

# The Effect of Using Brainstorming on Developing Innovative Thinking and Achievement in Teaching English Language Students

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## Abstract

This study aimed to determine whether or not brainstorming can help foster creative thinking and academic success in seventh-grade English classes at the Wadi Al Seer Directorate of Education. The study's sample was comprised of (240) students at this grade level. There were 124 students in the study's experimental group, who received instruction in the English language through brainstorming, and 116 students in the control group, who received instruction in the English language through the conventional method. Following the end of instruction, valid and reliable innovative thinking and accomplishment tests were administered using appropriate statistical methodologies to ensure their validity and reliability on a scientific basis.

The study found the following results:

- Results from a post-study test measuring creative problem-solving abilities (fluency, adaptability, and originality) showed that the experimental group that had studied English using brainstorming had a statistically significant advantage over the control group at the 0.05 level.
- Statistically significant differences were seen at a significance level of 0.05 between the average performance of the two groups in the study's achievement post-test. These differences were in favor of the experimental group, which used brainstorming as a method to study the English language subject.

**Keywords:** Brainstorming, Innovative thinking, Achievement

## 1. Introduction

Education systems are witnessing rapid and successive developments due to the tremendous information and communications technology revolution. The learning environment based on the Web (Learning Based-Web), with the services and capabilities it provides, is a renewable source of information related to curriculum topics; this would motivate students to self-learn according to their aptitudes and abilities and would develop their different levels of thinking (Al Saqriya & Kazem, 2021).

One of the most crucial tools for inspiring original thought and finding workable solutions to challenges in the academic, business, industrial, and political spheres is the brainstorming technique. American advertising agency manager Alex Osborn developed the brainstorming technique in 1938 due to the inefficiency of conventional business meetings. According to Jarwan (2005), a brainstorming session aims to generate new ideas for addressing an issue.

Brainstorming is a technique for coming up with many suggestions that could be applied to fixing an issue. It has been around for almost seventy years, and it is still used to get students interested in and involved in the process of addressing various problems <https://www.niu.edu/citl/resources/guides/instructional-guide/brainstorming.shtml>.

The use of e-learning, with its integrated system, in the learning environment is an essential requirement dictated by the need for the required qualitative development of the scientific content of the curricula, academic courses, and teaching methods necessary to activate the educational environment and enrich it with necessary data, methods, and technologies. E-learning, or "online learning," is a form of education that makes use of digital tools like computers, educational software, and the Internet to help students learn and grow by facilitating their interactions with course materials, instructors, and peers (Hammadena & Walqatis, 2015).

Despite the many advantages of e-learning, some see shortcomings in some aspects that this type of learning could not overcome, including that its costs are high, in addition to its lack of the element of human interaction between the teacher and the learner face-to-face, it does not help the individual enough to practice dialogue, discussion, and exchanging opinions. Learners who received electronic lessons are less efficient and skilled in dialogue and the ability to present ideas than others (Mahlangu, 2018; Alvarez, 2005).

Due to the availability of Internet applications and their uses in the educational process, many modern strategies have emerged that integrate the Internet into educational situations in an organized manner, with clear and sequential steps, such as the Electronic Brainstorming strategy, which is considered a development of traditional brainstorming, the idea of which appeared at the hands of Alex Osborn (in 1930) (Dhawan, 2022). Kohn et al. (2011) defined electronic brainstorming as the use of modern technology tools such as email, chat rooms, group support systems, and other various tools to facilitate the brainstorming process and help individuals share their ideas and build on the ideas of others.

Brainstorming is characterized by several advantages, including (Pham, 2022) maintaining complete confidentiality of the ideas presented and allowing the entry of ideas simultaneously and in parallel. It is also considered better for large groups and can reduce the harmful effects of the group's performance on the performance of individuals and increase the amount of ideas produced. Because of the comfort of individuals, the lack of intense fear of evaluation, the ease and speed of communication, and the ability to control cognitive interference.

Brainstorming strategy relies on student-centered learning. The one who examines its philosophical foundations, as Al et Momani Al (2008) state, is that it is based on the assumptions of Piaget's theories and constructivism through the principle of building knowledge; that is, the individual is the one who builds his knowledge of himself through a process of social negotiation with others, in order to achieve mental growth, get rid of self-centeredness, and build activity-based experience.

