

Constructing a Creative Teaching Scale for Mathematics Teachers in Jordan

Eman Rasmi Abed¹, Mo'en Salman Alnasraween² & Hamed Mubarak Al-Awidi^{1,*}

¹Faculty of Educational Sciences, Curriculum & Instruction Department, Yarmouk University, Jordan

²Faculty of Educational Sciences, Department of Psychology, Yarmouk University, Jordan

*Correspondence: Hamed Mubarak Al-Awidi, Faculty of Educational Sciences, Curriculum & Instruction Department, Yarmouk University, Jordan. E-mail: hamed@yu.edu.jo. ORCID: <https://orcid.org/0000-0002-0012-1000>

Received: March 14, 2026

Accepted: August 2, 2026

Online Published: October 9, 2026

doi:10.5430/jct.v15n4p1

URL: <https://doi.org/10.5430/jct.v15n4p1>

Abstract

This research constructs a scale for assessing creative teaching among mathematics teachers. A sample of 351 schools, stratified with respect to gender, location and authority, was selected. The participants in this study were 1605 teachers. The Factor analysis and discriminations validity were examined. The factor analysis showed that there were five Factors. By using both McDonnell's Omega and Cronbach alpha, the reliability indicated that the construction of the scale had good and acceptable values. The results also showed that the level of creative teaching among mathematics teachers was moderate. In addition, a significant difference in the means of each dimension and the total score based on gender was found in favor of male teachers.

Keywords: mathematics education, creative teaching, mathematical thinking

1. Introduction

1.1 Background of the Study

Recently, the educational systems and philosophies had witnessed a strong transformation because it is found that traditional approaches were insufficient for meeting the demands of the twenty-first century. Education processes had shifted from a teacher centered model towards dynamic student-centered learning affected by the rapid expansion of knowledge and advanced technology. The transformation processes reflected global trends in education. Because of this, systems adopted and adapted new policies and modernized curricula. To align with emerging concepts of creative and innovative education teachers' capacities were enhanced (Freeman et al., 2014).

In parallel, the traditional assessment methods that mainly focused on cognitive outcomes were limited because of the recognition of its limitations. As a result, new assessment tools had emerged in order to capture deeper learning outcomes, such as creative thinking, problem solving and flexible application of knowledge (Darwin et al., 2023). To modernize educational systems providing both technical and human resources and to develop indicators and standards to evaluate the impact of innovative teaching strategies on both teachers' and students' performances; important investments had been made (Coe et al., 2014).

Ismayilova & Bolander (2022) defined creative teaching as the process that can help teachers to employ imaginative, original, and adaptive strategies to make learning engaging, meaningful and effective. In addition, Karunarathne & Calma (2023) added that creative teaching involved presenting content in different ways that stimulating curiosity, fostering critical thinking, and promotes active participation. On the other side, Jeffrey & Craft (2004) suggested that by transmitting knowledge, creative teaching might empower students to apply flexible concepts, and to nurture innovation and problem-solving abilities. Belonging to creative teaching approach was the redefining of the teachers' role from knowledge transmitter or sender to facilitator and guidance. By supporting the learner's holistic cognitive, emotional, and social development, the teacher has to consider the students' individual differences as cultural and social contexts (Maor et al., 2024; Bar-Yam et al., 2002).

In mathematics education, it is very important and imperative to use creative teaching approach. It is noticed that

Mathematics is as abstract and disconnected from real-world applications. It was found that combining direct methods and instructions with active strategies such as problem-solving and discovery-based learning might enhance learners' conceptual understanding and engagement (Rosenshine, 2012; Stockard et al., 2018; Freeman et al., 2014).

Moreover, educational platforms could allow students to explore mathematical patterns and functions. Some of these educational platforms are GeoGebra and Desmos. Thereby, fostering deep understanding and scientific curiosity when using these technologies had been noticed (Lee, 2023; Wikaksana & Yuliyati, 2022). Other creative teaching approaches such as storytelling, humor, and games might reduce anxiety and increase motivation highlighting the intersection between emotional intelligence and mathematical thinking (Toka et al., 2015).

In line with the previously mentioned pedagogical advancements, assessment methods have evolved to capture creative teaching and learning outcomes more effectively. This recent study focused on developing specialized instruments and digital tools for evaluating creativity among students and teachers. The DISCOVER test and online assessments tailored for distance learning and were included in the teaching methods (Wijaya & Sari, 2021; Kandemir et al., 2019; Retnawati et al., 2022). Several studies had aimed to develop scales to measure teachers' creative and innovative instructional practices in various contexts. Some of these studies were Sheikh and Rana (2021) developed a scale for measuring creativity among university faculties in Pakistan. Maulidah et al. (2023) designed an instrument for Indonesian elementary teachers. They emphasized the "Creative Habits of Mind." Şişman et al. (2024) created a scale for scientific creativity for Turkish science candidates' teachers. Jerusalem (2020) developed a scale for measuring innovative teaching strategies for Philippine primary teachers.

In Spain, (Eva Izquierdo-Sanchis et al., 2024; Cai & Yang, 2023; Rubenstein et al., 2013; Rizeq et al., 2018; Leikin et al., 2013; Hayati et al., 2023; Ye et al., 2024; and Azamalah & Kang, 2023) explored aspects of creative teachings, cross cultural differences, digital integration and teacher Self-efficiency, the studies underscore the global interests in measuring and enhancing teacher's creativity; they also reveal a notable gap in specific Subjects and tailored cultural tools for mathematics teachers in Jordan.

This study aimed to address the gap by developing a scale tailored for Jordanian mathematics teachers. The teachers' pedagogical beliefs and digital competencies would be integrated in the items of the scale. The scale adopted a five-dimensional structure consisted of (1) fostering divergent thinking, (2) promoting learner's independence, (3) integrating technology, (4) creating a stimulus learning environment, and (5) encouraging reflection and critical thinking. This comprehensive scale structure might provide a contextual relevant instrument capable of capturing multipurpose nature of creative teaching in mathematics exceeding the scope of the previous studies and instruments that typically assessed a single dimension of creativity. The study responded to previous voices for constructing assessment tools which were aligned with digital transformation and the demands of the 21st century education (Retnawati et al., 2022; Wijaya & Sari, 2021). As it was shown, it was expected that the study might offer substantial contribution to research literature.

