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Cultural Integration on Geometry Lesson: The Impact of Traditional Game-Based Learning on Students' Creative Thinking

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Abstract

This study investigates the impact of traditional game-based teaching on the geometry students' creativity, emphasizing similarity and parallelism concepts. Creative thinking is important in education, but memorization typically overshadows it. Traditional games can connect the curriculum to students' cultures and boost engagement and creativity. A quasi-experimental design with a pre-test and post-test control group of 40 students assigned 24 to the experimental group, which received traditional games training, and 16 to the control group, which received conventional instruction. Students' fluency, flexibility, and originality were tested, and N Gain scores rated their improvement. The findings showed that the students in the experimental group excelled further than the students in the control group on all of the measures of creative thinking. The results achieved the most significant enhancement in fluency and flexibility while there was a less significant increase in originality. This indicates that playing traditional games helps students to come with ideas and diversify their approaches but would necessitate other activities to develop originality. The intervention also exhibited the effectiveness of culturally relevant pedagogy in combining the students' cultural background and sociometric ideas by making geometry more appealing. To deepen the understanding of how traditional games affect students' creative thinking further research should have a larger population, extended duration of the intervention and more games to ensure better understanding of the long-term effects and originality improvements. The originality of this study is centered on the fact that cultural assets can be embedded into classroom activities and shows the importance of using traditional games such as Gobak Sodor in promoting students' creative and mathematical thinking as well as their cultural identity in a holistic way.

Keywords: *Creative Thinking, Cultural Context, Geometry Lesson, Traditional Game.*

Introduction

Creative thinking is becoming more prominent in contemporary education as it promotes innovation, flexibility, and problem-solving which are critical in handling sophisticated and diverse situations (Handayani et al, 2020; Purnomo et al, 2023; M. Runco, 2008). However, nurturing creative thinking skills among the students poses a challenge especially in conventional classrooms where emphasis is put on rote and standardized testing rather than creativity (Kaufman, 2016; Kaufman et al, 2013a; Kaufman & Sternberg, 2010). Recently, there has been increased inclination towards incorporating cultural elements (traditional games) into teaching in order to foster creativity in students. Owing to their nature, traditional games are not only a means of culture but also a vital source of cognitive flexibility, originality and creativity which are key aspects of creative thinking (Kaufman et al, 2013b; Plucker et al, 2004). In Indonesia, traditional games like "Gobak Sodor" are deeply embedded with strategies, improvisation and team work. Such attributes resonate with the fundamentals of creative thinking and as such traditional games can be effective means of stimulating creativity among students (Kawuryan et al, 2018).

The influence of traditional or indigenous games in enhancing creativity is now gaining prominence in educational research as scholars look for effective alternatives to the traditional approach of pushing and constraining children through relevant culture and practices to enhance their cognitive abilities. According to previous researchers, scholars argue that the use of traditional games can facilitate the learners' active participation and the development of higher order thinking skills (Kawuryan et al., 2018). Players of these

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games are required to change their tactics, find solutions to problems as they arise, and think outside the box in order to beat the game, which can make certain cognitive processes that are related to creativity active (Breuer, 2011; Saenboonsong & Poonsawad, 2024). Many scholars, however, dealt with creative cognitive activity using Western approaches and techniques, while there are few who investigated the Culturally Situated Practice's role, namely traditional games, within a non-Western framework (Ge et al., 2022; Saura & Zimmermann, 2021). Moreover, while the literature on the role of creative thinking in education is growing, few concrete and workable ways to teach the creative thinking skills in activities that are appropriate to the region and its culture have been discussed. This article fills in these gaps by reporting a study which investigates the effectiveness of an intervention using traditional games on the enhancement of creative thinking skills in the Indonesian context.

This current study aims to evaluate the impact of a traditional game-based approach on students' creative thinking skills, particularly, fluency, flexibility and originality. The following research questions, among others, will direct this study: Contrary to traditional teaching methods, does an intervention employing traditional games help in improving any overall creative thinking skills of students relative to using usual impartation approaches? In addition, what aspects of creativity skills, that is, fluency, flexibility and originality, are emphasized by the intervention? In answering these questions, the study intends to testify these claims and particularly center on the role of culturally relevant methods in improving creativity and arguing in the wider framework of creative skills in schools.

This research is unique due to its focus on creative skills development through implementing traditional games within formal education. Although previous researches have covered creative thinking as well as cultural aspects in education, only few of them have targeted the role of traditional games in shaping one's creativity in classrooms (Trusty et al., 2004a). This research addresses the link between culture and cognitive development by emphasizing the use of traditional games as not just recreation but an integral part of the curriculum on developing one's creativity. The statement examines the possibility of traditional games augmenting educational objectives which in turn develops the existing pedagogical practices on improving creativity.