### *1.1 The Problem of the Study*

English has become the universal language due to its widespread use and status as the language of the modern age and technology. However, students struggle to master linguistic abilities, enhance their writing skills, and improve their thinking skills, all of which contribute to students' lack of proficiency in the English language. There has been an increase in the number of calls for the creation of English language curricula, the improvement of teaching abilities for educators, and the training of educators in contemporary teaching practices. Educators have blamed the methods used to teach English for pupils' poor command of the language. This is because a learner can only participate in real-world activities once he or she has mastered writing and speaking with others. While teaching English at Princess Alia University College, the researcher saw reduced female students' critical thinking abilities and academic performance due to their difficulties with reading, writing, and developing linguistic structures. Therefore, schools must implement cutting-edge teaching strategies, such as the brainstorming method, to ensure that their students are well-equipped to succeed in higher education and beyond in the English language. According to the researcher's understanding and the literature study results, there are no studies on the effectiveness of brainstorming for developing creative thinking. However, there are studies on the effectiveness of brainstorming for developing accomplishment and other characteristics. Researchers have found that encouraging teachers in elementary schools to use brainstorming in the classroom leads to favorable results. Drama was found to improve students' attitudes towards learning, and it was suggested that the method be applied to other factors, such as improving students' ability to listen and pick up on new concepts and trends.

This research aimed to determine the impact of brainstorming on students' creative thinking and performance in English class at Wadi Al Seer Directorate of Education in sixth grade.

### *1.2 The Aim of the Study and Its Questions*

The purpose of this research was to determine if and how employing brainstorming helped sixth-graders at Amman's Wadi Al Seer Directorate of Education think creatively and succeed in English class.

The current research aimed to accomplish this by addressing the following two questions:

1. How does brainstorming, instead of the conventional method of teaching English to seventh graders, affect the development of original thought?
2. How does using brainstorming to teach English to seventh graders compare to using the more conventional methods?

### 1.3 The Importance of the Study

The following are some areas where it is believed this research could prove helpful:

1. The use of the brainstorming technique in the field of Arabic studies.
2. Curriculum developers, classroom instructors, and school administrators can use this research's findings to improve their instruction methods.
3. Keep up with recent research on effective strategies for instructing English as a second language and stimulating creative thinking across the curriculum.
4. Give the instructor a template to follow for implementing brainstorming, and equip him with the knowledge, abilities, and experiences necessary to improve the educational process inside the classroom setting.
5. A record of the study's methodology, techniques, and analytical tools for further research.

### 1.4 The Study Hypotheses

Two hypotheses were explored in order to provide answers to the two research questions:

- There are no significant differences between using brainstorming and the traditional approach to encouraging creative thinking among sixth graders at the 0.05 significance level.
- Students' performance in sixth grade remains mostly the same ( $P > 0.05$ ) whether or not they employ brainstorming as an instructional strategy.

### 1.5 The Study Limitations

The extent to which the findings of this study may be applied to the community from which the sample was recruited or to communities like the one studied is determined by examining the indicators of validity and reliability of their tools.

### 1.6 Study Terms

The following are the meanings of the study's terms:

**Brainstorming:** This teaching method fosters an unrestrained and imaginative environment for students, free from the constraints of written texts. It introduces fundamental concepts using role-playing, improvisation, visualization, and gesture techniques. Then, it encourages students to explore and develop comprehensive ideas about it through their experiences. The outcomes are then presented symbolically.

It was operationally characterized as a teaching strategy incorporating physical and mental activity by having students engage in various theatrical activities that give them a chance to imagine and act.

**Innovative thinking** is recognizing issues and limitations, seeking answers, developing and testing theories, and sharing the findings with others.

According to the Torrance tests of inventive thinking, this is operationally defined as the students' scores on fluency, flexibility, and originality assessments.

**Achievement:** Students' performance on an achievement exam designed for this purpose can reflect how much they have learned from their academic experiences.

The procedural definition of the overall score in the achievement test was based on the researcher's preparation of the test according to Bloom's cognitive levels (remember, comprehend, apply).

## 2. Previous Studies

The following studies were reviewed:

Fazal et al. (2023) study comprising eighteen public elementary school teachers (ESTs) attempted to determine their opinions regarding increasing creative thinking and the roles played by family and school contexts in developing children's potential for creativity. Seven topics emerged from the analysis, including the following: the significance of creative thinking, the roles of instructors and the curriculum, teaching methods, implementation issues, school environments, and the role of the education department. Teachers understood the value of encouraging creative problem-solving but needed to gain the knowledge and tools to do it effectively. Furthermore, there needed to be more emphasis on creative thinking promotion in classrooms and curricula. Teacher education, adequate school supplies, and curricular improvements that encourage kids' originality are all necessities for solving this problem.