The transformation of universal educational practices such as the emphasis on creative teaching, the integration of technology, and the need for strong cultural relevant assessment instruments were used to underscore the timelines and significance of the recent research. By focusing, specifically, on mathematics education in Jordan, this study contributed to both theoretical and practical understanding, measuring and promoting creative teaching in a developing educational context, Mathematics education is an example.

1.2 Research Problem

It was found that constructing tools to measure the domains of creative teaching posed significant challenges due to the abstract and subjective nature of creativity. Not similar to standardized academic skills, creativity in teaching involved tiny behaviors such as spontaneity, adaptability, and the ability to encourage students' innovation qualities that are difficult to be objectively quantified claimed by (Jeffrey & Craft, 2004; Maor et al., 2024).

Moreover, creative teaching might look widely different across subjects, grade levels and cultural contexts that made it difficult to design a one - size fit all assessment tools explained by (Bar-Yam et al., 2002; Alali, 2020). This variable difference might lead to instruments that either oversimplified creative teaching or failed to capture their full depth and impact. Many other issues have appeared on the surface of education such as the lack of consensus on what constituted the core domains of creative teaching. Some frameworks emphasized originality, Fluency and flexibility (Beghetto & Kaufman, 2014; Rubenstein et al., 2013) and others prioritized emotional engagement, risk taking and the integration of interdisciplinary knowledge (Karunaratne & Calma, 2023; Maor et al., 2024).

This lack of standardization might complicate the development of the reliability of the measurement of the instruments. When tools were developed to ensure their validity and reliability across diverse education settings, they remained a

major “hurdle or problem”, explained by (Kandemir et al., 2019; Retnowati et al., 2022). Other challenges that might face education were the Limitation of understanding of how contextual factors such as gender and the type of the educational Sectors which might influence creative teaching practices.

Previous research highlighted gender disparities in teachers’ professional roles and recognition related to students’ creativity explained by Krayem & Al-Hroub (2019) and Gan et al. (2025); also, unequal opportunities and other creative approaches among male and Female teachers in the Arab region Alghneimin et al. (2024). Others, such as sectoral differences, public and private, Streams Could shape teachers’ opportunities, resources and readiness to adopt innovative practices viewed by Al-rsa’i et al. (2024). On the other hand, few studies had systematically examined the equity and contextual validity of these instruments.

More than that, developing and implementing tools required major resources including training, time, and instructional support pointed (Coe et al., 2014). Other researchers noticed that some teachers might feel apprehensive if they knew that they were to be evaluated on creativity, especially if evaluation processes were not sensitive to contextual and demographic differences, showed by (Freeman et al., 2014). The above challenges underscored the need for more researches and more contextual grounded approaches to construct tools that might take into consideration the demographic and institutional variations that contributed to fair and comprehensive assessments of creative teaching.

1.3 Research Questions

- 1) What are the validity indicators of the creative teaching scale among a sample of mathematics teachers in Jordan?
- 2) What are the reliability indicators of the creative teaching scale for mathematics teachers in Jordan?
- 3) What is the level of creative teaching among mathematics teachers in Jordan?
- 4) Does the level of creative teaching among mathematics teachers in Jordan differ according to the gender of the teacher?

1.4 Research Objectives

The aims of the current research are to:

- 1) determine the validity indicators of creative teaching scale a sample of mathematics teachers in Jordan.
- 2) determine the reliability indicators of the creative reaching scale among a sample of mathematics researchers in Jordan.
- 3) determine the level of creative teaching among mathematics teachers in Jordan.
- 4) identify the differences in the performances of mathematics teachers in Jordan on the creative teaching scale according to the teacher's gender.

1.5 Significance of the Research

Creativity in teaching is a challenge and unexplored matter especially in teacher's assessment, it consisted in diverse elements such as originality, flexibility, student engagement and problem solving, these elements are often difficult to capture using traditional assessment methods. Researchers had defined and emphasized that creativity is central to teaching practices (Jeffrey & Craft, 2004).

As an academic sector, the current study was contributed to addressing a research gap by focusing on the development of valid and reliable tools for measuring creative teaching. It was found that existing instruments lacked standardization or contextual validation limiting their usefulness across different educational settings (Kandemir et al., 2019; Retnowati et al., 2022).

By constructing and testing a tailored scale to find the domains of creative teaching, this study is expected to strengthen the theoretical and empirical foundations of creativity research in education, particularly, in the Jordanian sector and context because these tools ae still rare (Al-rsa’i et al., 2024).

It is expected that, when providing teachers with evidence - based tools for assessing creativity, it could support their professional growth and development, this might help them to reflect on their instructional practices and identify areas for development, school leaders and curriculum designers could also use the findings to integrate the results with training courses and programs, curriculum design and policy decisions in order to enhance the quality of teaching (Coe et al., 2014; Karunaratne & Calma, 2023).

Social relations might help to recognize and measure creative teaching to foster a cultural innovation in education. Educational systems need to move beyond rote learning and essential support practices that could help to prepare students for complex future challenges, this movement could be applied by adapting values, collaboration and critical

thinking,

This study might highlight its role as a central component of educational reform and quality. Creativity should be emphasized as a measurable and essential dimension of teaching.

1.6 Research Limitations

- The interpretation and generalization of the results of this research were determined in the light of its being limited to a stratified random sample of mathematic teachers, belongs to the Ministry of Education in Jordan for the scholastic year 2024/2025.
- The study was limited to a developed scale for mathematics teachers related to the Jordanian Educational Context. This procedure had to restrict its generalization to other cultures or educational systems.

It is recommended that future research should conduct cross-cultural validation to examine its reliability and applicability in diverse settings.

2. Method and Procedures

2.1 Research Participants

To select the sample of the study, the researchers followed the following procedures:

A Sample of (351) schools, stratified with respect to gender (male/ female), location (urban/ rural) and authority (public/ private/ UNRWA), was selected. All teachers of the selected schools constituted the sample of the study, who taught mathematics for grades (4-10) in Jordan during scholastic year 2024/ 2025.

