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Research Article

Creative Self-Regulation Scale: Adaptation, Validity, and Reliability Study

Yaratıcı Öz-Düzenleme Ölçeği: Uyarlama, Geçerlik ve Güvenirlik Çalışması

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Abstract

Purpose: *The aim of this study is to adapt the Creative Self-Regulation Scale, developed to determine students' self-regulation skills in creative projects, to Turkish culture.* ***Method:*** *Following the translation process suggested by Hambleton et al. (2005), initial translation, back-translation, and final checks were performed. Foreign language, science, and measurement-evaluation experts evaluated the scale according to the adaptation stages, and the scale was finalized. A survey design of quantitative research was used in the study. The translated scale was administered to 167 high school students.* ***Findings:*** *Exploratory factor analysis yielded a three-factor structure consisting of 25 items explaining 45.34% of the variance, and this structure was confirmed by confirmatory factor analysis. After validity checks, Cronbach's alpha and composite reliability coefficients were calculated to check the reliability of the scale, and it was determined that the reliability coefficients were greater than 0.70 for both the overall scale and the sub-factors.* ***Conclusion:*** *In conclusion, this study adapted a theoretically based measurement tool encompassing the dimensions of creative self-regulation into Turkish, and the validity and reliability of the adapted scale were checked. This measurement tool can be used, particularly by researchers, lecturers, and teachers, to determine students' levels of creative self-regulation.*

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Anahtar Kelimeler

Yaratıcı öz-düzenleme
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Öz

Amaç: *Bu çalışmanın amacı, öğrencilerin yaratıcı projelerde öz-düzenleme becerilerini belirlemek için geliştirilen yaratıcı öz-düzenleme isimli ölçeğin Türk kültürüne uyarlamasını yapmaktır.* ***Yöntem:*** *Hambleton ve arkadaşlarının (2005) önerdiği çeviri süreci dikkate alınarak ilk çeviri, geri çeviri ve son kontroller yapılmıştır. Yabancı dil, fen ve ölçme-değerlendirme uzmanları uyarlama aşamalarına göre ölçeği değerlendirmiş ve ölçeğe son şekli verilmiştir. Çalışmada nicel desenlerden biri olan tarama deseni kullanılmıştır. Çevirisi tamamlanan ölçek, 167 lise öğrencisine uygulanmıştır.* ***Bulgular:*** *Açımlayıcı faktör analizi sonucu varyansın %45,34'ünü açıklayan 25 maddeden oluşan üç faktörlü bir yapı elde edilmiş ve bu yapı doğrulayıcı faktör analizi ile doğrulanmıştır. Geçerlik kontrollerinden sonra ölçeğin güvenirliğini kontrol etmek için Cronbach alfa ve bileşik güvenirlik katsayıları hesaplanmış ve hem ölçek geneli hem de alt faktörler için güvenirlik katsayılarının 0,70'ten büyük olduğu belirlenmiştir.* ***Sonuç:*** *Sonuç olarak, bu çalışmada yaratıcı öz-düzenlemenin boyutlarını kapsayan, teorik temellere dayanan bir ölçme aracı Türkçeye uyarlanmış ve uyarlanan ölçeğin geçerlik ve güvenirlik kontrolleri yapılmıştır. Bu ölçme aracı özellikle araştırmacılar, öğretim görevlileri ve öğretmenler tarafından öğrencilerin yaratıcı öz-düzenleme düzeylerini belirlemek için kullanılabilir.*

Introduction

Scientific creativity has been a central focus for researchers for many years. These studies have offered comprehensive answers to questions about the definition of creativity (Moravcsik, 1981), its dimensions (Guilford, 1975; Hu & Adey, 2002; Osborn, 1953), the traits of creative individuals (Helson, 1996; McMullan, 1976), variables associated with creativity (Aflaki Fard & Akbari, 2019; Anderson & Haney, 2021; Puente-Diaz & Cavazos-Arroyo, 2020; Zielińska et al., 2022b), and recommendations for fostering creativity (Aktamış, 2007; Erdoğan et al., 2009; Walsh et al., 2013). Research findings indicate that even when people claim to have a creative idea, relatively few actually turn it into a product or action. Zielińska et al. (2022a) reported significant differences between having a creative idea and producing a creative product during the planning, process management, and evaluation stages. Recent evidence further suggests that creative action is dynamically shaped by creative confidence and self-regulation in students' everyday learning contexts (Zielińska & Karwowski, 2025).

While creativity is often discussed in everyday contexts, scientific creativity is increasingly recognized in science education as a specific form of creativity linked to the scientific field. Scientific innovation requires not just originality and usefulness but also validated interest and empirical skills; ideas must be testable, thoroughly examined, and properly evaluated. Consequently, scientific creativity closely relates to core scientific practices such as planning and documenting research, analyzing and interpreting data (including errors and reports), and replicating and expanding evidence-based findings (Ayas & Sak, 2014; Xu et al., 2025). This underscores the importance of self-regulation in

scientific creativity. Students should be able to set objectives, plan inquiry steps, follow methods, use evidence, manage effort based on outcomes, and revise findings if initial expectations are not met (Panadero, 2017; Zimmerman, 2000). From this perspective, self-regulation is not just a support mechanism but a central process that sustains creativity, leading to updated explanations, solutions, or products.

Given the complex nature of scientific creativity, multiple cognitive, emotional, and behavioral factors must be involved to unlock creative potential (Karwowski & Beghetto, 2019; Lebuda & Benedek, 2025). People with innovative ideas who lack confidence in their emotional abilities often avoid taking creative actions. On the other hand, if someone's self-confidence surpasses their actual abilities, it may impede their creative output (Zielińska et al., 2022a). Therefore, emotive variables alone are insufficient to transform a creative idea into a concrete product. This highlights the importance of creative self-regulation, which includes emotional factors and the process of developing a creative concept into a finished product.

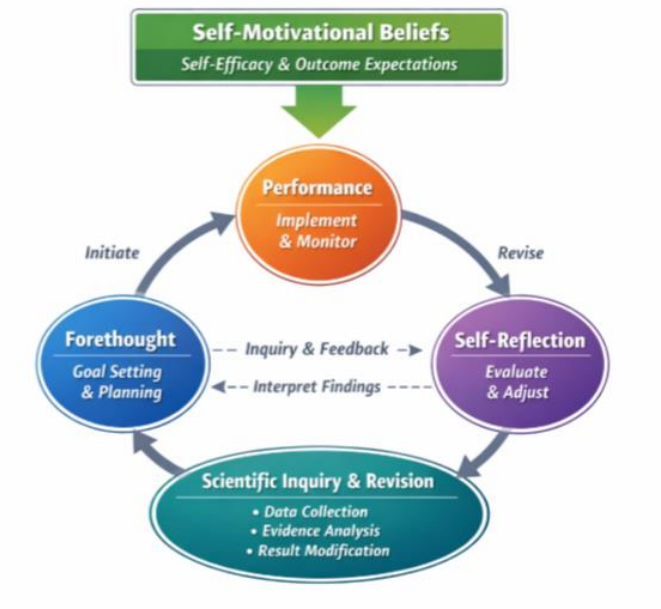
In science education, self-regulation should be understood in conjunction with inquiry and laboratory practices. Inquiry-based learning involves phases like conceptualization, investigation, conclusion, and discussion, which encompass asking questions or forming hypotheses, designing procedures, gathering and analyzing data, and reflecting on findings (Pedaste et al., 2015). These activities demand more than just generating ideas; students must combine originality with evidence-based reasoning and flexible revision. Research in virtual experiment settings indicates that students with stronger self-regulation skills tend to engage more effectively in experiments and achieve better results, highlighting how laboratory work requires careful planning, monitoring, and strategy adjustments (Verstege et al., 2019). Similarly, involvement in inquiry-based science projects correlates with both immediate and longer-term improvements in students' self-reported self-regulation, demonstrating that science-driven creativity develops through repeated cycles of planning, investigation, evaluation, and revision, rather than through idea generation alone (Moote, 2019).