Thornhill-Miller et al. (2023) article discusses the conceptualization, evaluation, and valorization of

"21st-century skills" in response to the educational difficulties provided by the future of work. Particular attention is paid to developing the "4Cs" (creativity, critical thinking, teamwork, and communication) as essential soft skills. We begin with an overview of individual performance assessment for each of the four Cs and then move on to the more nuanced assessment of institutional support for the 4Cs' development (in places like schools, universities, and professional training programs). After showing the need for a publicly trusted assessment of the 4Cs, researchers describe the official assessment and certification process known as "liberalization," suggesting it as a solution to both problems. Next, two variants of the "International Institute for Competency Development's 21st Century Skills Framework" are provided. The first of these all-encompassing systems rates and labels educational programs and institutions based on how much they encourage and facilitate the growth of the 4Cs. The second evaluates non-formal training activities like playing a game. The researchers examine how the 4Cs and the difficulties of teaching and institutionalizing them are intertwined and how an innovative interactionist model of the 4Cs (ironically dubbed "Crea-Critical-Collab-ication") could help promote educational and policy goals. We briefly touch on prospects presented by forthcoming research and cutting-edge technology like AI and VR.

Bahar et al. (2023). This study examines the relationship between students' mathematical connection skills and their metacognitive abilities and how the Brainstorming technique can be used during the learning process to extract the finest ideas for enhancing students' mathematical connection abilities. Sixty children from a Junior High School in Sukabumi, West Java, Indonesia, are the subjects of a quasi-experiment in this study. The mathematical connection skill test and the metacognition questionnaire were utilized in this study. Data analysis uses the t-test, N-Gain, and Correlation Test. The study's findings demonstrate that 1) pupils who learn through the Brainstorming approach have higher mathematical connection skills than those who learn through the Expository method. Students' ability to make mathematical connections is enhanced (2) when the Brainstorming technique is used. Students' ability to reflect on and improve their thinking relates to their connection skills (3). The preponderance of Arabic suggests a real-world mathematical connection between this topic and other scientific topics. As a result, brainstorming can be employed as an alternate learning approach to boost students' mathematical connection and metacognition.

Agustina et al. (2022) study aimed twofold: (1) to measure students' creative thinking skills in mathematics in terms of SRL, and (2) to test the efficacy of a Creative Problem Solving (CPS) learning model that incorporates performance assessment. The study's sample included both members of Class VIII A (the experimental group) and Class VIII B (the control group). Students in Class VIII A at SMP Negeri 1 Tayu collected data from six different research subjects according to their SRL level using the purposive sampling method during the 2022/2023 school year. The researchers discovered that students' mathematical creative thinking abilities are improved through CPS learning with performance assessment. Additionally, they observed that individuals with high self-regulated learning (SRL) achieved all the indicators of mathematical creative thinking abilities: fluency, flexibility, originality, and elaboration. Subjects with medium SRL only achieved fluency, originality, and elaboration, while those with low SRL only achieved fluency and originality.

Tsai et al. (2020). In this study, researchers created a 635-brainstorming flipped classroom model for civics teaching, in which students read assigned materials in advance and in-class conversations are guided by the instructor. This study conducted a 6-week quasi-experiment in a civics class with 56 eighth graders, dividing them into two groups: one employed the brainstorming flipped classroom technique, while the other received traditional instruction. Student performance, civics learning motivation, citizen participation, teacher-student relationships, peer interactions, and creative output were all shown to be significantly higher in the flipped classroom than in the control group. At the same time, they can still learn the fundamentals of civics. In addition to aiding in the delivery of civics education, the present research's innovative flipped classroom method offers a robust framework for the entire learning process, including course design and pre-class preparation. The 635 method of flipped classroom brainstorming has pedagogical value and can be used effectively in the classroom.

### **3. Method and Procedures**

This section focuses on the methodology employed in the study, including the population under investigation, the representative sample chosen, the tools utilized, and the statistical analysis used to address the study's two research questions and test its two hypotheses. It also elucidates the variables involved in the study, outlines the study's design, and clarifies the procedures followed by the researcher during the implementation of the study.