To ensure that the sample was representative, a multistage random sampling procedure was applied:

First, a list of all schools (public, private, and UNRWA) that provide mathematics teachers was obtained from the Ministry of Education, and then a stratified sample of (351) schools was randomly selected using a computer-generated random number table, ensuring representation of all sectors.

within each selected school, teachers who met the inclusion criteria were invited to participate:

- Currently teaching mathematics at the basic stages.
- having at least one year's experience of teaching.
- teachers on long term leave or not directly teaching mathematics were excluded.

The mentioned procedure helped to minimize selection bias and to ensure that the sample adequately represented variables. Table (1) shows the distribution of schools of research participants according to gender, location and authority.

Table 1. Distribution of Schools of Research Participants According to Gender, Location and Authority

Gender	No.	%	Location	No.	%	Authority	No.	%
Males	102	29.1	Urban	228	65.0	Public	264	75.2
Females	123	35.0	Rural	123	35.0	Private	72	20.5
Mixed	126	35.9				UNRWA	15	4.3
Total	351	100		351	100		351	100

The number of participants was (1605) male and female teachers (753 males, 852 females) distributed across 351 schools.

2.2 Scale Construction Procedures

The construction of the recent creative teaching scale followed a systematic, multi stage process informed by both critical review of literature and expert's review and inputs.

2.2.1 Stage 1: Identification of Aspects

Based on previous studies, seven initial aspects of creative teaching were identified to guide the development of the Scale. Each aspect explicitly linked to supporting literature:

1. Use of Innovative Strategies in Mathematics – informed by Rubenstein et al. (2013) and Kandemir et al. (2019), highlighting diverse, student-centered instructional methods that foster creativity and problem-solving.
2. Encouraging Students' Autonomy in Mathematics – based on Møller & Kara (2018), emphasizing student choice and self-directed learning to enhance independent decision-making.
3. Integration of Technology in Mathematics – guided by Alali (2020), reflecting the purposeful use of digital tools to support engagement, visualization, and interactive learning.
4. Promoting Divergent Thinking in Mathematics – drawn from Şişman et al. (2024) and Kandemir et al. (2019), focusing on generating multiple solutions, flexibility, and cross-conceptual thinking.
5. Creating a Stimulating Environment for Mathematics – supported by Rubenstein et al. (2013) and Møller & Kara (2018), emphasizing classroom design and experiences that spark curiosity and hands-on exploration.
6. Encouraging Play and Experimentation in Mathematics – inspired by Alali (2020), highlighting playful and exploratory activities that promote engagement and creative risk-taking.
7. Fostering Reflection and Metacognition in Mathematics – based on Şişman et al. (2024), emphasizing practices that develop students' self-regulation and critical evaluation of their problem-solving processes.

Each constructed item was operationally defined based on literature and experts' feedback confirming the clarity and relevance of each item definition.

2.2.2 Stage 2: Item Development and Expert Review

An initial pool of 36 items was created, with five items per aspect except for divergent thinking, which included six items. Both positively and negatively worded items were included to minimize response bias.

The items were reviewed by a panel of nine experts in mathematics teaching, pedagogy, and educational measurement. The Experts evaluated the:

- clarity of the item wording.
- relevance of the item to the intended construction.
- applicability of the item to mathematics classroom contexts.

The experts, also, provided three specific suggestions that were systematically as follows:

- items that received $\geq 75\%$ agreement on clarity and relevance to constructions were retained.
- items needing rewording were revised according to expert recommendations.
- items deemed redundant, ambiguous, or poorly represented were deleted.

2.2.3 Stage 3: Pilot Testing

A pilot study was conducted with a small sample of mathematics teachers ($n = 30$). Both quantitative responses (item ratings) and qualitative feedback (comments on clarity, wording, and relevance) were collected. Based on pilot feedback, several items were refined to improve readability and alignment with the intended constructs.

2.2.4 Stage 4: Factor Analysis and Item Reduction

Exploratory factor analysis (EFA) was performed to examine the underlying structure of the scale. Two initial factors—Encouraging Play and Experimentation and Fostering Reflection and Metacognition—were removed due to low item loadings (1–2 items per factor). This reduction process clarified the scale's final structure, maintaining theoretical and empirical consistency while reducing it from seven to five dimensions.

2.2.5 Dimensions Operations

Each remaining dimension was interpreted into measurable indicators via structured rubrics, observations, checklists and teachers' reflections surveys:

- Use of Innovative Strategies: Frequency of applying diverse teaching methods connecting mathematics to real-world problems.
- Encouraging Student Autonomy: Extent to which students are empowered to make independent choices and decisions in mathematical tasks.
- Integration of Technology: Use of digital tools to enhance understanding, engagement, and interaction.

- Promoting Divergent Thinking: Activities encouraging multiple solution paths, creativity, and flexible reasoning.
- Creating a Stimulating Environment: Classroom design and activities that spark curiosity and hands-on learning.

Respondents indicated the frequency of these practices on a five-point Likert scale ((1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, 5 = Always).

In its final form, the scale consisted of 27 items distributed across five aspects: fostering divergent thinking (8 items), encouraging student autonomy (5 items), integrating technology (4 items), creating a stimulating environment (6 items), and enhancing reflection and metacognition (4 items). The form showed that the structures of the scale construction reflected both theoretical, grounding and practical applicability.

This reflection ensured that the reliability of the scale measured the creative teaching practices across diverse mathematics classroom contexts in Jordan.

2.2.6 Statistical Processing

To answer the first question, the factorial validity was verified and an exploratory factor analysis of the principal components was conducted and discriminations validity was extracted. The internal consistency coefficients were calculated using Cronbach-alpha equation for each of the seven dimensions of the scale, The total score answered the second question. To answer the third question, the mean and standard deviation were calculated. Lastly, the independent sample T-test was used to determine the significance of differences among the females and males' average performances.

3. Research Findings

Results of the first research question: "What are the validity evidences of the creative teaching scale among a sample of mathematics teachers in Jordan"?