Previous research has demonstrated that individuals' self-regulation skills are crucial in the creative process (Al-Kreimeen, 2014; De Stobbeleir et al., 2011; Pagano, 1979). Important concepts such as individual differences, originality, self-awareness, process-oriented evaluation behavior, and the ability to adapt to unexpected conditions and generate immediate solutions are core to self-regulation and creative thinking (Hu & Adey, 2002; Kılıç & Tezel, 2012; Starko, 2013; Torrano Montalvo & González Torres, 2004; Wolters & Pintrich, 1998). Self-regulation skills play a vital role in the creative process and can serve as a resource for fostering creativity. Likewise, individuals who generate many creative ideas tend to actively use self-regulation skills. This cyclical process promotes the development of both self-regulation skills and creativity. Selby and colleagues (2005) found that individuals with a strong creative side can turn negative situations into advantages through unique and flexible plan changes. People with high levels of self-regulation are also aware of their potential and have foresight about what actions to take, how much effort to invest, and how to execute tasks. They find ways to

achieve their goals regardless of conditions (Chung, 2006; Pintrich, 2000; Zimmerman, 2000). Research on the creative process from a self-regulated learning perspective offers strong solutions to the challenge of transforming creative ideas into tangible outcomes (Callan et al., 2021; Rubenstein et al., 2018, 2020). This approach is inspired by Zimmerman's (2000) cyclical model of self-regulated learning.

Zimmerman (2000) describes self-regulation as the learner's process of transforming their mental potential into academic skills through their own efforts. Furthermore, learners' ability to plan their feelings, thoughts, and behaviors to achieve their goals and make necessary adjustments is directly linked to self-regulation. The self-regulated learning model, rooted in social cognitive theory, highlights key dimensions of self-regulation in creative processes: forethought, performance, and self-reflection (Rubenstein et al., 2018). The cycle involving forethought, performance, and self-reflection, along with how self-motivational beliefs help initiate and maintain actions, is depicted in Figure 1.

Figure 1: *Cyclical Model of Creative Self-Regulation in Scientific Contexts*



The forethought dimension encompasses task analysis and self-motivational beliefs, which are related yet distinct. First, the individual examines the features of the assigned task. During this process, they set a goal and develop a strategic plan to achieve it. These critical decisions are influenced by their internal beliefs and sources of motivation related to task performance and monitoring (Wolters & Rosenthal, 2000). Self-motivational beliefs, essential to the forethought dimension, include affective components like self-efficacy, outcome expectations, intrinsic interest or valuation, and goal orientation. These components foster creative activity driven by personal interest and action (Agnoli et al., 2019). As shown in Figure 1, these beliefs act as a bridge between planning and action, supporting persistence through the cyclic phases of creative self-regulation.

The performance dimension involves executing planned actions from the forethought stage, emphasizing self-control and self-observation. When exercising self-

control, individuals focus on their initial goal using tools like self-instruction, visualization, attention focus, and task strategies. Transforming a creative idea into action depends on both internal and external factors, requiring individuals to self-observe by monitoring their performance, outcomes, surrounding conditions, and success factors. This stage is especially critical in scientific contexts, where students must regulate their actions while collecting data, following procedures, interpreting evidence, and handling unexpected results. Self-efficacy beliefs help sustain effort and perseverance (Beghetto & Karwowski, 2017). Self-reflection involves comparing current performance to initial standards and adjusting behaviors accordingly—assessing progress, identifying reasons for not meeting goals, reconsidering strategies, and making necessary changes. This cyclical process demands creative thinking. In science education, self-regulation is vital in inquiry- and data-driven tasks, requiring students to plan investigations, monitor procedures, analyze data, identify errors, and revise explanations when evidence contradicts expectations. These activities involve cognitive skills and continuous regulation of attention, effort, and uncertainty, along with strategic decision-making. Scientific creativity emerges through evidence-based cycles, not just idea generation. From a self-regulation perspective, understanding how students translate creative scientific ideas into testable, data-informed, and adaptable outcomes enhances learning in laboratory and inquiry contexts.

Contrary to popular belief, self-regulation skills—closely linked to creativity—are learnable and developable processes (Strauman, 2017). While these skills tend to develop more rapidly in early childhood, they also change significantly during adolescence (Barbot & Heuser, 2017). During this period, adolescents who combine early learning with an awareness of their potential begin to refine their creative self-regulation abilities and recognize their talents (Barbot, 2020). Anderson and Haney (2020) found that creative self-efficacy skills are useful for understanding the dynamics within the individual-environment-behavior triangle and adolescents' creative development. Childhood and adolescence are especially crucial for building creative self-regulation skills (Gao et al., 2021; Pell et al., 2022). These skills are essential for helping learners realize their potential and nurturing their creative talents, regardless of educational background. To foster these skills in learners engaged in ongoing education and training, it is important first to assess their current levels. Traditional assessment tools are inadequate for measuring creativity, which is regarded as a high-level skill (Kylonen, 2012). Hence, alternative approaches are recommended. The literature suggests that rating scales, such as Likert-type scales, are effective and common for assessing high-level cognitive skills, such as creativity (Yalçın, 2018). Therefore, a rating-based measurement tool covering creative self-regulation dimensions has a strong theoretical foundation and has been validated; however, its reliability still needs to be established. Currently, there is no effective measurement tool in the national literature for assessing students' levels of creative self-regulation. Consequently, this study aims to develop such a tool for use in national research. While creating a new scale was considered, adapting existing scales was preferred due to the extensive research and development time required (Karakoç & Dönmez, 2014). Additionally, adaptation was deemed necessary because no existing

international scale fully aligns with the study's objectives and has demonstrated validity and reliability through various analyses.

The "Creative Self-Regulation (CSR)" scale, developed by Zielińska et al. (2022a) in their study titled "How adolescents develop and implement their ideas: On the self-regulation of creative action," was translated into Turkish. This scale draws on Zimmerman's three-stage cyclical self-regulation model. Originally, the scale has 33 items across three dimensions: 25 items from Ivcevic et al. (2020) and 8 crafted by Zielińska and colleagues. The first 10 items assess the pre-task period (forethought), 17 items evaluate during-task activities (performance), and the last 6 items examine post-task behaviors (self-reflection). To maintain terminological clarity, these three dimensions are consistently referred to as forethought, performance, and self-reflection throughout this paper, in line with Zimmerman's model.

This study involved adapting the CSR scale (Zielińska et al., 2022a), designed to measure students' creative self-regulation, into Turkish and evaluating its validity and reliability. In scale adaptation, it is essential to understand how to modify a scale properly. Adaptation involves tailoring a scale originally developed in one language to suit another cultural context through specific steps (Öner, 2008). Instead of creating a new scale, reconfiguring an existing one for a different language and culture conserves time and resources and enables group comparisons. Scale adaptation is more than simple translation; it is a systematic, technical process that requires expertise and involves specific stages (Öner, 2008). When transferring a scale between languages, it is vital to use sentence structures or idioms suitable for the target culture and modify any incompatible items (Savaşır, 1994). The question is: why adapt a scale rather than develop a new one? The literature highlights five key reasons: adaptation is more efficient and cost-effective, supports cross-cultural evaluations, requires less expertise than creating a new scale, benefits from previously established validity and reliability, and offers a viable approach for multilingual applications (Hambleton & Patsula, 1998). Consequently, we chose to adapt an existing scale into Turkish rather than develop a new one. Scale adaptation is crucial for creating valid, reliable measurement tools across cultures and languages. Hambleton and Patsula (1998) outlined 13 steps for this process, while Hambleton et al. (2005) described ten. Four main stages are particularly prominent in scale adaptation research.

1. Initial Translation: In this stage, translators who are fluent in both languages, have intercultural experience, and are knowledgeable about the subject should be preferred to accurately transfer the original language expressions of the scale into the target language. If the translators have deficiencies, necessary training should be provided, and psychometric experts should be involved. Additionally, it is recommended to work with multiple translators to gather diverse perspectives.

2. Back Translation: Back translation is performed to evaluate whether the scale translated into the target language preserves its meaning in the original language. This

step is a control mechanism for detecting problems overlooked during the forward translation.

3. Final Control: Experts evaluate whether there are any inconsistencies between the forward and back translations. During this process, elements such as the clarity and accuracy of expressions, the accuracy of translations, the appropriateness of word choice, and the fluency of expressions are analyzed. Experts evaluate through individual and group work and make revisions after agreeing on differences.

Methodology

Research Design

The study focused on adapting the CSR scale for use in Türkiye, originally designed to evaluate students' self-regulation in creative projects. A survey design, a common approach in quantitative research, was chosen because it suits the study's aims. This method helps gather collective insights from the target population. Therefore, survey studies are suitable for exploring participants' interests, skills, opinions, and attitudes on a specific topic, using various sampling methods (Fraenkel & Wallen, 2000; Koo & Yang, 2025)—the steps involved in adapting the scale for the chosen sample structured this research.