#### *3.1 The Study Methodology*

The researcher chose a quasi-experimental methodology because it seemed most appropriate for the study's objectives.

### 3.2 The Population of the Study

Students attending middle schools in the Wadi Al Seer Directorate of Education constitute the study population.

### 3.3 The Sample of the Study

In order to make the most of the resources and opportunities at their disposal, two 7th-grade classes at two different schools within the jurisdiction of the Wadi Al Seer Directorate of Education were explicitly selected. The participants in the study's two sections were divided randomly into the first section, which comprised the experimental group of 124 pupils. The group received instruction on the fifth unit of the English language textbook for the first semester of 2022/2023, including brainstorming techniques. The control group, including 116 students, was assigned to the second section and received traditional instruction on the same unit of the English language. Table 1 presents the distribution of the study sample according to the group and school.

Table 1. Classification of the study's sample subjects

Study Group	Number
Experimental group	124
Control group	116
Total	240

### 3.4 Tools of the Study

The researcher validated the study's two hypotheses using a previously developed imaginative thinking examination and a previously produced achievement test, respectively.

#### 3.4.1 First: The Innovative Thinking Test

The researcher employed the Torrence test for innovative thinking with verbal forms (A) by utilizing a test that had been previously used in other studies. The test of innovative thinking (fluency, flexibility, and originality) was explicitly created and tailored for the discipline and age group on which the current investigation focused.

##### 3.4.1.1 The Test Validity

Prior to its implementation, the test's validity was confirmed through presentation to a panel of proficient and experienced arbitrators in the respective field. Eleven arbitrators participated in the process of providing feedback on the language formulation, the suitability of the test items in relation to the student's competence level, and their capability to evaluate innovative thinking qualities such as fluency, flexibility, and originality. In response to the observations the assessors gave, the appropriate revisions were made, which ultimately led to the final approval of the exam.

##### 3.4.1.2 The Test Reliability

The Cronbach Alpha, a measure of reliability, was calculated for the test to establish the reliability level present within the test itself. This estimate was used on a pilot sample of 16 students who were not included in the study sample. The following are the reliability coefficients that were determined for the inventive thinking skills: fluency (0.84), flexibility (0.80), and originality (0.83). The total dependability coefficient for innovative thinking was found to be 0.82; considering the purpose of the research, this is an acceptable result.

#### 3.4.2 Second: The Achievement Test

In order to evaluate the extent to which students have acquired knowledge and understanding of the content taught in the fifth unit of English language arts in the first semester of seventh grade, the researcher created a thirty-question multiple-choice test. This test assesses students' abilities in the lower three levels of Bloom's taxonomy: knowledge, comprehension, and application.

##### 3.4.2.1 The Test Validity

The first version of the examination, which consisted of thirty different questions as well as a table outlining the criteria for passing and the behavioral standards to be met, was given to the panel of arbitrators that was discussed before so that they could provide input on how accurately it mirrored the desired outcomes of the educational program. After receiving feedback from arbitrators, test items were reformulated to ensure they were more in line with the exam's stated objectives, had more understandable language, and were appropriately challenging to the test students.

##### 3.4.2.2 The Test Reliability

A pilot sample of (18) male and female students was used to validate the accomplishment exam outside of the study population, and the reliability factor was obtained in two ways:

- The test's internal consistency was measured using the Keyword - Richardson equation (KR-20), which was found to be (.86).
- In this study, the test was given to a pilot group and then to the same group again two weeks later as part of the test/retest methodology. Cronbach's alpha was determined, and it came out to be 0.88. Therefore, the study can proceed with confidence. The achievement test's discrimination and difficulty levels were also determined.

### 3.5 Teaching Plan Using Brainstorming

The unit plan was developed by the learning outcomes for the fifth lesson in English 101 during the first semester. Several instructional strategies were incorporated into the plan to achieve these outcomes, including brainstorming, the Six Hats method for cutely staging ideas, the study's proposed archaeology model, and an altered CORT thinking program.

### 3.6 The Study Variables

The study variables were identified and established in the following manner:

- Brainstorming Style
- Innovative thinking
- Achievement

### 3.7 The Statistical Treatment

- In order to verify the two study hypotheses and provide answers to the first two questions, the researchers calculated means and standard deviations. Also, they performed a "T" test of statistical significance between the two groups.
- The reliability of the tests was calculated using the Test-retest technique and the Kjord Richardson (KR-20) equation for internal consistency.
- The ANCOVA was employed to ensure equivalence between the experimental and control groups on the pre-test, preventing the pre-test findings from influencing the post-test results. Consequently, there was no requirement to establish equivalence between the two groups on the pre-test.