First: Factorial Validity

The factorial validity of the scale was verified by applying it to a research sample of (1605) male and female teachers and conducting an exploratory factor analysis of the principal components. The suitability of the data for exploratory factor analysis was first verified, which requires that the correlation coefficient matrix of the scale items be different from zero. This was verified using Bartlett's Test of Sphericity. The adequacy of the sample used was also verified by using the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (Kaiser, 1974; Kaiser & Rice, 1974), as shown in Table 2. Results of the first research question: "What are the validity indicators of the creative teaching scale among a sample of mathematics teachers in Jordan"?

Table 2. The Value of the Kaiser-Meyer-Olkin Measure and Bartlett's Test of Sphericity to Verify the Validity of the Data for Conducting Exploratory Factor Analysis

Kaiser-Meyer-Olkin	Bartlett's Test of Sphericity		
	Chi-Square	df	Sig
0.906	5051.916	630	*0.000

Significant at ($\alpha = 0.05$)*

Table 2 shows that the value of Bartlett's Test of Sphericity reached (5051.916) with a statistical significance of (0.000) which is less than the statistical significance level ($\alpha=0.05$); which indicates the factorability of the correlation coefficient matrix of the scale items; that is, the correlation coefficient matrix of the scale items differs from zero; thus, we can extract a set of factors from this matrix. The value of the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (Kaiser, 1974; Kaiser & Rice, 1974) reached 0.630, which is a value greater than the minimum acceptance value of 0.50, indicating the adequacy of the sample used to conduct the exploratory factor analysis.

The factors comprising the scale were then extracted, and their latent root values and the proportions of variance they explain were calculated by conducting exploratory factor analysis of the principal components with orthogonal rotation (Varimax Rotation) for the scale items using SPSS v26, as shown in Table 3.

Table 3. Latent Root Values, Proportion of Explained Variance, and Cumulative Explained Variance for Each Factor

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	15.089	41.915	41.915
2	2.619	7.275	49.190
3	2.090	5.805	54.994
4	1.800	5.000	59.995
5	1.552	4.311	64.305
6	1.273	3.535	67.841
7	1.123	3.118	70.959

It is clear from Table 3 that there are seven factors whose latent root value exceeds (1), and they explain (70.959%) of the variance of scores on the creative teaching scale among teachers in Jordan. The scree plot was also used to reveal the number of factors that make up the creative teaching scale, as shown in Figure 1.

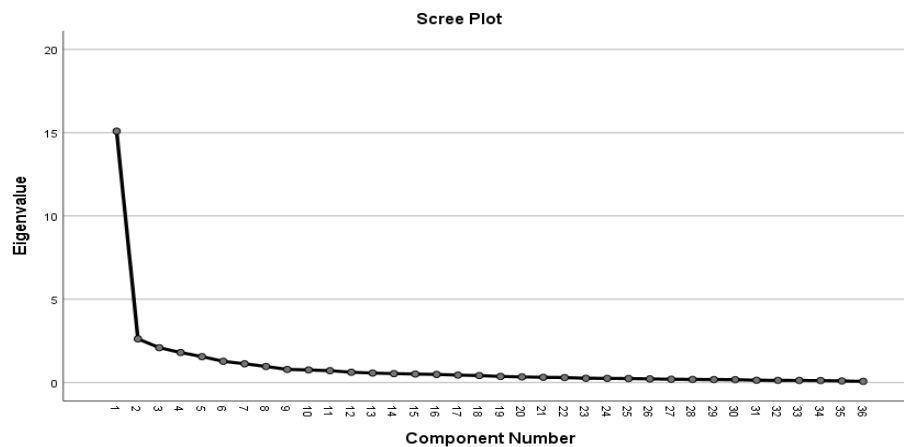


Figure 1. Scree Plot to Reveal the Number of Factors that Comprise the Creative Teaching Scale

Figure 1 shows the presence of a main factor, and then the figure shows that the remaining factors are remarkably close to each other, supporting the previous results that the scale measures a single trait.

The values of the saturations of the scale item on its component factors (factor loading) were calculated, and to judge the values of the saturations of the item on the factors, the criteria of (Gorsuch, 1983) for exploratory factor analysis were relied upon, which are: the inadmissibility of adopting the items with a saturation lower than (0.40), the inadmissibility of the saturation of the item on two dimensions with values greater than (0.40), and Table 4 shows the values of the saturations of the scale item on its component factors, which were shortened to 5 factors due to the saturation of one item on the seventh factor, and two item on the sixth factor.

Table 4. Factorial Structure of the Creative Teaching Scale Items and Their Saturations on Each of the Five Factors Rotated Component Matrix

#	The item	Component				
		Factor One	Factor Two	Factor Three	Factor Four	Factor Five
1	I incorporate real-world math problems to engage students.	.606				
2	I use project-based learning to connect math concepts to students' lives (e.g., budgeting, architecture).	.444			.527	
3	I present math puzzles to stimulate critical thinking.	.495			.576	
4	I use storytelling to contextualize abstract concepts (e.g., telling a story about shapes or fractions).	.511				
5	I encourage students to explore multiple strategies for solving the same problem.				.467	
6	I allow students to create their own word problems based on their personal interests.				.493	
7	I provide opportunities for students to choose the mathematical methods that can be applied to solve problems.				.608	
8	I encourage students to design their own data collection and analysis projects.				.715	
9	I support self-directed learning using online mathematics platforms or adaptive learning tools.				.583	
10	I guide students to set personal learning goals for mathematics and reflect on their progress.				.658	
11	I use dynamic geometry software (such as GeoGebra and Desmos) to help students visualize concepts.					.670
12	I incorporate math-based games or apps to make learning interactive and engaging.	.423				.456
13	I use graphing calculators or spreadsheet programs to teach advanced problem-solving techniques.					.821
14	I encourage students to create digital presentations of their mathematical results.					.841
15	I use online simulations to demonstrate abstract mathematical concepts (such as fractions or probability).					.692
16	I pose open-ended mathematical problems that allow for multiple correct answers.	.697				
17	I ask students to create and explain their own mathematical patterns or sequences.	.714				
18	I encourage students to find relationships between different mathematical concepts.	.775				
19	I provide students with opportunities to solve problems using unconventional methods.	.671				
20	I challenge students to identify and question assumptions in mathematical problems.	.654				
21	I use think-pair-and-share activities to generate diverse mathematical ideas.	.505				
22	I use hands-on materials (e.g., counters, blocks, or beads) to teach math concepts.	.507		.680		
23	I create interactive bulletin boards that present math challenges or puzzles.	.428		.536		.417
24	I design math learning stations where students can explore concepts hands-on.			.570		.475