Study Group

The study involved 167 ninth-grade students from a high school in Central Anatolia. To ensure the validity and reliability of the results, a sample size of 5 times the number of items was targeted, totaling 33, following guidelines from Tabachnick & Fidell (2007). Ninth graders were chosen for scale adaptation because the original scale had been used with adolescents at a similar grade level. Purposive sampling was employed, meaning researchers selected participants based on their knowledge and the study's purpose, rather than requiring a fully representative sample (Fraenkel & Wallen, 2000, p. 99). This approach provides a general perspective rather than a comprehensive one. Since this was an initial adaptation, using a purposively selected sample from one high school was acceptable for early psychometric testing. However, these results should be interpreted carefully regarding the extent to which they can be applied. The sample's limitation to ninth-grade students in a single Central Anatolian school means it does not reflect students from other regions, socioeconomic backgrounds, school types, or age groups in Türkiye. The sample was almost evenly split by gender, with 49% male and 51% female, and ages ranging from 13 to 15 years.

Data Collection Tool

The CSR was formulated by Zielińska and her associates in 2022. The measurement instrument assesses how adolescents structure their actions throughout creative

endeavors. The scale has a five-point Likert-type format. The initial scale was administered to 739 people aged 14 to 18.

Data Collection

The study data were collected in February during the 2022-2023 academic year. Necessary permissions were obtained from Zielińska to adapt the study's English-language data collection tool for use in Turkish, and the scale items were translated into Turkish. The scale was reviewed at each stage of adaptation by two foreign-language experts, four science education specialists, and two measurement and evaluation professionals. It was finalized after expert reviews. The foreign language expert actively participated in the translation and back-translation processes. Science education experts are individuals who have studied self-regulation and scientific creativity. The measurement and evaluation specialist assessed the data collection tool's measurement properties. Details of expert evaluations are provided in the findings section under content validity. Lastly, a Turkish teacher reviewed the adapted scale for language appropriateness. After completing expert reviews, a digital version of the scale was created using Google Forms and distributed to a group representing the target audience. Validity and reliability analyses were conducted on the collected data, and detailed results are presented in the findings section.

Data Analysis

The research data were analyzed using SPSS 27. For the validity and reliability checks of the scale,

- Translation and expert opinions for language validity check,
- Normality analysis to provide the prerequisite before factor analysis,
- Confirmatory and exploratory factor analysis for structural validity check,
- AVE (Average Variance Explained) and CR (Composite Reliability) values for the divergent validity check,
- Cronbach's alpha and composite reliability analyses were performed for reliability checks.

Findings

Normality Assumption

Before conducting the construct validity analysis, we checked whether item scores were normally distributed. Normality was assessed using the mean, mode, median, skewness, and kurtosis (Fraenkel & Wallen, 2000). The mean, median, and mode were similar, but kurtosis and skewness differed from the acceptable range of -2 to +2. Prior to validity testing, the reliability of each item was evaluated for discrimination. Items 9 (0.178) and 29 (-0.172) were excluded because their reliability coefficients were below .30 (DeVellis, 2017; Fields, 2017). The remaining items adequately represented the creative self-

regulation dimension, so omitting these two items did not compromise the scale's content validity or theoretical foundation. Item 20, stating "I go with the flow and do not plan what I will do," measures planning ability, similar to item 9's claim, "I do not plan to achieve any specific outcome in the study." To reduce the impact of outliers and improve the assumption of normality—especially regarding kurtosis, which is crucial for parametric tests—10 cases were removed from the dataset. This procedure, as supported by Pallant (2016) and Tabachnick & Fidell (2007), did not change the significance level or the overall direction of the results; it only increased kurtosis values, ensuring the data more closely met the normality assumption.

Validity

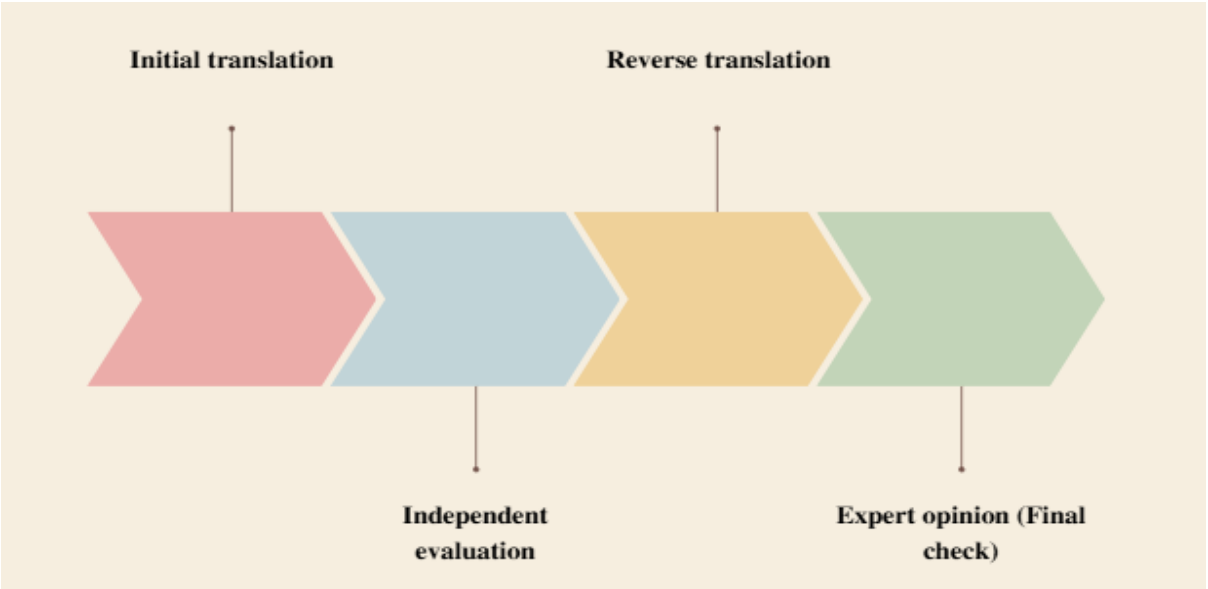
Validity, especially the validity of the scale scores, refers to how well the scale measures what it is supposed to measure (Pallant, 2016). There is no single definitive method for determining scale validity, but it is supported by evidence from its practical use. In this section, content and criterion validity, two of the main types of validity evidence, will be discussed.

Content Validity

Content validity can be expressed as the extent to which the scale items reflect the content. For a scale to have content validity, its items are expected to be consistent (Fraenkel & Wallen, 2000).

During the adaptation process into Turkish, various sources were examined, and the study plan was developed by following the stages shown in Figure 2, which was created in accordance with the recommendations of these sources (Brislin, 1973; Hambleton et al., 2005; Hambleton & Patsula, 1998; ITC [International Test Commission], 2017).

Figure 2: *Scale Adaptation Processes*



First translation: The process of translating the scale into the target language is conducted by expert translators with intercultural experience and strong proficiency in both the original and target languages. In this study, the researchers translated the English statements into Turkish.

Independent evaluation: The scale is checked by independent experts (critics or translators) in both languages. At this stage, two linguists evaluated the translations by comparing the original and translated forms.

Reverse translation: An expert who knows both languages and has never seen the original form before translates the translated form back into the source language. At this stage, a language expert translated the first translation form back into the original language. The back-translated version was compared with the original scale form. The expert feedback obtained from the first translation and back-translation, along with the changes made, is presented in Appendix 1.

Expert opinion (Final check): Different field experts evaluated the finalized translation form in terms of measurement and evaluation, applicability, and content. At this stage, the finalized scale was checked by two science education experts and one measurement and evaluation expert. The feedback from the experts and the changes made are presented in detail in Appendix 2.

Construct Validity

The KMO value for the Creative Self-Regulation Scale was .79, exceeding the acceptable threshold of .70, indicating a sufficient sample size. Consequently, factor analysis was considered appropriate (Pallant, 2016). Additionally, Bartlett's test was significant ($\chi 2 = 1506.727$, $p < 0.01$), confirming that factor analysis could be performed.

Exploratory Factor Analysis. The study applied principal component analysis to 31 items, using data from 157 participants. Initially, a five-factor structure was identified. To assess the construct validity of the scale through EFA, factor loadings were examined. Items with loadings below .30 and those with cross-loadings (items 6, 25, 28, and 30) were removed. During this process, low loadings, the representational quality of the items for creative self-regulation, and potential redundancy identified via modification indices were considered. Removing overlapping or similar items enhanced the scale's statistical power while maintaining its theoretical integrity. For example, high modification indices indicated semantic overlap between items 6 and 3, and item 25 contributed little to the model. The remaining items effectively capture the creative self-regulation sub-dimensions and align with the theoretical framework. The removal process did not alter the original three-factor structure nor compromise content validity. Items 6 and 3 serve similar functions, with item 25's negative statement, 'I blame myself when things go wrong,' countered by the positive statement in item 33, 'I decide to try again to do better.'