### 3.8 Correcting the Study Tool

First: Fluency: The student's score was determined by the number of accurate answers in each task, with one point awarded for each correct response.

Second: Flexibility: Following is a breakdown of how many questions the student got right in each exercise.

1. Since elasticity is in a direction-shifting process, no degree of elasticity is assigned to the initial response.
2. If there is no fluctuation in the pattern of answers, the degree of flexibility is 0.
3. A grade is awarded for each change in direction made, but no extra credit is given if the exact change is made more than once.

Third: Authenticity: To determine the level of uniqueness, we decoded all of the students' replies into a unique table for responses that detail the number of times we saw each response.

The frequency percentage for a specific response was calculated by taking the total number of occurrences of that response and dividing it by the total number of replies to the activity. The response is considered unique if the percentage of duplicate responses is less than 5%. However, when the occurrence rate is at least 5%, the answer is not regarded as novel, and the sign is not considered (Torrance, 1993).

## 4. Findings

This report aims to describe the findings of a study conducted in the Jordanian city of Amman, which addressed the following two questions: (1) What is the effect of employing brainstorming on fostering creative thinking and academic success in seventh-grade English classes?

### First: Findings related to question one:

"How does the use of brainstorming as opposed to the conventional method of teaching English to seventh graders affect the development of original thought?"

In order to answer this question and investigate the concomitant hypothesis, mean and standard deviation scores on a post-test measuring innovative thinking were calculated for a sample of seventh-graders. The test measured students' ability to think creatively and solve problems in novel ways. Table 2 displays the results.

Table 2. Standard deviations and means for students' scores on an originality quiz covering the elementary Arabic language curriculum in fifth grade Before and after

Group	N	Skill	Pretest		Posttest	
			Mean	Standard deviation	Mean	Standard deviation
Control	58	Fluency	3.32	1.887	4.42	2.277
		Flexibility	2.21	1.31	3.77	1.627
		Originality	1.81	.703	2.55	1.207
		Total	7.61	2.246	10.74	2.756
Experimental	62	Fluency	3.68	2.170	6.65	3.152
		Flexibility	2.21	1.009	6.12	1.181
		Originality	1.88	.808	4.76	1.208
		Total	7.76	2.955	17.53	4.589

The results of the inventive thinking test (fluency, flexibility, and originality) are presented in Table 2, which shows substantial differences in the average performance of elementary school pupils in the seventh grade studying English. The experimental group, who used brainstorming approaches, outperformed the control group, who used the more traditional method of instruction, with a mean score of (6.65) on the fluency skill.

Regarding the ability to be flexible, the experimental group achieved a mean score of 6.12, significantly higher than the score the control group received, which was 3.77. The experimental group, who were instructed to hone the ability of originality, averaged 4.76, whereas the control group averaged 2.55. The experimental group, employing brainstorming as a study method, attained a significantly higher average score of 17.53 on the innovative thinking test than the control group, which was instructed using the usual approach and achieved an average score of 10.74.

In order to assess the statistical significance of the mean differences, a one-way analysis of variance (ANOVA) was conducted at a significance threshold of  $\alpha \leq 0.05$ . The results of the ANOVA are presented in Table (3).

Table 3. Students' scores on the inventive thinking test in English 7 were analyzed using a one-way analysis of covariance (ANCOVA) to determine whether they differed significantly based on the teaching method.

Source of variance	Skill	Sum of squares	df	Mean of squares	F value	Sig	ETA square
Pre-test	Fluency	249.784	1	249.784	66.315		
	Flexibility	53.515	1	53.515	24.865		
	Originality	14.991	1	14.991	13.913		
	Total	553.358	1	553.358			
Teaching strategy	Fluency	57.011	1	57.011	15.136	0.000	<b>0.196</b>
	Flexibility	105.029	1	105.029	48.801	0.000	<b>0.440</b>
	Originality	75.992	1	75.992	70.527	0.000	<b>0.532</b>
	Total	709.412	1	709.412	119.18	0.000	<b>0.658</b>
ERROR	Fluency	233.529	62	3.767			
	Flexibility	133.434	62	2.152			
	Originality	66.804	62	1.077			
	Total	369.048	62	5.952			
Adjusted total	Fluency	563.785	64				
	Flexibility	276.000	64				