Through understanding the importance of retaining and valorizing the culture, it is evident that there is a problem with regards to education in regions such as Asia, where traditional methods are prevalent. The challenges of the modern world require new age problem solvers which cannot be accomplished because educational systems have remained stagnant and overdependant on textbooks. In Indonesia, explaining how nurturing these games creates new opportunities for children's education while simultaneously supporting a crucial national agenda is important. So, there is a scope of study which is constructive and embraces issues of culture and improves the situation in terms of creative thinking skills.

The research explores a framework with strategies that can be utilised to enhance the educational content that cultivates and enriches a specific culture by including creativity through the use of traditional games. This study emphasises the concrete impacts of this method on the enhancement of creative attributes in individuals, which would benefit both educators and organisations aiming at wider audiences. Furthermore, it provides the rationale for integrating cultures into the educational curriculum, hence enhancing the applicability of innovative educational practices across other cultures (Palinkas et al., 2015; Shih, 2022). This study suggests that enhancing children's informational skills is beneficial, provided that cultural heritage is preserved and utilised to promote educational outcomes.

Methodology

Research Design

The purpose of this study was to determine the effectiveness of a particular educational intervention on students' creative thinking skills in a quasi-experimental design with a pre-test and post-test control group. This approach is suitable in one or more educational interventions when there is no or extreme objection against randomization of samples yet the groups have to be compared in order to draw a possible influence (Creswell, 2014). For example, some people, like primers, were put into an experimental group which received the intervention, and primed in control group which did not. This allowed the researchers to compare players in the same group over time to see how their scores changed and between different groups to assess the impact of the intervention (Shadish et al., 2002).

Participants

In this particular study, 40 students participated, 24 of whom were placed in the experimental group, while the 16 were included in the control group. Using purposive sampling, the sample was also selected in such a way, that the students possessed similar baseline characteristics pertinent to the study; Grade level, previous academic performance and exposure on similar teaching methodologies before the intervention. As emphasized by Palinkas et al. (2015), purposive sampling is within the scope of quasi-experimental designs when the study intention is to include research subjects depending on certain characteristics rather than through randomization.

Intervention

The intervention comprised a module of study aimed at the improvement of the students' creative thinking abilities. This program included exercises aimed at achieving fluency, flexibility, and originality which are important components of creativity in the educational perspective (Guilford, 1967; Sawyer & Henriksen, 2023). The intervention phase was practiced across sections for a period of 4 weeks during which the students of the experimental group participated in activities incorporating traditional game contexts and exercises designed to foster fluency, flexibility and originality. The control group however carried on with the normal syllabus. This kind of arrangement made it possible to measure the development of creative thinking in on the one hand the experimental and on the other hand the control groups (Mathisen & Bronnick, 2009; Yan et al., 2022).

Data Collection Instruments

Creative Thinking Test

In order to evaluate the creative thinking skills of the participants, a Creative Thinking Test (CTT) was utilized both as a pre-test and a post-test. The CTT has tasks that 'fluency', 'flexibility', and 'originality' as criteria which are regarded as elements of creative thinking (M. Runco, 2008; M. A. Runco, 2014; M. A. Runco & Jaeger, 2012). All the components were given a score in isolation so that an overall score for creative thinking and separate scores for fluency, flexibility, and originality could be derived from the assessment.

N-Gain Calculation

The relative advancement concerning creative thinking skills from pre-test to post-test in this case, was quantified by a score which is more frequently referred to as an N-gain, or a normalized gain. In educational research, the N-Gain is a formula which is quite frequently utilised in order to measure the level of improvement achieved in learning in a standardized manner, especially in instances when pre- and post-test designs are employed (Hake, 1998, 2007). In this research, the N-Gain for the overall creative thinking score as well as for each subcomponent- fluency, flexibility and originality, was computed. These subcomponent scores provided additional information on how each of the indicators of creative thinking assessed in the study was affected by the intervention.

Data Analysis

Descriptive Statistics

Descriptive statistics were calculated for both groups' pre-test and post-test scores. These statistics provided an overview of the baseline performance and post-intervention outcomes for each group. According to Pallant (2020), descriptive statistics are essential for understanding the data's general trends and comparing

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the central tendencies and variabilities across groups.

Assumption Testing

Before analyzing the data inferentially, it was ascertained through conducting assumption tests that the data adequately satisfied the requirements for either parametric or non-parametric tests. To establish whether the dataset was normally distributed, Kolmogorov-Smirnov and Shapiro-Wilk's tests were utilized as recommended by Ghasemi and Zahediasl (Ghasemi & Zahediasl, 2012). Also, Levene's Test for Equality of Variances was carried out in order to evaluate the equality of variances, a pre-requisite in Independent Samples T-Test. For the pre-test and post-test datasets, assumption tests assisted in choosing appropriate statistical techniques for their analysis (Field, 2017).