Table 4. Factorial Structure of the Creative Teaching Scale Items and Their Saturations on Each of the Five Factors Rotated Component Matrix (continued)

#	The item	Component				
		Factor One	Factor Two	Factor Three	Factor Four	Factor Five
25	I use math-themed decorations or posters to create a visually stimulating classroom.			.777		
26	I use real-world objects (e.g., measuring tools and 3D models) to make math lessons tangible.			.674		
27	I use math board games or card games to teach concepts like probability and fractions.			.592		
28	I organize math scavenger hunts to help students apply math concepts in a fun way.			.735		
29	I allow students to experiment with creating their own algorithms or formulas.			.523	.430	
30	I encourage students to test different ways to solve the same math problem.		.534	.467		
31	I include opportunities for students to "play" with math tools, such as a protractor or compass.		.414	.471		
32	I ask students to explain their reasoning and justify their mathematical solutions.		.812			
33	I use error analysis activities to help students learn from mistakes.		.812			
34	I guide students to reflect on the strategies they used to solve a problem.		.840			
35	I encourage students to compare different approaches to solving the same problem.		.831			
36	I provide opportunities for students to document their problem-solving process in school bulletins.		.456			

To determine the extent to which an item relates to the dimension (factor) to which it belongs, a set of criteria was used: An item is considered statistically acceptable if its factor saturation coefficient is no less than 0.40. If a single item is saturated on more than one dimension, determining its affiliation to a multiple factor depends on the difference between the saturation values on the two dimensions. If this saturation exceeds 0.20, the item is counted on the higher dimension only. If the difference is less than that, the item is deleted (Tabachnick et al., 2019; Hair et al., 2019). Table 4 shows that 8 items were saturated on the first factor, namely: (1, 4, 16, 17, 18, 19, 20, 21). Table (4) also shows that 5 items were saturated on the second factor, namely: (32, 33, 34, 35, 36), and that 4 items were saturated on the third factor, namely: (25, 26, 27, 28), and 6 items were saturated on the fourth factor, namely: (5, 6, 7, 8, 9, 10). While 4 items were saturated on the fifth factor, namely: (11, 13, 14, 15). Nine items were deleted due to their lack of strong saturation on one dimension, namely: (2, 3, 12, 22, 23, 24, 29, 30, 31). Considering the content of the items gathered on the dimensions, the dimensions were named as shown in Table 5.

Table 5. Dimensions of the Scale and the Content of Its Collected Items

#	Dimension	Items
1	Promoting divergent thinking in mathematics	1, 4, 16, 17, 18, 19, 20, 21
2	Encouraging students' independence in mathematics	32, 33, 34, 35, 36
3	Integrating technology into mathematics	25, 26, 27, 28
4	Creating a stimulating environment	5, 6, 7, 8, 9, 10
5	Promoting reflection and awareness	11, 13, 14, 15

Second: Discriminant Validity

The discriminant validity of the Creative Teaching Scale was determined by ranking the examinees' responses in

descending order of the total score, then taking the top 27% and the bottom 27%. Thus, 434 respondents were selected from the highest category and 434 from the lowest category. A t-test was then conducted for two independent samples, as shown in Table 6.

Table 6. The Findings of Independent Sample T-Test

	Total degree	N	Mean	Std. Deviation	Std. Error	t	Sig
group	Higher	434	4.1778	.27783	.01334	50.97	*0.000
	Lower	435	2.6667	.55198	.02647		

Significant at ($\alpha = 0.05$)*

It is noted from the results of Table 6 that the value of “t” reached (50.97) and is statistically significant at the level ($\alpha=0.05$), which indicates the ability of the creative teaching scale to distinguish between respondents who are high in the trait and those who are low in the trait.

Finding of the second research question: "What are the reliability evidences of the creative teaching scale for mathematics teachers in Jordan"?

First, internal consistency was extracted using Cronbach's alpha, as shown in Table 7.

Table 7. Results of Internal Consistency Values Using Cronbach's Alpha and McDonnell's Omega

Dimension	Cronbach alpha	Omega
Promoting divergent thinking in mathematics	0.87	0.88
Encouraging students' independence in mathematics	0.80	0.85
Integrating technology into mathematics	0.81	0.82
Creating a stimulating environment	0.82	0.84
Promoting reflection and awareness	0.86	0.90
Total	0.91	0.93

It is noted from the results of Table 7 that the reliability values were acceptable, reaching 0.91 for the total score using Cronbach's alpha and 0.93 using McDonnell's omega.

Second: The standard error was extracted as a reliability indicator for the means for each item, and its value ranged between 0.01 and 0.02.

Results of the third research question: "What is the level of creative teaching among mathematics teachers in Jordan"?

To answer this question, the arithmetic means and standard deviations were extracted, as shown in Table 8.

Table 8. Arithmetic Means and Standard Deviations of the Creative Teaching Scale Items Arranged in Descending Order

Dimension	Mean	Std. Deviation	Rank	Level
Promoting divergent thinking in mathematics	3.6007	.75905	1	Moderate
Encouraging students' independence in mathematics	3.5368	.75073	2	Moderate
Integrating technology into mathematics	3.5301	.87823	3	Moderate
Creating a stimulating environment	3.3734	.82239	4	Moderate
Promoting reflection and awareness	3.0467	.98627	5	Moderate
Total	3.4577	.65753		Moderate

It is noted from the results of Table 8 that the level of creative teaching among mathematics teachers in Jordan was average, with the arithmetic mean for the total score being (3.46) with a standard deviation of (0.66), and the arithmetic means for the dimensions being moderate.

Results of the fourth research question which state: "Does the level of creative teaching among mathematics teachers in Jordan differ according to the gender of the teacher?"

To answer this question, arithmetic means and standard deviations were extracted, as shown in Table 9.