Additionally, item 28, 'I am pleased to share the effects of my work,' can be replaced with item 29, "I fear presenting my work," which is its opposite.

We concluded that item 30 ("I am proud of the results of my work regardless of the outcome") could be combined with item 32 ("I wonder if it can be improved during the study") due to their similar structure. Removing item 30 was considered unlikely to harm the original scale's integrity. The related factor analysis tables are in Tables 1 and 2. Before interpreting these tables, we checked each item's extraction values, all of which were above .10 (Field, 2017), indicating a sufficient explanation of the shared variance. Table 1 revealed that the factors explained 45.34% of the total variance, which is within acceptable limits (Seçer, 2015). We analyzed the scale data using the direct oblimin because we anticipated relationships among the sub-dimensions (Seçer, 2015, p. 170). Table 2 shows that all item loadings across the three factors are acceptable, ranging from .75 to .33. No overlapping items were found when examining the table. The Scree plot graph in Figure 3 supports the three-factor structure.

Table 1: *Total Explained Variance*

Components	Initial Eigenvalues			Total Sum of Squares of Factor Loadings		
	Total	Variance %	Cumulative %	Total	Variance %	Cumulative %
1	6.32	25.26	25.26	6.32	25.26	25.26
2	3.36	13.45	38.71	3.36	13.45	38.71
3	1.66	6.63	45.34	1.66	6.63	45.34
4	1.44	5.77	51.11			
5	1.15	4.61	55.72			
6	1.05	4.21	59.94			
7	.99	3.94	63.88			
8	.86	3.45	67.33			
9	.84	3.36	70.68			
10	.82	3.29	73.97			
11	.73	2.90	76.87			
12	.70	2.79	79.67			
13	.66	2.62	82.29			
14	.59	2.36	84.64			
15	.53	2.13	86.78			
16	.50	1.99	88.76			
17	.46	1.82	90.58			
18	.41	1.63	92.22			
19	.38	1.52	93.73			
20	.36	1.43	95.16			
21	.33	1.30	96.47			
22	.27	1.08	97.54			
23	.23	.92	98.46			
24	.21	.82	99.28			
25	.18	.72	100.00			

Figure 3: *Scree Plot Graph*

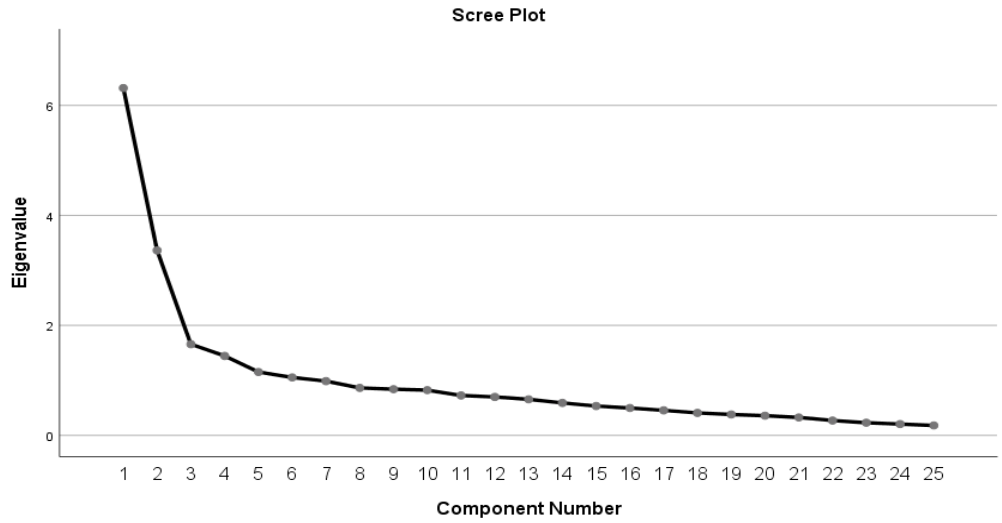


Table 2: *Factor Loadings of the Scale Items*

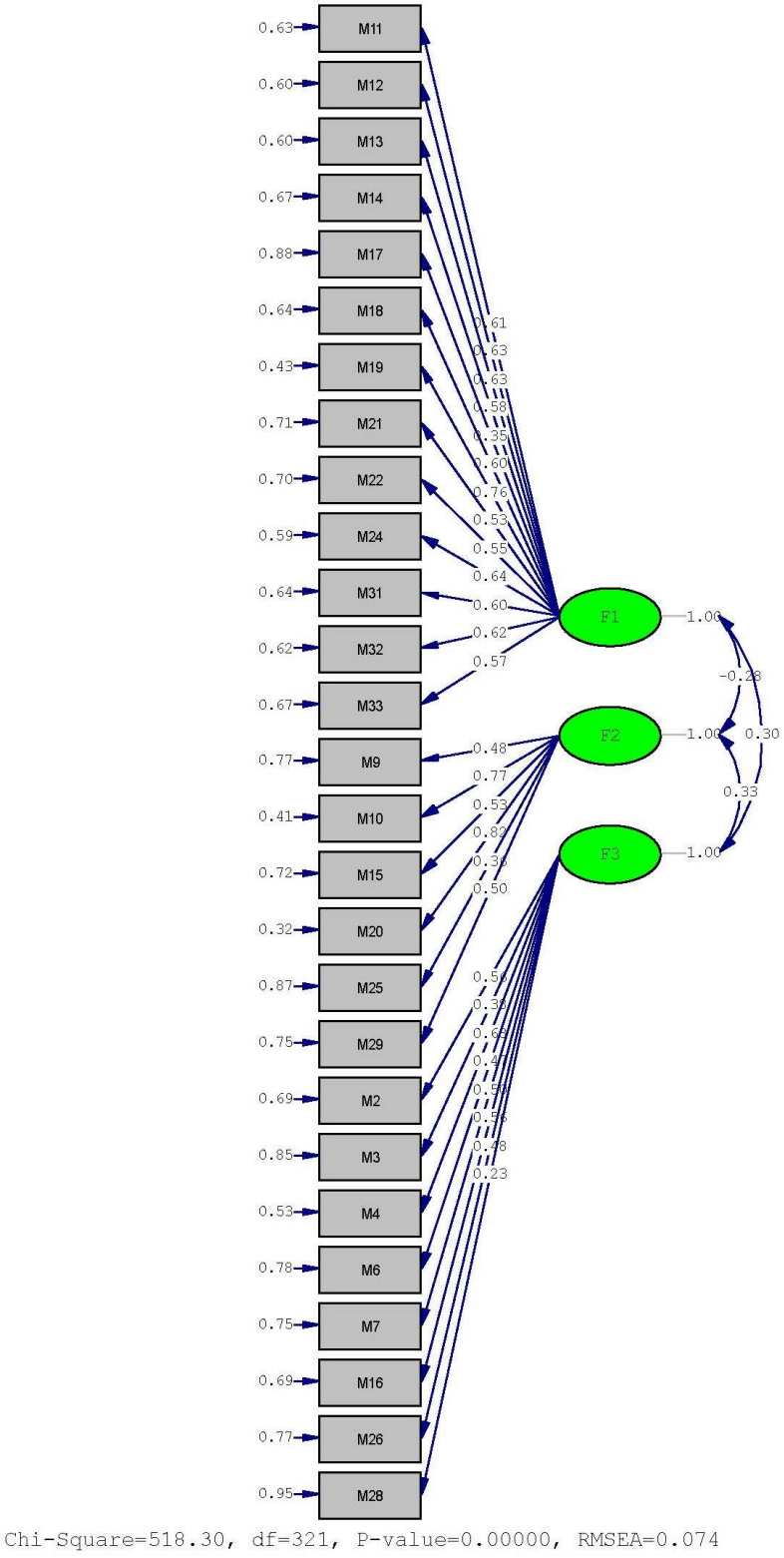
Items	Factor		
	1	2	3
M19	.75		
M22	.71		
M31	.70		
M21	.68		
M14	.65		
M33	.64		
M24	.64		
M32	.61		
M18	.61		
M8	.61		
M11	.59		
M12	.58		
M23	.55		
M13	.54	.34	
M7		.65	
M1		.64	
M3		.62	
M4		.61	
M2		.61	
M26		.55	
M5		.54	.33
M10			.82
M20			.75
M15			.73
M16			.36