Inferential Statistics

The assumption tests led to various statistical analyses being performed for the pre-test data and the post-test data. The specific one-tailed Independent Samples T-Test conducted in this study was used in the case of average scoring of an experimental group and control group and therefore formed the pre test, but this is supported by the fact that normality and homogeneity of variance are satisfied. These assumptions have been shown to be suitable for the comparison of two independent groups by Aljandali (2017), Field (2017), Ghasemi & Zahediasl (2012) and Tabachnick et al. (2019). The t-test has also been necessary in establishing whether there were statistically significant differences in Baseline Scores between the target groups ensuring that all groups received equivalent treatment before the intervention began.

Normality of the data distribution of the variables cannot be established, thus, the Mann-Whitney U test was done to examine the difference between the mean ranks within the two populations. The Mann-Whitney U test is aimed at comparing two independent samples out of which normal distribution is not made a prerequisite (Nachar, 2008). This test sought to find out the post-test N gains of experimental groups and control group in terms of overall test score and each of the three subcomponents that is fluency, flexibility and originality. If the statistical data does not satisfy the parametric assumption, the Mann-Whitney U test will yield favorable results which is the case in this study (Tabachnick et al. 2019).

Effect Size Analysis

In order to further shed light on the practical relevance of any differences observed, effect sizes were derived using Cohen's d for the t-test results and rank-biserial correlation for the Mann-Whitney U Test results. According to Trusty et al., 2004 , effect sizes are useful in a situation where there is a desire to make interpretations about the importance of differences between groups in addition to their statistical significance. In this particular research, Cohen's d and Hedge's correction was utilized for analysis of the pre-test t-test, while the rank-biserial correlation was applied to the analysis of Mann-Whitney U Test for post-test N-Gain scores, as suggested by Pallant (2020). These effect size analyses enhanced comprehension of the creative thinking skills intervention's impact on the educational environment.

Findings and Discussion

Normality Test

Determining whether a set of data follows a normal distribution pattern is of utmost importance in statistical inferences, and it determines the selection of a particular statistical test or procedure. (Both parametric and non-parametric tests can be used according to the normality distribution of data). This was the case, for instance, in this research where participants' pre-test and post-test control and experimental groups normality was observed using Kolmogorov-Smirnov and Shapiro-Wilk tests.

As for the pre-test, as shown in Table 1, the Kolmogorov-Smirnov test yielded a statistic of 0.062 with a significance value of 0.200 ($p > 0.05$), and the Shapiro-Wilk test indicated a statistic of 0.984 with a significance of 0.830 ($p > 0.05$). From the results published the pre-test signified that normal distribution

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of scores were assumed. This, indeed, corroborates with the existing body of evidence in the educational research that with confirmed normal distribution, it is possible to reliably apply parametric statistical methods.

For the post-test as shown in Table 1, the Kolmogorov-Smirnov test returned a statistic of 0.128 with a significance of 0.099 ($p > 0.05$), indicating normality. However, the Shapiro-Wilk test showed a significance level of 0.017 ($p < 0.05$), indicating a deviation from normality for the post-test data. The inconsistency between these two tests suggests that the post-test scores may not meet the assumptions for normality. According to Field (Field, 2017), the Shapiro-Wilk test is often more reliable for smaller sample sizes, which further validates the interpretation of the post-test data as not perfectly normal. Consequently, in situations of non-normality for post-test scores, researchers recommend either transforming the data or opting for non-parametric analysis methods, especially for outcome comparisons(Vrbin, 2022).

Table 1. Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-Test	.062	40	.200*	.984	40	.830
Post-Test	.128	40	.099	.930	40	.017

Homogeneity Test

The efficiency of Levene's Test in addressing the question of group's similarity with regards to variances which is a prerequisite for conducting the Independent Samples T-Test is illustrated by(Panos & Boeckler, 2023).

As reported, the significant values for pre-test and post-test Levene's Test results were 0.412 and 0.405 respectively, both $p > 0.05$. These results validate the assumption that the variances 'the control group and the experimental group measure are invariant or equal. Invariance of the factor measurement across groups is one of the key principles underlying the use of parametric tests. Furthermore, the outcome of the study (Panos & Boeckler, 2023) also highlights the same feature of the homogeneity, the assumption ensures that the differences in mean scores can be attributed to the treatment rather than to variance across the groups, thereby supporting the appropriateness of the Independent Samples T-Test.

Table 2. Independent Samples Test

				t-test for Equality of Means			
		F	Sig.	t	df	Significance	
						One-Sided p	Two-Sided p
Pre-Test	Equal variances assumed	.688	.412	-.364	38	.359	.718
	Equal variances not assumed			-.348	27.398	.365	.730
Post-Test	Equal variances assumed	.708	.405	-1.315	38	.098	.196
	Equal variances not assumed			-1.387	37.153	.087	.174

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Pre-Test Results

The pre-test results were analyzed utilizing an Independent Samples T-Test to ascertain whether the experimental and control groups differed significantly at baseline. This analysis is to confirm that the groups were comparable at baseline, which is one of the requirements for conducting experiments when making post-intervention comparisons (Boeckler, Panos, 2023).