Table 9. Means and Standard Deviations Related to Gender

Dependent Variable	Gender	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
dim1	Male	3.334	.037	3.261	3.407
	Female	3.217	.035	3.149	3.286
dim2	Male	3.336	.045	3.248	3.423
	Female	3.249	.042	3.167	3.330
dim3	Male	3.400	.042	3.317	3.484
	Female	3.292	.040	3.214	3.369
dim4	Male	3.564	.039	3.488	3.640
	Female	3.444	.036	3.373	3.515
dim5	Male	3.072	.051	2.972	3.172
	Female	3.055	.048	2.962	3.149
Total	Male	3.356	.033	3.290	3.422
	Female	3.260	.031	3.199	3.322

It is noted from the results of the above table that there are apparent differences between the means of creative teaching due to teacher gender. To find out whether these differences are statistically significant, a multiple analysis of variance test was conducted, and Table 10 shows this.

Table 10. MANOVA Test for the Differences Between the Means of the Creative Teaching Due to Gender

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Gender	Promoting divergent thinking in mathematics	5.403	1	5.403	10.430	.001
	Encouraging students' independence in mathematics	3.020	1	3.020	4.077	.044
	Integrating technology into mathematics	4.711	1	4.711	6.994	.008
	Creating a stimulating environment	5.688	1	5.688	10.159	.001
	Promoting reflection and awareness	.107	1	.107	.110	.741
	Total Degree	3.650	1	3.650	8.722	.003
Error	Promoting divergent thinking in mathematics	829.888	1602	.518		
	Encouraging students' independence in mathematics	1186.540	1602	.741		
	Integrating technology into mathematics	1079.142	1602	.674		
	Creating a stimulating environment	896.964	1602	.560		
	Promoting reflection and awareness	1559.941	1602	.974		
	Total Degree	670.408	1602	.418		
Total	Promoting divergent thinking in mathematics	21733.047	1605			
	Encouraging students' independence in mathematics	21237.960	1605			
	Integrating technology into mathematics	19349.063	1605			
	Creating a stimulating environment	20980.417	1605			
	Promoting reflection and awareness	16458.750	1605			
	Total Degree	19882.008	1605			

The results of the multiple analysis of variance table show that the "F" values were statistically significant at the $\alpha=0.0$ according to gender score and all dimensions except dimension 5. Referring to the arithmetic means table, it is noted that these differences are attributed to male teachers.

4. Discussion

The present study aimed to construct and develop a validate scale for assessing creative teaching among mathematics teachers in Jordan. The Findings indicated that the constructed scale possessed strong psychometric properties. These properties included construction validity, discriminations validity and reliability. The mentioned factors made it suitable for diagnostic and developmental purposes (Rubenstein et al., 2013; Kandemir et al., 2019; Şişman et al., 2024), the analysis of the exploratory factor revealed Five main dimensions promoting divergent thinking, encouraging students' independence, integrating technology, creating a stimulating learning environment, and fostering reflection and metacognition. That collectively explained approximately (71%) of the total variance. This result aligned with previous research that suggested that creative teaching is a multi-facted construction encompassing several interrelation domains (Jeffrey & Craft, 2004; Møller & Kara, 2018). In addition, the scale reflected the Jordanian context, and it was expected that the scale might enhance the cultural and institutional relevance of the measurement. This Finding was emphasized in cross cultural studies on teacher creativity, teaching and learning (Leikin et al., 2013; Azamalah & Kang, 2023). In contrasting this measurement with previous ones, It was founds that these studies Focused on general or scientific creativity (Sheikh & Rana, 2021; Maulidah et al., 2023; Şişman et al., 2024). Also, it addressed creative teaching in mathematics.

It is observed that the reliability indicators including Cronbach's alpha and McDonald's Omega were high ($\alpha = 0.91$, $\omega = 0.93$). This finding supported the internal consistency and Stability of the scale. The scale also was able to discriminate effectively among teachers with high and low levels of creative teaching confirming its utility as an accurate assessment instrument. These findings were consistent with the findings of previous research that emphasized the importance of establishing robust psychometric properties before employing assessment tools in educational contexts (Kandemir et al., 2019; Retnawati et al., 2022).

Analysis of the level of creative teaching among mathematics teachers revealed an overall moderate level across all dimensions, The highest observed scores were related to promoting divergent thinking and the lowest one was related to fostering reflection and meta cognition, The moderate performances should be attributed to many contextual Factors. For example, some of the chosen schools might not provide sufficient incentives for innovative teaching efforts (Freeman et al., 2014; Bar-Yam et al., 2002). Another one might be the prevalent assessment culture at Jordanian schools that prioritize quantitative academic achievement that could limit teachers' motivation to implement creative instructional practices (Beghetto & Kaufman, 2014). Moreover, some teachers couldn't consistently employ open-ended or problem-solving tasks that were expected to encourage divergent thinking, promote students' autonomy, and facilitate reflective practices (Rubenstein et al., 2013; Kandemir et al., 2019). These mentioned factors gave the reason why the level of creative teaching was moderate rather than high. The results, also, showed that the male teachers' results outnumbered the female teachers on most dimensions. This finding was consistent with previous studies conducting in Jordan and other countries (Alali, 2020; Alghneimin & Krabbendam, 2024; Krayem & Al-Hroub, 2019).

The differences among male and female teachers might be influenced by classroom autonomy, the way of accessing to professional development and cultural and social expectations that affected the implementation of creative teaching strategies (Gan et al., 2025). Although the gender differences were statistically significant, the current data did not directly assess the underlying factors. The interpretation, as was expected, should be approached cautiously. It was recommended that further research should be implemented to explore the other influences that might contributed to the Jordanian contexts.

The developed scale offered a comprehensive tool for creative teaching practices in mathematics as it was explained by the researchers. It enabled identification of areas for teacher development, informed professional training programs, and supports the adoption of innovative, instructional strategies (Rubenstein et al., 2013; Kandemir et al., 2019; Şişman et al., 2024). Compared to existing instruments such as Kandemir et. el., (2019) the present scale integrated multiple dimensions of creative teaching, including student's independence, divergent thinking and reflected practices. It was found that these dimensions were not fully addressed in previous measures. In addition, the validation of this scale within the Jordanian educational system captured local cultural curricular and institutional factors. Because of this, it might enhance its contextual relevance, (Alali, 2020; Møller & Kara, 2018). Future studies should examine the validity of the scale by exploring its relationship with other creative teaching indicators and its predictive capacity for

students' outcomes including academic achievements, creative thinking and problem-solving skills.