Table 2 indicates that the adapted scale maintained a three-factor structure. For consistency in terminology throughout the manuscript, these factors are referred to as forethought, performance, and self-reflection, which align with the pre-task, task, and post-task phases of creative self-regulation. Consequently, fourteen items (8, 11, 12, 13, 14, 18, 19, 21, 22, 23, 24, 31, 32, and 33) are associated with the first factor (forethought), seven items (1, 2, 3, 4, 5, 7, and 26) with the second factor (performance), and four items

(10, 15, 16, and 20) with the third factor (self-reflection). The factor structure identified by exploratory factor analysis (EFA) was validated through confirmatory factor analysis (CFA) using multiple techniques on the same dataset. The research shows that conducting sequential analyses on the same sample is an appropriate method for verifying the model's stability, especially when the sample size precludes data splitting (Gefen, 2003; Matsunaga, 2010). In this study, the sample size (N=157) was too small for cross-validation through dividing data into two groups; therefore, construct validity was sequentially evaluated (EFA followed by CFA) across the entire dataset. This approach is supported in the literature for assessing the overall stability of the model and its alignment with the data in limited samples (van Prooijen & van der Kloot, 2001).

Confirmatory Factor Analysis tests and confirms a structure suggested by EFA (Sumer, 2000). CFA, often used in scale adaptation studies, evaluates whether the factor structure of the adapted scale aligns with the original (Seçer, 2015, p. 154). In this research, the Robust Maximum Likelihood (ML) method was employed to verify the three-factor structure identified by EFA, using LISREL 8.80. Multiple fit indices were examined, including Chi-square, GFI, RMSEA, CFI, NFI, RFI, and IFI. The Chi-square value was 527.42 with 272 degrees of freedom, resulting in $\chi 2/df = 1.93$, indicating good fit. The CFA supported the EFA structure (Schumacher & Lomax, 2004). Fit indices such as GFI (.79), RFI (.79), NFI (.81), CFI (.89), IFI (.89), and RMSEA (.078) were assessed. The $\chi 2/df$ and RMSEA indicated excellent and acceptable fit, respectively (Schumacker & Lomax, 2010). However, other indices like GFI, RFI, NFI, CFI, and IFI were below the 0.90 threshold, which can be influenced by sample size and model complexity, especially in smaller samples (<200; Kenny, 2020; Sharma et al., 2005). This may relate to the specific structure of the creative self-regulation framework or sample size limitations. Nonetheless, the robust indices such as RMSEA and $\chi 2/df$, along with all factor loadings being significant ($p < .01$), suggest that the model fits well and the scale's structure is valid. The CFA results are consistent with the EFA findings. The path analysis of the scale is shown in Figure 4.

Figure 4: *Path Diagram Results*



A stepwise measurement invariance analysis was conducted to test the structural and statistical similarity of the scale between gender groups (women and men). Within the scope of the analysis, formal, metric, scalar, and strict invariance models were tested, and their fit statistics are presented in Table 3.

Table 3: *Fit Statistics Related to the Stages of Measurement Invariance*

Measurement invariance	χ^2	df	CFI	TLI	RMSEA	SRMR	ΔCFI
Formal	1052	544	0.67	0.64	0.11	0.11	
Metric	1078	566	0.67	0.65	0.11	0.11	0.00
Scalar	1116	588	0.66	0.66	0.11	0.12	0.01
Strict	1119	591	0.66	0.66	0.11	0.12	0.00

Examining Table 3 reveals that the initial stage of the formal invariance model falls short of acceptable fit criteria (CFI=0.67, TLI=0.64, RMSEA=0.11). According to widely accepted thresholds in the literature (CFI > 0.90, RMSEA < 0.08), this indicates the basic model does not adequately fit the data. Nonetheless, when analyzing the differences between the stages, the CFI changes (ΔCFI ≤ 0.01) among the metric, scalar, and strict invariance models remained below the critical threshold. This suggests that constraints between models did not significantly worsen the fit. However, due to the poor fit of the baseline model, it remains difficult to confirm full measurement invariance across gender groups. Overall, the results suggest that the scale structure may not function equivalently in both groups.

Reliability

Reliability, the first essential condition in scientific research, refers to the repeatability and consistency of scale scores (AERA et al., 2014). In this study, the reliability of the 25-item creative self-regulation scale was assessed, and Cronbach's alpha was calculated in SPSS. The analysis results are shown in Table 4.

Table 4. *Reliability Coefficients for Factor and Total Items of the Creative Self-Regulation Scale*

Factor	Items	Cronbach's Alpha Reliability Coefficient	CR	AVE	Example item
Forethought	8, 11, 12, 13, 14, 18, 19, 21, 22, 23, 24, 31, 32, and 33	.89	.91	.40	I choose the best way to achieve the goals I set.
Performance	1, 2, 3, 4, 5, 7, and 26	.75	.77	.47	I know that the activities I have to do at work will not always be fun.
Self-reflection	10, 15, 16, and 20	.71	.80	.36	My aims may shift from what I had originally imagined.
Total	All items	.84	.94	.42	

As Cronbach's alpha approaches 1.00, test reliability improves (Madadizadeh & Bahariniya, 2025). According to Table 4, the Cronbach's alpha for the entire scale was .84, with the first factor at .89, the second factor at .75, and the third at .71. This indicates that

the scale and its factors have acceptable reliability levels (Pallant, 2016). Additionally, the composite reliability for the total scale and each factor was examined (see Table 4). The overall Cronbach's alpha is 0.84, while the composite reliability is .94. The table shows that both Cronbach's alpha and composite reliability for each sub-dimension exceed .70 (Pallant, 2016). An AVE value near .5 further supports the scale's composite reliability (Hair et al., 2011).

Discussion & Conclusion

This study developed a Turkish adaptation of the CSR scale created by Zielińska and colleagues (2022a). The report covers its language, content, construct validity, and reliability, confirming the validity and consistency of its scores. To ensure language validity, referred to as scope validity, we reviewed existing literature and the procedures used in related studies (Brislin, 1973; Hambleton et al., 2005; Hambleton & Patsula, 1998; ITC [International Test Commission], 2017). Following these guidelines, our process involved "first translation, independent evaluation, back translation, and expert review." Similar steps have been observed in other studies on scale adaptation (Çüm & Koç, 2013; Kayri & Günüç, 2009). For example, Kayri and Günüç (2009) translated a 31-item English scale on internet addiction, with experts ensuring clarity and simplicity. In our study, the scale items were initially translated into Turkish and then reviewed by three faculty members and four teachers specializing in science education, measurement, evaluation, and foreign languages. The back-translation was also employed to verify the equivalence between the original and the Turkish version. The Turkish version, refined based on expert feedback, was translated back into English by two language specialists and compared to the original, confirming compatibility. The scale was finalized after this review. Literature also shows frequent use of back-translation (Köymen, 1994; Saylan Kırmızıgül et al., 2022). Köymen (1994) translated an English learning strategies inventory into Turkish, then back-translated it into English to ensure accuracy, and also tested its comprehensibility across different groups. Our study's scale was not tested in a different group, so it differs from Köymen's approach in this respect.

Ensuring language validity in scale adaptation studies and following the required steps prevents permanent scientific errors and negative outcomes, such as other researchers using the scale and perpetuating these errors (Delice & Ergene, 2015). This study adhered to the necessary procedures to establish language validity (Hambleton & Patsula, 1998). Detailed reporting was conducted to identify and eliminate these issues. This emphasis on transparent reporting is consistent with recent international adaptation and validation studies, which have highlighted the joint importance of translation quality, cultural appropriateness, and psychometric confirmation across exploratory and confirmatory stages (Ventura-León et al., 2025; Boukari et al., 2025).

In scale adaptation research, it is crucial to clearly specify and comprehensively report the adopted procedure. Many studies in the literature only mention this superficially or omit it entirely (Delice & Ergene, 2015). According to Delice and Ergene (2015), only 52.96% of the 18 examined scale adaptation studies documented following

the proper steps. This suggests that many adaptation studies are not properly aligned (Çüm & Koç, 2013). While there are positive examples in the literature (Kayri & Günüç, 2009), our current study's detailed procedural reporting aims to guide researchers developing new scales. It demonstrates the steps necessary for successful scale adaptation. Additionally, content validity often relies solely on expert opinions, with minimal information provided about these opinions. Çüm and Koç (2012) analyzed 21 scale adaptation studies and found some surprising results. Notably, only three studies involved a measurement and evaluation expert during translation. We highlighted that many scales are translated into the native language without expert evaluation, which could introduce errors. To prevent these scientific inaccuracies, we engaged three specialists—a science education expert and two measurement experts—to review and modify the scale. Their feedback resulted in essential amendments and a comprehensive report.