Table 3. Pre-test Results

	Group	N	Mean	Std. Deviation
Pre-Test	Experimental	24	20.29	10.457
	Control	16	18.94	13.005

The interpretation of the results shows that the experimental group had an average pre–test score of 20.29 with a standard deviation of 10.457 while the control group had a mean score of 18.94 and a standard deviation of 13.005, as shown in Table 3. The difference observed in the mean test scores of the groups was quite low at 1.354 and this shows that the two groups were more or less at the same level before the intervention. The relatively high standard deviations in both groups are quite common in educational research contexts. (Panos & Boeckler, 2023).

In order to test the suitability of the Independent Samples T-Test, the Levene's Test for Equality of Variances was done. A significance level of 0.412 ($p > 0.05$) was found which implies that the variances of the two groups were not significantly different. This gives evidence that there was equality of variances and also one of the prerequisites for carrying out the Independent Samples T-Test as stated by Schmidt (1996).

A T-test for Independent Samples in 4 reported a t = 0 364 df = 38 and two tailed p = 0.718 such that $p > 0.05$: Given that this value is more than 0.05 is the level between the two groups Experimental and Control in terms of Pre-test Mean was not certain. This suggests that the two groups assessment's pre-test results do not reveal any statistically significant difference thereby confirming that they were at the same level at the start of the experiment (Ghasemi & Zahediasl, 2012). The confidence interval (CI) for the mean difference ranges from -6.179 to 8.888 even further implying that the observed mean difference may have arisen merely by chance. Further, when the CI includes zero, it is suggested by the current statistical guidelines that the mean difference is not of any statistical significance (Kline, 2016).

Table 4. Independent Samples Test

				t-test for Equality of Means							
		F		t	df	Significance		Mean Diff	Std. Error Diff	95% Confidence Interval of the Diff	
						One-Sided p	Two-Sided p			Lower	Upper
Pre-Test	Equal variances assumed	.688	.412	.364	38	.359	.718	1.354	3.721	-6.179	8.888
	Equal variances not assumed			.348	27.398	.365	.730	1.354	3.889	-6.621	9.329

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Effect size is vital in providing the magnitude of the differences between groups and not only the statistical significance level (Cumming & Calin-Jageman, 2016). Kosinski et al. (2018) reported Cohen's d consistent with this study. In this context, Cohen's ds were applied in determining the significance of the minimum differences witnessed on the mean of pre-test marks across the two groups, and in this case experimental and control. The computed value of Cohen's d shows that the effect is close to zero (d = 0.117) as would be expected since the p-value is also not significant. Cohen's d values which are less than 0.2 are in most instances considered to have no appreciable effect and thus support the reasoning that there is no difference at the baseline among the groups (Trusty et al., 2004b). Small effect sizes were also observed when Hedges' correction and Glass Delta was used at 0.115 and 0.104 respectively implying that the observed threshold difference is likely to be very insignificant. These small effect sizes indicate that the two groups were comparable on the pre intervention measures and therefore lend credibility to subsequent comparisons (Yi et al., 2022).

Table 5. Independent Samples Effect Sizes

		Standardizer[a]	Point Estimate
Pre-Test	Cohen's d	11.530	.117
	Hedges' correction	11.764	.115
	Glass's delta	13.005	.104

Post-Test Results

Post-test outcome measurements were compared between the two independent groups using the Mann-Whitney test, which is appropriate in this scenario because the assumptions related to the data distribution are not fulfilled (Nachar, 2008). This tactic was selected based on a pre-test evaluation demonstrating normal aversion tendencies on the post-test data, which in turn makes the Mann-Whitney U Test the most appropriate in testing for differences between groups (Field, 2017).

Table 6. Mann-Whitney Test Result (Ranks)

	Group	N	Mean Rank	Sum of Ranks
Post-Test	Experimental	24	23.23*	557.50
	Control	16	16.41	262.50
	Total	40		

The Ranks table gives hints about the position of test scores of the experimental group and control group in relation to each other. The ranks' mean of the experimental group was 23.23, the sum of ranks was 557.50 while the control group had a mean of 16.41 and the sum was 262.50. In the experimental group, the mean rank being higher than that of the control group indicates that the students in this particular group had higher scores in the post-test than their colleagues in the latter group. When mean ranks favourable for one group to the exclusion of another are substantially different from each other it is a common rule of thumb that they reflect differences in the degree of performance of the groups in context and this means a beneficial consequence of the treatment on the students in the experimental group (Pallant 2020).