5. Conclusion

This study resulted in the development of a psychometrically sound scale for assessing a creative teaching among mathematics teacher in Jordan. The findings supported five factors structure and demonstrated acceptable levels of reliability based on both McDonald Omega and Cronbach alpha providing evidence for the scale validity and internal consistency. The finding further indicated that mathematics teachers demonstrated a moderate level of creative teaching, suggesting that creative instructional practices are present but may not yet be consistently embedded in mathematics teaching. Significant gender differences were also identified across the dimension of creative teaching and the overall skill with male teachers reporting higher levels. These findings highlight the opportunities for teachers to develop and apply creative instructional practices in mathematics classrooms the developed scale may serve as a useful instrument for researchers, teachers, and educational policymakers in assessing creative teaching and identifying areas of professional development. Further research using independent samples and different educational contexts is recommended to provide additional evidence regarding the stability generalizability and measurement invariance of the skill.

References

- Alali, R. M. (2020). Developing a scale for creative teaching practices of faculty members at King Faisal University. *Universal Journal of Educational Research*, 8(5), 1801–1813. <https://doi.org/10.13189/ujer.2020.080552>
- Alghneimin, J., Varga, A., & Kovács, M. (2024). Gender disparities and potentials in STEM approach in Jordan and Saudi Arabia: An analytical literature review. *Hungarian Educational Research Journal*, 14(2), 217–230. <https://doi.org/10.1556/063.2023.00236>
- Al-rsa'i, M. S., Waswas, D., Altawarah, A., & Al-Rowad, F. (2024). Evaluating the quality of teaching performance among Jordanian teachers in light of certain demographic variables. *International Electronic Journal of Elementary Education*, 16(3), 295–309. <https://doi.org/10.26822/iejee.2024.332>
- Azamalah, V., & Kang, N. H. (2023). Teachers' perceptions of creativity and teaching: A comparison of African and South Korean teachers. *Innovation and Education*, 5, 32–53.
- Bar-Yam, M., Rhoades, K., Sweeney, L. B., Kaput, J., & Bar-Yam, Y. (2002). *Changes in the teaching and learning process in a complex education system*. New England Complex Systems Institute. Retrieved from <https://necsi.edu/changes-in-the-teaching-and-learning-process-in-a-complex-education-system>
- Beghetto, R. A., & Kaufman, J. C. (2014). Classroom contexts for creativity. *High Ability Studies*, 25(1), 53–69. <https://doi.org/10.1080/13598139.2014.905247>
- Cai, Y., & Yang, Y. (2023). The development and validation of the scale of design thinking for teaching (SDTT). *Thinking Skills and Creativity*, 48, 101255. <https://doi.org/10.1016/j.tsc.2023.101255>
- Coe, R., Aloisi, C., Higgins, S., & Major, L. E. (2014, October). *What makes great teaching? Review of the underpinning research*. Sutton Trust. Retrieved from <https://durham-repository.worktribe.com/output/1607293>
- Darwin, Rusdin, D., Mukminatien, N., Suryati, N., Laksmi, E. D., & Marzuki. (2023). Critical thinking in the AI era: An exploration of EFL students' perceptions, benefits, and limitations. *Cogent Education*, 11(1), 1–18. <https://doi.org/10.1080/2331186X.2023.2290342>
- Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences*, 111(23), 8410–8415. <https://doi.org/10.1073/pnas.1319030111>
- Gan, Y., Deng, J., Liu, C., & Li, S. (2025). Exploring gender differences in workload and job satisfaction among teachers. *BMC Psychology*, 13(184), 1–14. <https://doi.org/10.1186/s40359-025-02439-z>
- Gorsuch, R. L. (1983). *Factor analysis* (2nd ed.). Lawrence Erlbaum Associates.
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Pearson.
- Hayati, P., Mistima, M., & Sofwan, M. (2023). The relationship between teacher's self-efficacy and creative teaching of primary mathematics teachers. *Journal of Educational and Social Research*, 13(5), 340–353. <https://doi.org/10.36941/jesr-2023-0141>