Originality	161.446	64
Total	1669.45	64

The results presented in Table 3 indicate statistically significant differences (at a significance level of 0.05) in the performance of seventh-grade students studying the English language subject on the innovative thinking test. These differences are observed in fluency, flexibility, and originality, specifically in the teaching strategy. The differences are based on the variable of the teaching method, as indicated by the calculated (P) value; the results indicate variations in the performance of seventh-grade students studying the English language subject on the innovative thinking test. Specifically, they achieved a high level of fluency (57.011) with a significant level of (0.000), and they also demonstrated a high level of flexibility (105.029) with a significant level of (0.000); with this result, the first null hypothesis is rejected, which asserts that: if the score on the originality skill test is (75.992), then the score on the originality skill test is (75.992). If the score is (75.992), then the score on the originality skill test is (0.000).

There is no statistically significant distinction in the development of creative thinking between utilizing brainstorming and the conventional method of instructing English to 7th-grade students at a significance level of 0.05.

The results shown in Table (4) show that modified arithmetic averages and standard errors were used to determine the differences between how well fifth-grade primary students did on the dimensional innovative thinking test (fluency, flexibility, and originality) when they were taught using different methods.

Table 4. Data from the Innovative Thinking Test (regarding students' fluency, adaptability, and originality) are shown for both the traditional and the alternative approaches to teaching English to seventh graders.

Group	Skill	Adjusted mean	Standard error
Control	Fluency	4.601	<b>0.348</b>
	Flexibility	3.658	<b>0.265</b>
	Originality	2.575	<b>0.188</b>
	Total	10.832	<b>0.439</b>
Experimental	Fluency	6.483	<b>0.334</b>
	Flexibility	6.224	<b>0.253</b>
	Originality	4.742	<b>0.179</b>
	Total	17.449	<b>0.419</b>

As seen in Table 4, the modified mean performance of primary school children in the seventh-grade English language subject changed depending on the teaching technique, particularly the innovative thinking test (fluency, flexibility, and originality). The mean fluency score of the experimental group taught with brainstorming strategies was 6,483, significantly higher than that of the control group taught with more conventional strategies (4,601).

The experimental group had a higher level of flexibility, with a mean score of 6.224, compared to the control group's mean score of 3.658. Similarly, the experimental group showed more extraordinary originality with a mean score of 4.741, compared to the control group's score of 2.575. In terms of the overall sum, the experimental group obtained a mean of 17.449, surpassing the control group's mean, which was 10.84.

The experimental group, which utilized brainstorming as a teaching strategy, outperformed the control group, which was taught using conventional methods, regarding the performance of 7th-grade students in the English language subject on the post-innovative thinking test. This difference was observed in fluency, flexibility, and originality; the size of the effect, as measured by ETA square values (0.659), suggests that students' usage of brainstorming significantly impacts their inventive thinking when studying the English language in seventh grade.

**Second: Results related to the second question:**

"How does using brainstorming to teach English to seventh graders compare to using the more conventional methods?"

In order to address this inquiry and evaluate the associated hypothesis, the averages and measures of variability for the performance of 7th-grade pupils in the English language topic were computed using the pre/post thinking test. The data shown in Table 5 demonstrates this.

Table 5. Statistics on the pre-and post-test achievement levels of 7th graders in English, including means and standard deviations

Group	N	Pre-test		Post-test	
		Mean	Standard deviation	Mean	Standard deviation
Control	116	16.34	3.46	18.18	<b>4.56</b>
Experimental	124	14.64	2.22	25.25	<b>3.63</b>

As seen in Table 5, there are significant variations in how well 7th graders, on average, do on the English language post-achievement test. The experimental group taught through brainstorming obtained a mean score of (25.25), unlike the conventional teaching group, which averaged (18.18). The standard instruction group was taught through traditional methods. In order to determine whether or not the differences between the means are significant at the (0.05) level, we ran an associated one-way analysis of variance (ANCOVA), and the results are shown in Table 6.