The experimental and control group's performance after the intervention is statistically evaluated using the Mann Whitney U Test results. The Mann-Whitney U Test was calculated to be 126.500 with Wilcoxon W 262.500, Z-score – 1.811 and Asymptotic Significance (2-tailed) 0.070. The p-value (Asymp. Sig. = 0.070) in general implies that little difference exists between the experimental and control groups at the common 0.05 significance level ($p > 0.05$). It can be said that this p-value slants towards significance but does not reach it, it may be supported by evidence at a 10% significance level ($p < 0.10$). In the context of recent

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literature, it has been observed that trends can be at 10% as it seeks to show potential trends while enabling exploratory studies or small samples that provide understanding of intervention effect that do not hit the usual mark of significance level (Gibson, 2021).

N-Gain Results

As outlined in the Table 7, the Mann-Whitney U test was employed to conduct the statistical analysis of N-Gain scores owing to the fact that it is ideal for the comparison of two separate groups with no normal distribution of data. This test was used to analyze changes in the scores of students in both the experimental and control groups after the intervention, taking into consideration their scores from the pretest and the post-test with the aim of determining if such changes existed between the groups. The N-Gain scores were calculated for overall gain and specific dimensions: fluency, flexibility, and originality.

From the analysis, the results show that the comparable group had lower mean ranks than the experimental group across every N-Gain measure(as shown in Table 7). First addressing N-Gain as a whole, the experimental group achieved a mean rank of 22.35 alongside a Sum of Ranks of 536.50 — the figures of the comparable group were lower, at 14.61 for the mean rank and 204.50 for the Sum of Ranks. Turning our focus to N-Gain Fluency, the experimental group's mean rank was 22.71 this time, and for the control group remain the same at 14.00. Aside from N-Gain Originality, where the control groups mean rank moved down to 16.00 — the experimental group's mean rank value remained the same alongside the N-Gain. All of these results portray a distinct pattern.

Table 7. N-Gain result (Ranks)

	Group	N	Mean Rank	Sum of Ranks
N-Gain	Experimental	24	22.15	536.50
	Control	16	14.61	204.50
	Total	40		
N-Gain Fluency	Experimental	24	22.71	545.00
	Control	16	14.	196.00
	Total	40		
N-Gain Originality	Experimental	24	21.54	517.00
	Control	16	16.00	224.00
	Total	40		

With reference to Table 8, the findings of the Mann-Whitney U test provide a mate between the general N-Gain as well as its components (fluency and originality) of the experimental and control groups. The disparities in the general N-Gain and N-Gain Fluency were found to be statistically significant ort while the N-Gain Originality was not found to have any significant disparity.

In regard to overall N-Gain, the Mann-Whitney U test produced $U = 99.500$ for the test statistic, $Z = -2.074$ for the Z score, and $p = 0.038$ for the p value. Such a p value is significantly higher than the level of significance of 5 percentage which indicates the presence of at least one statistically significant difference between the two samples. It can be inferred that, there was an improvement in performance by the experimental group relative to the control, bearing in mind that the experimental group maintained a higher average rank than the control group and the intervention performed did have its effects. This demonstrates that the treatment done to the purely experimental group made tremendous progress in the students' performance when compared to their counterparts.

For the N-Gain Fluency which was derived from Mann Whitney U test as $U = 91.000$, Z score of -2.332 and the p result of 0.020, The intervention significantly raised students' performance as it was at $p < 0.05$. This indicates that the experimental group was able to improve faster in fluency than the control group. Fluency is one of the elements in creative thinking and it means producing a great number of ideas or

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solutions. The high p value confirms statistical significance and the statement that the students` fluency was improved in the experimental group compared to the control group.

On the other hand, for the case of N-Gain Originality, the Mann-Whitney U test results showed $U = 119.000, Z = -1.486$ and $p = 0.137$. Because the p-value is too high, > 0.05, this means that originality gains were not statistically significantly different between the experimental and control groups. Thinking creatively can also be defined as the 'ability to think of new or unique ideas', and the implication of the result being insignificant is that the strategy used in the intervention was not able to address this dimension of creative thinking.

Table 8. Mann-Whitney U Test Score

	N-Gain	N-Gain Fluency	N-Gain Originality
Mann-Whitney U	99.500	99.500	99.500
Wilcoxon W	204.500	204.500	204.500
Z	-2.074	-2.074	-2.074
Asymp. Sig. (2-tailed)	0.038	0.038	0.038

In determining N-Gain Flexibility within this specific study, a t-test was established as the data collected for the experimental and control groups were determined to be normal and within range making the parametric test able to be utilized to evaluate the variance between the two processes. The results uncovered an evident disparity between the sample averages possessed by the two groups (t=1.898,p=0.033). This alludes to the fact that students' flexibility, one of the most important elements of creative thinking, was enhanced during the course of the intervention. Flexibility is defined as switching the point of view on a task or a problem and comes in great hand in supporting innovative and flexible thinking.