- Ismayilova, K., & Bolander Laksov, K. (2022). Teaching creatively in higher education: The roles of personal attributes and environment. *Scandinavian Journal of Educational Research*, 67(4), 536–548.
- Izquierdo-Sanchis, E., Echegoyen-Sanz, Y., & Martín-Ezpeleta, A. (2024). Primary school teachers' creative self-perception and beliefs on teaching for creativity. *Education Sciences*, 15(2), 211. <https://doi.org/10.3390/educsci15020211>
- Jeffrey, B., & Craft, A. (2004). Teaching creatively and teaching for creativity: Distinctions and relationships. *Educational Studies*, 30(1), 77–87. <https://doi.org/10.1080/0305569032000159750>
- Jerusalem, R. Y. (2020). Teachers' innovative teaching strategies: Scale development using exploratory factor analysis. *International Journal of Social Science and Humanities Research*, 8(2), 80–95.
- Kaiser, H. F. (1974). An index of factorial simplicity. *Psychometrika*, 39(1), 31–36. <https://doi.org/10.1007/BF02291575>
- Kaiser, H. F., & Rice, J. (1974). Little Jiffy, Mark IV. *Educational and Psychological Measurement*, 34(1), 111–117. <https://doi.org/10.1177/001316447403400115>
- Kandemir, M. A., Tezci, E., Shelley, M., & Demirli, C. (2019). Measurement of creative teaching in mathematics class. *Creativity Research Journal*, 31(3), 272–283. <https://doi.org/10.1080/10400419.2019.1641677>
- Karunaratne, W., & Calma, A. (2023). Assessing creative thinking skills in higher education: Deficits and improvements. *Studies in Higher Education*, 49(1), 157–177. <https://doi.org/10.1080/03075079.2023.2225532>
- Krayem, M., & Al-Hroub, A. (2019). Gender differences in teachers' recognition of overexcitabilities among gifted adolescents in Jordan: An experimental vignette study of twice-exceptionality. *International Journal for Talent Development and Creativity*, 7(1), 113–124. <https://eric.ed.gov/?id=EJ1297322>
- Lee, K.-W. (2023). Effectiveness of gamification and selection of appropriate teaching methods of creativity: Students' perspectives. *Heliyon*, 9(10), e20420. <https://doi.org/10.1016/j.heliyon.2023.e20420>
- Leikin, R., Subotnik, R., Pitta-Pantazi, D., Singer, F., & Pelczer, I. (2013). Teachers' views on creativity in mathematics education: An international survey. *ZDM Mathematics Education*, 45, 309–324. <https://doi.org/10.1007/s11858-012-0472-4>
- Maor, R., Paz-Baruch, N., Mevarech, Z., Grinshpan, N., Levi, R., Milman, A., ... Zion, M. (2025). Teaching creatively and teaching for creativity – Theory, teachers' attitudes, and creativity-based practices. *Educational Studies*, 51(5), 958–972. <https://doi.org/10.1080/03055698.2024.2371091>
- Maulidah, N., Sapriya, S., & Supriatna, N. (2023). An instrument development to measure the creative habits of mind for prospective elementary school teachers. *Jurnal Kependidikan: Jurnal Hasil Penelitian dan Kajian Kepustakaan di Bidang Pendidikan, Pengajaran, dan Pembelajaran*, 9(3), 846–857. <https://doi.org/10.33394/jk.v9i3.8389>
- Møller, J., & Kara, S. (2018). Learning environments that support student creativity: Developing the SCALE. *Thinking Skills and Creativity*, 24, 45–54. Retrieved from <https://www.punyamishra.com/wp-content/uploads/2018/02/Richardson-Mishra-SCALE-2017-pub.pdf>
- Retnowati, E., Ayu, M., Sari, A. R., & Ghufro, M. A. (2022). Assessment of mathematical creative thinking: A systematic review. *Thinking Skills and Creativity*, 44, Article 101047. <https://doi.org/10.1016/j.tsc.2022.101019>
- Rizeq, R., Qatami, T., & Al Sous, R. (2018). The degree of using creative thinking teaching strategies for gifted students in Jordan. *Hebron University Research Journal (HURJ): B- (Humanities)*, 13(1), e00600. Retrieved from <https://www.hebron.edu/index.php/en/hurj-b/a-natural-sciences/33-v13-1/331-v13-1-4en.html>
- Rosenshine, B. (2012). Principles of instruction: Research-based strategies that all teachers should know. *American Educator*, 36(1), 12–19. Retrieved from <https://www.aft.org/sites/default/files/periodicals/Rosenshine.pdf>
- Rubenstein, L. D., McCoach, D. B., & Siegle, D. (2013). Teaching for creativity scales: An instrument to examine teachers' perceptions of factors that allow for the teaching of creativity. *Creativity Research Journal*, 25(3), 324–334. <https://doi.org/10.1080/10400419.2013.813807>
- Sheikh, I., & Rana, R. A. (2021). Development of scale to measure teachers' creativity. *Journal of Development and Social Sciences*, 2(3), 306–319. [https://doi.org/10.47205/jdss.2021\(2-III\)27](https://doi.org/10.47205/jdss.2021(2-III)27)
- Şişman, H. E., Aydoğan, N., & Çankaya, Ö. (2024). A scientific creativity scale development process for science teacher candidates. *International Journal on Social and Education Sciences (IJonSES)*, 6(1), 50–66.

<https://www.ijonnes.net/index.php/ijonnes/article/view/587>

- Stockard, J., Wood, T. W., Coughlin, C., & Rasplia Khoury, C. (2018). The effectiveness of Direct Instruction curricula: A meta-analysis of a half century of research. *Review of Educational Research*, 88(4), 479–507. <https://doi.org/10.3102/0034654317751919>
- Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2019). *Using multivariate statistics* (7th ed.). Pearson.
- Toka, S., Bahtiyar, A., & Karalök, S. (2015). The effects of teaching mathematics creatively on academic achievement, attitudes towards mathematics, and mathematics anxiety. *International Journal of Innovation in Science and Mathematics Education*, 23(4), 1–24. <https://core.ac.uk/download/pdf/229407218.pdf>
- Wicaksono, I., & Yulianti, L. (2022). Implementation of Mandala and SCAMPER models to improve students' creative thinking skills in mathematics learning. *Heliyon*, 8(11), e11672. <https://doi.org/10.1016/j.heliyon.2022.e11672>
- Wijaya, T. T., & Sari, D. (2021). Improving the creative thinking skills of the next generation of mathematics teachers using dynamic mathematics software. *International Journal of Emerging Technologies in Learning (IJET)*, 16(13), 212–226. <https://doi.org/10.3991/ijet.v16i13.21535>
- Ye, T., Ng, C. F., & Leung, K. (2024). Examining mathematics teachers' creative actions in programming-based mathematical activities. *ZDM Mathematics Education*, 56, 695–711. <https://doi.org/10.1007/s11858-024-01579-7>

Author Statements

Author(s) declared the statement below:

Acknowledgments

We greatly appreciate the valuable contributions of our community advisory committee members. We would also like to thank the study sample members who took the time to participate in this study.

Author Contributions

Prof Eman Abed and Dr. Moen Alnsarween were responsible for study design and revising and Data Analysis and data collection. Prof. Hamed Al-Awidi drafted the manuscript and Prof. Eman Abed revised it. All authors read and approved the final manuscript. In this paragraph, also explain any special agreements concerning authorship, such as if authors contributed equally to the study.

Consent for Publication

All authors have read and approved the published version of the manuscript.

Funding

This work received no funding

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed Consent

Obtained.

Ethics Approval

The Publication Ethics Committee of the Sciedu Press.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Use of Artificial Intelligence

AI was not used in this study.

Supplementary Materials

No supplementary materials are available.

Journal Information

The Editorial Board declared the below statement on behalf of the journal and publisher:

Ethics Statement

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Preservation Policy

This journal is archived by Library and Archives Canada (LAC).

Open Access

This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0). Please find details at <https://creativecommons.org/licenses/by/4.0>.

Copyright © The Author(s)

Copyright remains with the author(s). The author(s) grant the journal the right of first publication, and the article is published under the terms of the Creative Commons Attribution (CC BY 4.0) License.