Following content validity assessment, construct validity was examined using EFA and CFA. The authors reported that the draft scale's KMO value was .79, comprising three factors and 25 items, which collectively accounted for 45.34% of the total variance. Since a variance explanation between 40% and 60% suggests a robust factor structure (Scherer et al., 1988), this result was considered adequate. The original scale and theoretical framework identified the factors as forethought, performance, and self-reflection. CFA then validated this factor structure, a crucial step in scale development (Schumacker & Lomax, 2004). The study emphasizes CFA's importance, as recent research often confirms EFA results with CFA (Gökçe et al., 2022; Kaplan et al., 2021; Karaca et al., 2022a; Karaca et al., 2022b; Yolagiden & Bektaş, 2021). Although some fit indices, such as GFI and NFI, fell below .90, this is likely due to the small sample size (N=157) and model complexity (Kenny, 2020; Sharma et al., 2005). Positive indicators such as RMSEA (.078) and $\chi 2/df$ (1.93) support the overall validity of the model. CFA was performed on the same sample as EFA, which is statistically acceptable according to the literature (Brown, 2015; Kline, 2016). A notable limitation is that the scale's factor structure, confirmed in the overall sample, did not demonstrate formal invariance across gender groups. The low fit indices at the configural level suggest that male and female participants may have perceived the scale items differently. The literature advises against intergroup score comparisons without measurement invariance due to potential bias (Han et al., 2019; Jeong & Lee, 2019; Lacko et al., 2022; Putnick & Bornstein, 2016). This limitation restricts the validity of direct score comparisons between genders using this scale.

After conducting the validity analysis, we calculated Cronbach's alpha and composite reliability for the final scale version and each factor. In line with recent psychometric guidance, internal consistency in the present study was assessed not only by Cronbach's alpha but also by composite reliability, acknowledging that alpha alone may not fully capture reliability across all measurement conditions (Madadizadeh & Bahariniya, 2025). The overall scale had a Cronbach alpha of .84, while the factors showed reliabilities of .89 for forethought, .75 for performance, and .71 for self-reflection. Although the literature typically reports the reliability of the entire scale, some studies do

not perform reliability analysis for the sub-factors (Pedaste et al., 2021; Seema et al., 2022; Tzafilkou et al., 2022). We Büyükemphasize reporting the reliability coefficients for each factor, as they reflect the statistical robustness of the scale's components and offer valuable information for future users. The fact that both the Composite Reliability (CR) and Cronbach's alpha exceed .70 supports the scale's internal consistency. Although some factors' AVE values are below the expected threshold, the higher CR values compared to AVE suggest construct validity (Byrne, 2016). This indicates that the items do measure the intended structure, though their variance may differ due to cultural perceptions. Moreover, positive and moderately significant correlations (.25 to .36; $p < .01$) among the sub-dimensions show that, while supporting the overall structure of creative self-regulation, they measure related but distinct constructs. This provides evidence for the scale's discriminant validity and confirms that the sub-dimensions are conceptually separate (Kline, 2015; Tabachnick & Fidell, 2013). For future research, testing the scale's discriminant and criterion-related validity with additional variables is recommended.

Validity and reliability tests indicated overlap in the factor structures of the original and adapted scales. Items 1-10 in the original scale are part of the forethought factor, items 11-27 belong to the performance factor, and items 28-33 relate to the post-process factor. However, in the adapted scale, most items do not correspond with these categories. For example, items 1, 2, 3, 4, 5, and 7 are placed in the process factor, with item 10 shifting to the post-process factor. Likewise, items 11-14, 18-24 from the performance factor moved to the forethought factor, while items 15, 16, and 20 are now in the post-process factor. According to Hofstede's (2001) cultural dimensions, Polish culture, where the original scale was developed, exhibits higher individualism compared to Turkish culture. In individualistic societies, creative self-regulation tends to develop performance-focused, driven by intrinsic motivation and autonomous goals. Conversely, collectivist societies like Türkiye, with a strong aversion to uncertainty (Kağıtçıbaşı, 2017), view creativity as closely linked to social context and external expectations from family, educators, and society. This redistribution of items can be viewed critically in this cultural context. The shift in Turkish students' items from the "performance process" to the "pre-task prediction" stage suggests they engage in more detailed cognitive evaluations of potential outcomes, challenges, and social implications prior to undertaking a task, unlike their Western counterparts. This behavior may arise from Türkiye's centralized, exam-centric educational system, which imposes high achievement standards and promotes careful planning and risk assessment over proactive engagement (Cheung & Lau, 2010). Therefore, these changes in factor structure are not flaws but reflect cultural traits, illustrating meticulousness and the capacity for creative self-regulation in Turkish culture.

Unlike many adaptation studies in the literature, this research involves not only translating but also conceptually restructuring the material. The study addresses the methodological reporting gaps pointed out by Delice and Ergene (2015) by following transparent procedures. In summary, the adapted scale is a culturally sensitive, reliable tool for assessing students' capacity to manage their creative processes in Turkish

educational contexts. Future research should employ this instrument in longitudinal studies to explore how various teaching methods influence creative self-regulation. Primarily, researchers, educators, and instructors use this tool to gauge students' levels of creative self-regulation. However, these results should be viewed as preliminary evidence from a relatively homogeneous sample, and additional validation is required across diverse regions, school types, socioeconomic backgrounds, and age groups.

Practical Implications

The adapted CSR scale is practically valuable in science education, serving as both a measurement tool and a diagnostic and formative guide for instructional design. Teachers can use the scale to identify students' strengths and weaknesses in forethought, performance, and self-reflection within creative self-regulation. This enables educators to pinpoint whether students require additional support in planning, monitoring their progress during inquiry, or evaluating and revising their results after completing a task.

Second, the framework can guide the design of classroom and lab activities. For example, before inquiry tasks, teachers might use planning prompts to encourage students to set goals, identify variables, anticipate potential challenges, and choose appropriate strategies. During the activity, self-monitoring checklists can help students track procedures, record data accurately, recognize unexpected results, and manage their effort and focus. Afterward, structured reflection prompts can help students assess the quality of their evidence, detect errors, compare results with initial expectations, and revise their explanations or plans. This way, the scale promotes a clearer and more teachable model of how scientific creativity develops through self-regulation. Therefore, beyond its measurement capabilities, the adapted scale provides a practical framework for fostering students' creative engagement in science with targeted, phase-specific support.

Limitations

- **Sample and Cross-Validation:** In this study, both Exploratory Factor Analysis and Confirmatory Factor Analysis were conducted on the same sample group to determine construct validity. Because the sample size does not allow the data to be split, this situation, which was necessarily preferred, may increase the risk that the obtained factor structure is specific to the dataset. To minimize the potential impact of this situation on the generalizability of the results, cross-validation analyses with different sample groups can be conducted in future studies.
- **Criterion Validity:** Although the study presents strong evidence regarding the internal structure of the scale, criterion validity analyses examining the relationship between scale scores and other tools measuring similar constructs or external criteria such as academic success have not been conducted. This limitation is inherent to the study, and correlation analyses across different scales are planned for future research to test the scale's predictive power.

- **Measurement Invariance:** In future studies, we recommend conducting Item Functioning Variability analyses to understand the gender-based differences of the scale or to include qualitative interviews aimed at measuring the semantic perception of items between groups.
- **Diversity of Data Collection Tools:** Research data was collected solely using a self-reported Likert scale. In future studies, supporting quantitative findings with open-ended questions, qualitative interviews, or document analyses will contribute to a deeper and more multidimensional understanding of students' creative self-regulation skills.
- **Contextual and Demographic Limitations:** Although the adapted scale meets the assumption of normal distribution, in its current form, it reflects the characteristics of a specific sample group. A comparative examination of the scale's psychometric properties across students from different socio-economic levels, geographical regions, and educational stages (e.g., middle school, university) in Türkiye could enhance the tool's generalizability and test its cultural universality.
- **Domain-Specific Applications:** The scale measures a general creative self-regulation structure. However, the creativity literature argues that this skill may be domain-specific. Therefore, testing the scale by tailoring it to specific disciplines, such as science education, art, or mathematics, could yield more targeted contributions to the literature.
- **Contextual and Demographic Limitations:** Although the present sample was adequate for an initial scale adaptation study, it consisted only of ninth-grade students from a single high school in the Central Anatolian region and was selected through purposive sampling. Therefore, the findings should be regarded as preliminary evidence rather than as results directly generalizable to all student populations in Türkiye. The psychometric properties of the adapted scale may vary across different geographical regions, socioeconomic strata, school types (e.g., vocational, science, Anatolian, private schools), and age groups. For this reason, future studies should examine the scale with more diverse and representative samples in order to test the stability and generalizability of the factor structure across different educational and demographic contexts.