The mean score of the experimental groups was recorded as 0.5704 (showing a standard deviation of 0.23132) while the control group had a mean score of 0.4308 and a standard deviation of 0.17490. The control group's scores were even lower than the average, indicating that the improvement was significantly higher for the experimental group as compared to the control group. Moreover, there is a significant difference between the average scores of the two groups, defining the experimental group's high flexible thinking ability development which was a result of the intervention done to the group.

Moreover, the intervention analysis revealed statistical significance with a Cohen's d value of 0.654 which is interpreted as a moderate effect size. This further implies that the intervention was practically useful in developing flexibility along with being statistically significant, while the medium effect size adds to the evidence that the intervention did assist the students in broadening their thinking and employing different mental strategies in the problem-solving tasks.

Discussion

Normality Test and Homogeneity Test

The results of both the normality and homogeneity tests serves as a basis for choosing the best statistical tests. The normal distribution of the prewest scores and homogeneity of variances of both the pretest and posttest scores justifies the use of the Independent Samples T-Test for the pre-test. However, normality of post-test data was not fully confirmed (p = 0.017 in Shapiro-Wilk) therefore a level of caution should be employed.

In practice, such slight deviations from ideal normality as found in this study, may not invalidate the results of parametric tests,such as the T-Test, where sample sizes are of reasonable size (Schmidt, 1996). However,

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in order to take extra precautions, some researchers like Pallant (Pallant, 2020) recommend applying non-parametric tests in post-test analyses so as not to introduce potential biases due to non-normality of data. Moreover, the effect sizes computed for the pre-test and post-test respectively suggest that although groups are different, the differences may not be great enough to yield statistical significance. This outcome indicates that further research will be worthwhile with larger samples and therefore improved considerability of statistical conclusions.

In conclusion, the pre test and post test were administered in a way that the data's normality and homogeneity assumptions were not completely violated thereby allowing for the use of parametric testing for the pre test and passive caution for the post test. The findings obtained add to the understanding of how various statistical tests can be applied in educational interventions with emphasis on assumption tests which allow valid conclusions to be drawn (Kline, 2016).

Pre-Test Results

Pretest analysis findings showed that there was no pre-existing statistically significant difference between the experimental group and the control group. This equivalency is important in that it minimizes the chances of pre-existing disparities being mistaken as post-test results that are attributable to the intervention program (Panos & Boeckler, 2023).

Other studies recommend that pre-existing differences should be addressed especially in experimental studies within an educational context, where there is a high potential for individual differences (Ghasemi & Zahediasl, 2012; Schmidt, 1996). Such finding conforms to current literature indicating that it is non-significant baseline difference where the intervention effect is demonstrated that minimizes bias in the interpretation of intervention effect (Kline, 2016).

Having no significant difference in the pre-test scores indicates that the internal validity of the experimental design has not been compromised and thus provides greater legitimacy in the evaluation of the effectiveness of the intervention. As noted by Trusty et al. (Trusty et al., 2004b), such moderate small effect sizes as reported in this study definitely increase the chances that the difference is not caused by systematic differences between groups. These therefore give strong support in the validity and interpretation of outcome post-intervention analysis.

Pre-test analysis results buttress the view that experimental groups and control groups are at equilibrium prior to experimentation with no statistically significant difference in their starting level. This result confirms the validity of the research design for the study, enabling the researcher to proceed with more confidence in the post-test differences as having been primarily caused by the treatment implemented.

Post-Test Results

The Mann-Whitney U Test analysis indicates that the application of the treatment was beneficial. That is despite the fact that the outcome did not achieve statistical significance level. Indeed, the comparison of mean ranks supports the consideration that the intervention worked since post-test scores of students who learned with the help of the intervention were generally better than those of the students in the control group although this difference did not reach the conventional level of significance.

Despite the fact that the vote is negative due to the fact that the Asymptotic Significance value is in the range of 0.070, the study within the framework of the meta (perception) analysis by Nakagawa and Cuthill (Nakagawa & Cuthill, 2007) also claims that such conclusions are limited. It further claims that in each educational research these results should be considered and devoid in all other instances since future revisions of the approach might generate more essential difference in the statistically significant figures with a larger number of participants in the study.Backing this view, the present study, although not intending to test the hypothesis, provides information that the intervention possibly mam kumshauri to improve student performance.

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The interpretation of these findings is that post intervention mean rank of the experimental group was greater than that of the control group. This is consistent with some recent studies arguing that anything greater than the marginal differences that are statistically significant . Shadish et al., 2002 suggest that such changes have a significance in terms of application. Practical significance means concentrating on the change interventions bring to education rather than on the conventional models of significance. In particular, the increase in the scores achieved by members of the experimental group, which improvement however did not quite attain the strict $p < 0.05$ cut off threshold, suggests that the intervention should be beneficial in as far as the learning outcomes are concerned (Nakagawa & Cuthill, 2007; Trusty et al, 2004b).

