Creativity	Do you encourage students to view topics from various perspectives?	λ11	0.522	0.056	9.324	<.001	0.412	0.632	0.654
	Do you encourage students to come up with their own ideas?	λ12	0.468	0.047	9.993	<.001	0.376	0.559	0.737
	Do you encourage students to consider new possibilities?	λ13	0.460	0.046	10.084	<.001	0.371	0.549	0.712
	Do you encourage students to develop their own ideas and put them into practice?	λ14	0.521	0.037	14.051	<.001	0.448	0.593	0.745
	Do you encourage students to use their imagination?	λ15	0.498	0.053	9.478	<.001	0.395	0.601	0.738
Imagination	Do you give students time to develop their ideas?	λ21	0.649	0.058	11.117	<.001	0.535	0.764	0.776
	Do you provide support for students to turn their ideas into products or performances? (e.g. plays, artifacts, *software*, etc.)	λ22	0.675	0.060	11.298	<.001	0.558	0.792	0.653
	Do you provide moments for students to receive *feedback* on their ideas?	λ23	0.723	0.058	12.522	<.001	0.610	0.836	0.785
	Do you provide moments for students to develop their creativity?	λ24	0.647	0.061	10.553	<.001	0.527	0.767	0.757
	Do you provide moments for students to express their creativity?	λ25	0.679	0.043	15.685	<.001	0.594	0.764	0.834
Innovation	Do you expect students to submit their work for external evaluation by other people?	λ31	0.818	0.074	11.010	<.001	0.672	0.963	0.744
	Do you expect students to exhibit their work publicly?	λ32	0.737	0.072	10.229	<.001	0.596	0.878	0.766
	Do you expect students to submit their work to competitions?	λ33	0.703	0.089	7.888	<.001	0.528	0.877	0.583
	Do you expect students to make an impact with their work?	λ34	0.457	0.062	7.379	<.001	0.336	0.579	0.537
	Do you expect students to be innovative (that their work makes a contribution)?	λ35	0.354	0.067	5.286	<.001	0.223	0.486	0.487

Source: JASP, version 17.1.

In the Brazilian version of the ICI, each factor had 5 items, as in the original instrument, totaling 15 items and 3 factors, namely Factor 1 = Creativity, Factor 2 = Imagination, and Factor 3 = Innovation.

Discussion

After analyzing the research on creativity, innovation, and imagination, the relevance of this topic to society became clear. However, this task is not without its challenges and obstacles. Fostering creativity in the school environment requires a continuous and well-planned effort, which implies that the institution and its members develop a series of skills and knowledge that are not always easily accessible. It is essential to investigate creativity in-depth, understand how it works, and learn how to implement creative teaching, as well as consider the various nuances that surround this process (Neves-Pereira; Alencar, 2018).

Following the information from the Cosmin Taxonomy (Mokkink *et al*., 2012), the ICI Inventory was translated, summarized, and back-translated, as well as analyzed by the expert committee and pre-tested in the pre-final version. The expert committee meeting was attended by two translators, three linguists, and three professors. The analysis of semantic, linguistic, cultural, and conceptual equivalence conducted by the committee was carried out effectively, with all members evaluating and debating each item, as well as suggesting possible changes for a better understanding of the Portuguese language.

The expert committee's analysis of the T1 and T2 translations, aimed at confirming the T12 version of the inventory, resulted in a request to change the word "pupil" to "student" in all the questions in which the term appeared. It was also suggested that the word "you" be added before some sentences to make it clearer to the reader that the question was directed at the teacher and not the educational institution. Some other changes were made by consensus among the committee's judges in order to make the instrument easier to understand and in line with the initial translations. These changes made the inventory questions consistent, ensuring that the adaptation was easy for respondents to understand and that it represented a reliable translation of the original instrument.

After the pre-test, with 30 participants, there were changes to questions 4, 7, and 11, as shown in Chart 2. The suggested changes were made after the legal experts had analyzed them, and the final questionnaire was prepared for application. The inventory was applied to 191 teachers, and the CFA and reliability tests showed that the Brazilian version of the ICI has good evidence of validity.

Final considerations

This research aimed to culturally adapt and validate the ICI scale for use in the Brazilian Portuguese-speaking context, with a focus on basic education teachers. By confirming the adaptation of the ICI scale and its application in educational institutions, it was possible to obtain more accurate data on teachers' perceptions of the themes of imagination, creativity and innovation in the school environment, as well as contributing to their teaching practice.

It is important to note that the data generated by the ICI scale provides a solid basis for teachers and, when used appropriately, can bring benefits to both educational institutions and society as a whole, helping to ensure that the activities carried out at school promote creative and innovative thinking.

REFERENCES

ALENCAR, Eunice M. L. Soriano de; FLEITH, Denise de Souza. Contribuições teóricas recentes ao estudo da criatividade. **Psicologia: Teoria e Pesquisa**, Brasília, v. 19, n. 1, 2003. DOI: 10.1590/S0102-37722003000100002. Available at: https://www.scielo.br/j/ptp/a/Bw5kHpvyCYwFPsfxM7n5FMp. Accessed in: 19 Jan. 2024.

BROWN, Timothy A. **Confirmatory factor analysis for applied research**. New York: The Guilford Press, 2015. (Methodology in the social sciences.). v. 2.

DISTEFANO, Christine; MORGAN, Grant B. A Comparison of Diagonal Weighted Least Squares Robust Estimation Techniques for Ordinal Data. **Structural Equation Modeling**, [*s. l.*], v. 21, n. 3, p. 425-438, 2014.

GADERMANN, Anne M. *et al*. Comorbidity and disease burden in the national comorbidity survey replication (NCS-R). **Depression and Anxiety**, [*s. l.*], v. 29, n. 9, p. 797-806, 2012. DOI: 10.1002/da.21924. Available at: https://pubmed.ncbi.nlm.nih.gov/22585578/. Accessed in: 19 Jun 2024.