Ethical Approval

This research was conducted with the permission of Erciyes University Social and Human Sciences Ethics Committee dated 31/01/2023 and numbered 53.

Author Contributions

Melek Karaca: Methodology, Data Collection, Data Analysis, Results, Conclusion

Seyide Eroğlu: Literature Review, Methodology, Data Collection, Results, Conclusion

Oktay Bektaş: Methodology, Data Analysis, Results, Conclusion

Conflict of Interest

This study has no conflict of interest, and no financial support has been received.

Plagiarism Checks

Turnitin

Artificial Intelligence Usage Statement

ChatGPT 5.5 was used solely for language editing and readability enhancement. All outputs were reviewed and revised by the authors, who are fully responsible for the final content of the manuscript.

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APPENDICES

Appendix 1. *Expert feedback and changes as a result of the first and back translation*

No	Original State	Translation (Turkish)	Back Translation	Language Expert	The final state of the item (Turkish)
S1	I knew I would not always have a clear picture of how my project would look.	Çalışmamın her zaman öngördüğüm gibi sonuçlanamayacağını bilirim.	**My study may not always turn out as I envisioned.**	In the file starting with Turkish, in Item 1, "may not" would be more appropriate than "does not." Also, all items need "study" because "study" is used in scientific articles and research.	Çalışmanın her zaman hayal ettiğim gibi sonuçlanamayacağını biliyorum.
S2	I knew I could not predict all the steps of my project.	Çalışmamın tüm adımlarını tahmin edemeyeceğimi bilirim.	**I know that I cannot predict all the steps of my study.**	In the file starting with Turkish, there is no issue with items 2 and 3; as I said, "study" will be preferred instead of "work.	Çalışmanın tüm adımlarını tahmin edemeyeceğimi bilirim.
S3	I reminded myself that some parts of my work would be tedious, frustrating, or painful.	Çalışmanın bazı bölümlerinin sıkıcı, sinir bozucu ve zahmetli olabileceğini kendime hatırlatırım.	**I remind myself that some parts of the study can be tedious, frustrating, and troublesome.**		Çalışmanın bazı bölümlerinin sıkıcı, sinir bozucu ve zahmetli olabileceğini kendime hatırlatırım.
S4	I knew that my initial idea may not be the one I had.	Çalışmanın başında sahip olduğum fikirlerin çalışma sonunda değişebileceğini bilirim.	**I know that my ideas at the beginning of the study can change at the end.**	In Item 4, at the end, sufficient	Başlangıçta sahip olduğum fikirlerin çalışmanın sonunda değişebileceğini bilirim.
S5	I understood that sometimes I would put in work that would be discarded later on.	Çalışmama bazen sonradan vazgeçebileceğim işler koyduğumun farkındayım.	**I understood that sometimes I would put in work that would be discarded later on.**	Appropriate	Çalışmaya daha sonra çıkarabileceğim bazı parçaları eklediğimin farkındayım.
S6	I expected to encounter obstacles that I would need to overcome.	Çalışmada üstesinden gelmem gereken engellerle karşılaşmayı beklerim.	**In the study, I expect to encounter obstacles I must overcome.**	In Item 6, must should be used instead of have to.	Çalışmada, üstesinden gelmem gereken engellerle karşılaşmayı beklerim.
S7	I knew that working on this project would not always be enjoyable.	Çalışmada yapmam gereken etkinliklerin her zaman keyifli olmayacağını bilirim.	**I know that the activities I have to do in the study will not always be enjoyable.**	In Item 7, the study takes place.	Çalışmada yapmam gereken aktivitelerin her zaman eğlenceli olmayacağını bilirim.
S8	I could not begin working before the steps of the project were clear.	Adımlarını netleştirmeden çalışmaya başlayamam.	**I cannot begin the work without clarifying the steps.**	In Item 8, the phrase "I cannot begin" should be followed by "work." The Turkish version of Item 8 should start with the phrase "Çalışmadaki aşamaları netleştirmeden…"	Çalışmadaki adımları netleştirmeden çalışmaya başlayamam.
S9	This activity was not a planned project—I just played with it, not planning any specific results to achieve.	Çalışmamda belirlediğim özel bir sonucu başarmaya yönelik planlama yapmam.	**I do not plan to achieve a particular result, but I have determined to do so 0in my work.**	Appropriate	Çalışmada herhangi bir spesifik sonuca ulaşmak için plan yapmam.
S10	This activity was primarily improvised, without a specific purpose or plan.	Çalışmada yaptığım görevleri belirli bir amaç veya plan olmaksızın büyük ölçüde doğaçlama yaparım.	**I improvise the tasks I do in the study to a large extent, without a specific purpose or plan.**		Çalışmada belirli bir amaç veya plan olmadan büyük ölçüde doğaçlama yaparım.
S11	I adjusted the way I worked to achieve specific goals best.	Belirlediğim hedeflere en iyi şekilde ulaşmamı sağlayacak yolu seçerim.	**I choose the path that will allow me to achieve the goals I set in the best way.**	Appropriate	Belirlediğim hedeflere ulaşmamı sağlayacak en iyi yolu seçerim.

S12	When I encountered obstacles, I tried different ways of solving the problem.	Engellerle karşılaştığımda, sorunu çözmenin farklı yollarını denerim.	**When I encounter obstacles, I try different ways to solve the problem.**	Appropriate	Engellerle karşılaştığımda, sorunu çözmenin farklı yollarını denerim.
S13	I was open to new opportunities when they came up during my project.	Çalışma süresince karşıma çıkan yeni fırsatlara açığım.	**I am open to new opportunities that come my way during my studies.**	Appropriate	Çalışma sırasında ortaya çıkabilecek yeni fırsatlara açığım.
S14	I was mindful not to get too attached to specific ways of working.	Farklı tarz çalışma biçimlerini kullanmaya dikkat ederim.	**I make sure to use different study styles.**	Appropriate	Farklı çalışma tarzları kullanmaya özen gösteririm.
S15	When I had a new idea, I dropped what I was doing to pursue it.	Aklıma yeni bir fikir geldiğinde, peşinden gitmek için o anda yaptığım şeyi bırakırım.	**When a new idea comes to mind, I stop what I am doing to pursue it.**	Appropriate	Aklıma yeni bir fikir geldiğinde, o an yaptığım işi bırakıp peşinden giderim.
S16	My goals changed from what I had initially envisioned.	Hedeflerim başlangıçta hayal ettiğimden farklı bir noktaya kayabilir.	**My goals may shift to a different point than I initially imagined.**	Appropriate	Hedeflerim başlangıçta hayal ettiğimden farklı bir noktaya kayabilir.
S17	While working on my project, I set more specific goals as time went on.	Çalışmam üzerinde çalışırken zaman geçtikçe daha spesifik hedefler belirlerim.	**As time passes, I set more specific goals as I work on my studies.**	The Turkish version of Item 17 would be better as "Çalışmam üzerinde ilerlerken..."	Çalışmam üzerinde ilerlerken zaman geçtikçe daha spesifik hedefler belirlerim.
S18	I would test my ideas throughout my project before fully committing to them.	Çalışmam boyunca, kesin karar vermeden önce fikirlerimi test ederim.	**Throughout my work, I test my ideas before making any final decisions.**	Appropriate	Çalışmam boyunca, kesin karar vermeden önce fikirlerimi test ederim.
S19	I created a plan to work on my project best suited to my working style.	Tarzıma en uygun çalışmayı seçip bir plan oluştururum.	**I choose the study that best suits my style and create a plan.**	Appropriate	Çalışma tarzıma en uygun planı yaparım.
S20	I go with the flow and do not plan ahead.	Akışa göre hareket ederim ve ne yapacağımı planlamam.	**I act according to the flow and do not plan what to do.**	In Item 20, I used the idiomatic equivalent of the expression "to act according to the flow."	Akışa göre hareket ederim ve ne yapacağımı planlamam.
S21	I adapted how I organized my work depending on where I was.	Sürecin neresinde bulunduğuma bağlı olarak çalışmamı nasıl organize etmem gerektiğini sürekli gözden geçiririm.	**I constantly review how I should organize my work depending on where I am.**		Sürecin neresinde bulunduğuma bağlı olarak çalışmamı nasıl organize etmem gerektiğini sürekli gözden geçiririm.
S22	I reminded myself that I could do it well when things seemed difficult.	İşler zor göründüğünde, kendime bunu iyi yapabileceğimi hatırlatırım.	**When the work seems complicated, I remind myself that I can do it well.**		Çalışma zor göründüğünde, kendime bunu iyi yapabileceğimi hatırlatırım.
S23	I found ways to stay motivated even when I was uninspired.	Olumsuz koşullarda motive kalmanın yollarını bulurum.	**I find ways to stay motivated in adverse conditions.**	Appropriate	Olumsuz koşullarda motive kalmanın yollarını bulurum.
S24	I told myself that the mistakes I made were learning opportunities.	Yaptığım hataların öğrenme fırsatları olduğunu kendime söylerim.	**I tell myself that the mistakes I make are opportunities to learn.**		Kendime yaptığım hataların öğrenme fırsatları olduğunu söylerim.
S25	I blamed myself when things went wrong.	İşler ters gittiğinde kendimi suçlarım.	**I blame myself when things go wrong.**		İşler ters gittiğinde kendimi suçlarım.
S26	I took breaks when I was feeling	Çalışmada bunalmış hissettiğimde ara veririm.	**I take a break when I feel overwhelmed by my studies.**	In Item 26, the "by the (my) study" section should be removed.	Kendimi bunalmış hissettiğimde ara veririm.