Taking into account the results, future research might address the statistical power issues by replicating the study with a larger sample size. There could also be the use of paired Wilcoxon signed-rank test if both pre- and post-test data is gathered in a time series manner within each group (Field, 2017). Increasing the duration of the intervention, or the intensity of the program content is likely to increase the chances of observing a substantial difference between the groups under study. In summary, the results of the Mann-Whitney U Test suggest that there is a reasonable chance the intervention improved the experimental group's post-test performance, even reaching 5% statistical significance. The result leaves an impression of emphasizing the relevance of practical aspects and effect sizes in educational research, where even close to significant results have the potential to change the practice and the design of the developed interventions.

N-Gain Results

N-Gain analysis demonstrates that the intervention is capable in enhancing students' creative thinking skills in overall improvement and specific dimensions such as fluency and flexibility. Incorporating traditional games, especially traditional games field's geometric shapes, enabled students to anchor and obtain geometric and mathematical skills. This approach of integrating cultural context could have been important in the results obtained (Banks, 2015; Matindike & Ramdhany, 2024).

The overall N-Gain ($U = 99.500, Z = -2.074, p = 0.038$), N-Gain Fluency ($U = 91.000, Z = -2.332, p = 0.020$) increases, implies that, the methodology applied was able to use traditional game contexts in optimizing students' creativity in solving — generating ideas. Students were able to understand geometric concepts like area, perimeter and symmetry by employing traditional games such as Gobak Sodor where students played on rectangular or square shapes. As a result, these activities were most probably able to assist students in approaching more general and familiar cultural themes from more sophisticated angles which in turn helped them in developing more fluency in their creative thinking. (Tesfaw et al., 2024; Widjaja, 2013).

For N-Gain Flexibility, which also showed a statistically significant improvement ($t = 1.898, p = 0.033, d = 0.654$), the intervention's focus on using traditional contexts to frame mathematical problems likely contributed to the development of flexible thinking. By requiring students to approach problems from multiple perspectives—for instance, analyzing different strategies to divide or calculate parts of a game field—the intervention encouraged flexibility in problem-solvin. The cultural relevance of the tasks further enhanced engagement, making it easier for students to explore alternative methods and perspectives in their solutions (Gay, 2000; Ladson-Billings, 2009).

The near similar impact value of N-Gain Originality, that is $U=119.000, Z=-1.486, p=0.137$ highlights a critical deficit in the intervention that is generating or thinking out of the box or rather unique information while measuring. Originality when the ability to think of and devise new ideas is concerned, was not significantly modified by the intervention. This could be due to the fact that the tasks were too structured to allow for sufficient imagination to break away from established ones (Runco & Acar, 2012). The traditional game contexts definitively provided a sound base for the development of geometric ideas, but supplementary activities such as open-ended problems where students have to design their own game fields or perform without set rules could facilitate the growth of this dimension more (Moore-Russo Deborah and Demler, 2018; Runco & Acar, 2012; Yazgan et al., 2021).

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The use of traditional games as a context for learning mathematics reflects the importance of culturally relevant pedagogy in engaging students and making abstract concepts more accessible (Banks, 2020; Gumbo, 2021). Traditional game fields, such as those in *Gobak Sodor*, were used not only to introduce geometric shapes and properties but also to frame real-world problems that students could solve mathematically. For example, students might calculate the area of a game field, explore symmetry in its layout, or analyze proportions when dividing the field into sections for gameplay. These tasks linked students' cultural experiences with mathematical reasoning, enhancing their ability to connect abstract concepts with tangible, familiar scenarios (Anwar et al., 2024; Kawuryan et al., 2018).

In addition, traditional games emerged as one of the suitable sources of meaningful problems that were in need of inventive solutions. Involvement in culturally relevant work led students to be tremendously involved, which might account for the impressive increases in fluency and flexibility. Traditional games also promoted conversation and inquiry because of their social and cooperative nature, adding to the increases seen in these dimensions (Gay, 2018).

Although the results indicate the usefulness of traditional game scenarios in achieving fluency and flexibility, there are also observations regarding originality that indicate the need for the intervention to be modified. In particular, subsequent implementations might feature activities that facilitate students in thinking out of the box like being tasked with designing traditional games as well as altering already existing ones in a bid to create new challenges (Runco & Acar, 2012). Furthermore, stretching the length of the intervention and including evaluations of performance after quite a few months may result in better understanding of how well the intervention helped in nurturance of originality along with other creative thinking perspectives (Hargrove, 2013).

Conclusion

This study focused on the impact of traditional games on a student's creative thinking skills using geometrical concepts such as similarity and parallelism. As the use of traditional games such as Gobak Sodor was used it greatly increased these students' creative thinking approaches as they were able to score better than the control group in regards to the three types of creative thinking measures which include fluency, flexibility and originality. This also shows that by combining culture with education you can improve a student's understanding of specific concepts such as geometry. Nonetheless, while the traditional games improved the fluency and flexibility of the students the same in origination was not possible which does provide a great insight on how to allow students to explore ideas using a multitude of strategies.