LI, Cheng Hsien. Confirmatory factor analysis with ordinal data: Comparing robust maximum likelihood and diagonally weighted least squares. **Behavior Research Methods**, [*s. l.*], v. 48, n. 3, p. 936–949, 2016. Available at: https://link.springer.com/article/10.3758/s13428-015-0619-7. Accessed in: 19 Dec. 2024.

MOKKINK, Lidwine B *et al.* **COSMIN checklist manual**. Amsterdam: Cosmin, 2012.

NAKANO, Tatiana de Cássia. Investigando a criatividade junto a professores: pesquisas brasileiras. **Revista Semestral da Associação Brasileira de Psicologia Escolar e Educacional**, São Paulo, v. 13, n. 1, p. 45-53, 2009. DOI: 10.1590/S1413-85572009000100006. Available at: https://www.scielo.br/j/pee/a/VbHTJbzJgMV7LHzF6Hy45Bn. Accessed in: 19 Dec. 2024.

NAKANO, Tatiana Cassia; FUSARO, Luana Hillary; BATAGIN, Laís Rovina. Criatividade: percurso das pesquisas na temática. **Iberoamerican Journal of Creativity and Innovation**, Campinas, v. 1, n. 2, p. 89-106, 2020. Available at: https://recriai.emnuvens.com.br/revista/article/view/39. Accessed in: 7 Aug. 2024.

NEVES-PEREIRA, Mônica Souza; ALENCAR, Eunice Maria Lima Soriano. A educação no século XXI e o seu papel na promoção da criatividade. [*s. l.*], v. 1, n. 1, 2018.

NÓVOA, A. **Escolas e professores proteger, transformar, valorizar**. Salvador: SEC/IAT, 2022.

NUNNALLY, J.; BERNSTEIN, I. **Psychometric theory**. New York: McGraw-Hill, 1994.

OLIVEIRA, Zélia Maria Freire de. Fatores influentes no desenvolvimento do potencial criativo. **Estudos de Psicologia**, Campinas, v. 27, n. 1, 2010. DOI: 10.1590/S0103-

166X2010000100010. Available at: https://www.scielo.br/j/estpsi/a/YhfMj9CLJcmFZPg7qL9Cnky. Accessed in: 19 Oct. 2023.

RAYKOV, Tenko; HANCOCK, Gregory R. Examining change in maximal reliability for multiple-component measuring instruments. **British Journal of Mathematical and Statistical Psychology**, [*s. l.*], v. 58, n. 1, p. 65-82, 2005. DOI: 10.1348/000711005X38753. Available at: https://pubmed.ncbi.nlm.nih.gov/15969840. Accessed in: 19 Oct. 2023

RENZULLI, Joseph *et al.* Development of an instrument to measure opportunities for imagination, creativity, and innovation (ICI) in schools. **Gifted Education International**, [*s. l.*], v. 38, n. 2, p. 174–193, 2022.

RENZULLI, Joseph. Modelo de enriquecimento para toda a escola: um plano abrangente para o desenvolvimento de talentos e superdotação. **Revista Educação Especial**, Santa Maria, v. 27, n. 50, p. 539–562, 2014. DOI: 10.5902/1984686X14676. Available at: https://periodicos.ufsm.br/educacaoespecial/article/view/14676. Accessed in: 13 Mar. 2025.

ROBINSON, Ken; ARONICA, Lou. **Escolas criativas**: a revolução que está transformando a educação. Porto Alegre: Penso, 2019.

SANTOS, Marcel Oliveira dos *et al.* Adaptação cultural e evidências de validade da escala Imagination, Criativity and Innovation (ICI) para uso na língua portuguesa do Brasil. **Revista @mbienteeducação**, São Paulo, v. 17, n. 00, p. e023034, 2024. DOI: 10.26843/ae.v17i00.1386. Available at: https://publicacoes.unicid.edu.br/ambienteeducacao/article/view/1386. Accessed in: 13 Mar. 2024.

ŞIMŞEK, Gülhayat Gölbaşi; NOYAN, Fatma. McDonald's ω t, Cronbach's α, and Generalized θ for Composite Reliability of Common Factors Structures . **Communications in Statistics - Simulation and Computation**, [*s. l.*], v. 42, n. 9, p. 2008-2025, 2013.

TORRANCE, Ellis Paul. **Criatividade**: medidas, testes e avaliações. São Paulo: IBRASA, 1976.

ZINBARG, Richard E. *et al.* Estimating generalizability to a latent variable common to all of a scale's indicators: A comparison of estimators for ω h. **Applied Psychological Measurement**, [*s. l.*], v. 30, n. 2, p. 121–144, 2006.

CRediT Author Statement

- **Acknowledgements**: We would like to thank Associação Planalto Central, União Centro Oeste Brasileira, and UNASP for their support for this research.
- **Funding**: Planalto Central Association and Central West Brazilian Union.

- **Conflicts of interest**: There are no conflicts of interest.
- **Ethical approval**: The work was approved by UNASP's ethics committee. Opinion number: 5.265.025, CAAE: 55831922.9.0000.5377.
- **Data and material availability**: The data and materials used in the work are available for access.
- **Authors' contributions**: Alzira Luciana: He wrote the theoretical part, and collected and analyzed the data. Helena Viana: He wrote the theoretical part, carried out the statistical analysis, edited the article, and made the final corrections. Alceli Ribeiro: He made contributions to the theoretical body of the article and suggested the presentation of the data. Dayse Neri de Souza: He contributed to the methodological part and the final correction of the work.

Processing and editing: Editora Ibero-Americana de Educação
Proofreading, formatting, standardization and translation