	overwhelmed by my project.				
S27	When something did not go according to plan, I accepted it and moved on.	Bir şeyler plana göre gitmediğinde durumu kabul ederim ve projeye devam ederim.	**When things do not go according to plan, I accept the situation and continue the project.**		İşler planladığım gibi gitmediğinde durumu kabullenip çalışmaya devam ederim.
S28	I was happy to share the effects of my work with other people.	Çalışmamın etkilerini/katkılarını diğer insanlarla paylaşmaktan mutlu olurum.	**I would be happy to share the effects/contributions of my work with other people.**	Appropriate	Çalışmanın etkilerini/katkılarını başkalarıyla paylaşmaktan mutluluk duyarım.
S29	I was afraid to show the results of my work to others.	Çalışmamın sonuçlarını başkalarına göstermekten korkarım.	**I am afraid to show others the results of my work.**		Çalışmanın sonuçlarını başkalarına göstermekten korkarım.
S30	I was proud of what came out of my activity.	Çalışmamın sonucu ne olursa olsun, ortaya çıkanlarla gurur duyarım.	**Whatever the outcome/result of my work, I am proud of what has come out.**	"I am proud of" should be added.	Çalışmanın sonucu ne olursa olsun, faaliyetimden çıkanlarla gurur duyarım.
S31	I was not entirely convinced that this was "it"-I thought about how to improve the solution.	Sonuca tam olarak ikna olmadığımda, bu çözümü nasıl geliştireceğimi düşünürüm.	**When I am not entirely convinced of the outcome, I think about how to develop this solution.**	Appropriate	Sonuçtan tam olarak emin olmadığımda, bu çözümü nasıl geliştireceğimi düşünürüm.
S32	I was wondering if it could be done even better.	Çalışma süresince daha da iyisi yapılabilir mi diye merak ederim.	**I wonder if it can be done even better during the study.**	Appropriate	Çalışma sırasında daha da iyi yapılabilir mi diye merak ederim.
S33	I decided that I would try it again, but it was better.	Daha iyisini yapmak için tekrar denemeye karar veririm.	**I decided to try again to do better.**	Appropriate	Daha iyisini yapmak için tekrar denemekten korkmam.

Appendix 2. *Expert feedback and modifications*

N	Item (Turkish)	Science education expert	Measurement and evaluation specialist	Changes and corrections	The final state of the item (Turkish)
1	Çalışmanın her zaman hayal ettiğim gibi sonuçlanamayacağını biliyorum.	It differs from the original item's meaning. It would be good if it were checked. The term "study" can lead to varying interpretations. The age of the intended audience is crucial in this instance. The verb "to work" may also be contemplated. It may not align with my desires after each study. However, what is meant here is "product". At the outset of the items, the definition of "work" should be articulated in the instructions or elucidated to the pupils before implementation.	Using the phrase "working" might lead to variances in connotation. The age of the target audience is important in this case. The action of "working" can also be considered. It may not be what I want at the end of every study. However, what is meant here is "product". Initially, the concept of "work" should be defined in the instructions or elucidated to the students before implementation.	The information portion of the scale clarifies what exactly work means. "The term 'study' in the scale items refers to activities such as projects and performances carried out during the education process." The sentence's expression "I imagine" has been changed to "I envision". Time is also organized as present tense throughout the scale.	Çalışmanın her zaman öngördüğüm gibi sonuçlanamayacağını bilirim.
3	Çalışmanın bazı bölümlerinin sıkıcı, sinir bozucu ve	You could call it a working process.		The proposed change has been implemented.	Çalışma sürecinin sıkıcı, sinir bozucu ve

	zahmetli olabileceğini kendime hatırlatırım.				zahmetli olabileceğini kendime hatırlatırım.
4	Başlangıçta sahip olduğum fikirlerin çalışmanın sonunda değişebileceğini bilirim.	There is a tense mismatch with the original scale. This situation should be carefully examined in all items.		Language experts have stated that a single tense should be used throughout the scale and that the present tense is more appropriate for comprehensibility.	Başlangıçta sahip olduğum fikirlerin çalışmamın sonunda değişebileceğini bilirim.
5	Çalışmaya daha sonra çıkarabileceğim bazı parçaları eklediğimin farkındayım.	There are some differences between "understanding" and "being aware." It should be rearranged according to the original scale.		As in this item, the original version of the scale includes items that can be used to determine participant experiences after any study. Since we wanted to extend the scale's usage time, it has been made more general.	Çalışmaya daha sonra çıkarabileceğim bazı parçaları eklediğimin farkındayım.
6	Çalışmada, üstesinden gelmem gereken engellerle karşılaşmayı beklerim.	This item would be more meaningful if rephrased: "I know that I may encounter difficulties in my work that I need to overcome." There is a problem with the item's clarity.		The proposed change has been implemented.	Çalışmamda üstesinden gelmem gereken zorluklarla karşılaşabileceğimi bilirim.
8	Çalışmadaki adımları netleştirmeden çalışmaya başlayamam.			The proposed change has been implemented.	Çalışmamın adımlarını netleştirmeden çalışmaya başlayamam.
9	Çalışmada herhangi bir spesifik sonuca ulaşmak için plan yapmam.	The wording in the original item is quite abbreviated. You can recheck it.		In the original version of the scale, we thought that the low average of this item indicated low comprehensibility, so we simplified the item.	Çalışmada herhangi bir belirgin sonuca ulaşmak için plan yapmam.
14	Farklı çalışma tarzları kullanmaya özen gösteririm.		The original item and this item are slightly different. The original emphasizes not being stuck, particularly by using different study approaches. It can be left as is if there is a problem with the item analysis in the pilot study.	The proposed change has been implemented.	Tek bir çalışma yaklaşımına takılı kalmadan farklı çalışma yaklaşımları kullanmaya özen gösteririm.
17	Çalışmam üzerinde ilerlerken zaman geçtikçe daha spesifik hedefler belirlerim.	Instead of the word "specific," another word has been proposed.		The proposed change has been implemented.	Çalışmam üzerinde ilerlerken zaman geçtikçe daha belirgin hedefler belirlerim.
29	Çalışmanın sonuçlarını başkalarına göstermekten korkarım.	It is one's work. Therefore, it would be appropriate to edit it as “my work.” This should also be examined for other items.		All appropriate statements in the scale were organized as “my study.”	Çalışmamın sonuçlarını başkalarına göstermekten korkarım.
30	Çalışmanın sonucu ne olursa olsun, faaliyetimden çıkanlarla gurur duyarım.	The wording of this item should be edited.		The proposed change has been implemented.	Çalışmamın sonucu ne olursa olsun, ortaya faaliyetimden çıkanlarla gurur duyarım.