Table 6. One-way analysis of covariance (ANCOVA) to determine whether or whether there are statistically significant differences in the achievement test scores of seventh graders in English, broken down by teaching method

Source of variance	Sum of squares	df	Mean of squares	F value	Sig	Eta square
Pretest	151.477	1	151.477	10.419	0.003	
Teaching strategy	850.938	1	850.938	58.525	0.000*	<b>0.487</b>
ERROR	901.482	62	14.541			
Adjusted total	1857.2	64	1857.2			

The findings shown in Table (6) demonstrate that there are statistically significant disparities, with a significance level of (0.05), in the performance of 7th-grade students in the English language subject on the post-achievement test. The test was administered to measure the student's level of achievement in the English language topic. These disparities are observed across different teaching strategies, as indicated by the teaching method variable. The second null hypothesis was rejected based on the calculated value of (q), 58.525, and the significance level (0.0000). This result contradicts the hypothesis that there are no statistically significant differences ( $\alpha \leq 0.05$ ) in the English language subject achievement of seventh-grade students when brainstorming is utilized as opposed to the conventional method.

The modified means and standard errors are shown in Table (7) to help us understand the significance of the changes in post-achievement test scores for 7th graders in English language subjects by teaching approach.

Table 7. Seventh-grade primary students' post-achievement test scores in English, adjusted for means and standard deviations across instruction methods, show a wide range of performance

Group	Adjusted arithmetic mean	Standard error
Control group	18.079	0.687
Experimental group	25.342	0.656

The results of the post-achievement test taken by seventh-grade students in the English language subject are presented in Table 7, and they show that the student's average performance differed depending on the instructional method used. The experimental group, instructed through brainstorming, attained a mean score of 25.342, exceeding the mean score of the control group instructed in the traditional manner, which was 18.079. This suggests that brainstorming has a noticeable influence on the academic achievement of seventh-grade students in the English language subject. The experimental group, which employed brainstorming, demonstrated superior performance to the control group regarding English language competency on the post-assessment test.

This study was conducted among sixth-grade children exposed to different teaching methodologies.

## 5. Discussion of the Results

The purpose of the research done in Amman, Jordan, was to find out how effectively using brainstorming may encourage innovative thought and improve student performance in English lessons for seventh graders. Significant differences in 7th graders' English language performance were found in fluency, flexibility, and originality, all related to the first question's focus on developing unique thought.

The mean scores for both the traditional instruction group and the brainstorming group are shown in Table 2. In every category of the inventive thinking test, the experimental group outperformed the control group, with mean scores of 6.65 versus 4.42, 6.12 versus 3.77, 4.76 versus 2.55, and 17.53 versus 10.74.

Table 3 displays the results of a one-way analysis of variance (ANOVA), confirming the statistical significance of the variations in means presented there. The first null hypothesis was rejected since the ETA square values showed significant effects of the teaching approach on fluency (0.658), flexibility (0.440), originality (0.532), and total score (0.658).

For the second part of your inquiry, we compiled data on 7th graders' English pre-and post-test scores to show how brainstorming compares to more traditional approaches (see Table 5). The experimental group, taught through brainstorming, displayed a considerably higher mean score on the post-achievement test than the control group (25.24 vs. 18.19).

Table 6 further supports these results through a one-way analysis of covariance (ANCOVA), which shows statistically significant differences in the post-achievement test scores of seventh-graders when stratified by teaching technique. The results of the second hypothesis test showed that the two approaches to teaching English resulted in statistically significant variations in student outcomes.

Table 7 presents the adjusted means and standard errors for the seventh-grade students' English language scores, highlighting the apparent influence of brainstorming on these scores. After being instructed to use brainstorming, the experimental group's mean score on the post-achievement test increased to 25.341 from 18.078 in the control group.

Compared to the current literature, the findings corroborate previous studies showing how innovative teaching strategies can improve students' inventive thinking and academic performance. Numerous studies, such as those conducted by Fazal et al. (2023), Agustina et al. (2022), Thornhill-Miller et al. (2023), Bahar et al. (2023), and Tsai et al. (2020), highlight the value of encouraging creative thinking, the success of CPS models, and the significance of 21st-century skills, among which is creativity, in educational settings.

In conclusion, the study's in-depth research and statistical evidence support the claim that brainstorming considerably contributes to cultivating creative thinking and boosting academic success among seventh-graders in English classes.

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#### Websites

<https://www.niu.edu/citl/resources/guides/instructional-guide/brainstorming.shtml>

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#### Authors contributions

Dr. Amaal Al Masri was responsible for the study design and revising the language and the literature review section. Dr. Mona Smadi was responsible for data collection and data analysis. All authors read and approved the final manuscript.

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#### Data sharing statement

No additional data are available.

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