As fruitful as these findings are, the authors nonetheless acknowledge certain limitations. To begin with, the sampling in this study was thin, which reduced the strength of the statistical tests employed and may hinder the transferability of the findings. Second, the intervention was given for short periods of time and this could underexpose the research subjects to the intervention and thus the extent of the effects they had on their creative and geometric comprehension may have been underestimated. Moreover, the research targeted one specific traditional game, Gobak Sodor, perhaps restricting the generalization of results to different cultural or educational settings. The emphasis on the quantitative measures of creativity, while helpful, also limits the understanding of the more complex ways in which students conceive and demonstrate creativity in the course of game play.

According to the results and limitations of this study, several recommendations can be presented for further research and educational practices. Future research studies might seek to try the effects of traditional games on creative thinking and geometry learning with larger sample sizes and prolonged intervention to make the testing more conclusive. It may be worthwhile to extend the study by integrating other forms of traditional games to see how other activities of a different culture encourage creativity and mathematical activity. Besides, the use of qualitative approaches, like interviews or observation, might provide a better insight into the results by enhancing the understanding of the students' engagement and views in the learning activity.

From this research, it can be concluded that teachers, as well as curricula designers, could consider incorporating culturally oriented education practices like traditional games as part of the teaching content in a mathematics class. Diverse activities or programs such as playing Gobak Sodor could help in introducing students to geometrical shapes through the concepts of similarity and parallelism. The integration of traditional games with set learning outcomes could also be an effective way of conserving culture and promoting education through the enhancement of creativity and cultural identity. Cultural heritage certainly can be the basis of the focal skills of the 21st century. It prompts us all to look at complementing the educational process with a broader viewpoint.

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References

Aljandali, A. (2017). Multivariate Methods and Forecasting with IBM® SPSS® Statistics. Springer.

Anwar, L., Sa'dijah, C., Fauzan, A., Johar, R., . S., & Cahyani, S. D. (2024). Exploring Ethnomathematics in the Traditional House of Suku Tengger: Bridging Structures and Classrooms. Journal of Ecohumanism, 3(6), 1872–1882. https://doi.org/10.62754/joe.v3i6.4143

Banks, J. A. (2015). Cultural Diversity and Education. Routledge. https://doi.org/10.4324/9781315622255

Breuer, J. (2011). (In)formative play - The effects of digital games on creativity and problem-solving skills. Proceedings of the 6th International Conference on the Foundations of Digital Games, FDG 2011. https://doi.org/10.1145/2159365.2159399

Creswell, J. W. (2014). Research design: Qualitative, quantitative, and mixed methods approaches. SAGE Publications, Inc.

Cumming, G., & Calin-Jageman, R. (2016). Introduction to the New Statistics. Routledge. https://doi.org/10.4324/9781315708607

Field, A. P. (2017). Discovering statistics using IBM SPSS statistics, 5th edition. https://api.semanticscholar.org/CorpusID:69843782

Gay, G. (2000). Culturally responsive teaching : theory, research, and practice. New York : Teachers College Press, [2000] ©2000. https://search.library.wisc.edu/catalog/999890205402121

Ge, X., Xu, C., Furue, N., Misaki, D., Lee, C., & Markus, H. R. (2022). The Cultural Construction of Creative Problem-Solving: A Critical Reflection on Creative Design Thinking, Teaching, and Learning (pp. 291–323). https://doi.org/10.1007/978-3-031-09297-8_15

Ghasemi, A., & Zahediasl, S. (2012). Normality Tests for Statistical Analysis: A Guide for Non-Statisticians. International Journal of Endocrinology and Metabolism, 10(2), 486–489. https://doi.org/10.5812/ijem.3505

Gibson, E. W. (2021). The Role of p -Values in Judging the Strength of Evidence and Realistic Replication Expectations. Statistics in Biopharmaceutical Research, 13(1), 6–18. https://doi.org/10.1080/19466315.2020.1724560

Guilford, J. P. (1967). The nature of human intelligence. In The nature of human intelligence. McGraw-Hill.

Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. American Journal of Physics, 66(1), 64–74. https://doi.org/10.1119/1.18809

Hake, R. R. (2007). Design-Based Research In Physics Education: A Review. In A. E. Kelly, R. A. Lesh, & J. Y. Baek (Eds.), Handbook of Design Research Methods in Mathematics, Science, and Technology Education. Erlbaum.

Handayani, U. F., Sa'Dijah, C., Sisworo, Sa'Diyah, M., & Anwar, L. (2020). Mathematical creative thinking skill of middle-ability students in solving contextual problems. In H. Habiddin, S. Majid, Ibnu Suhadi, N. Farida, & I. W. Dasna (Eds.), The 3rd International Conference on Mathematics and Science Education (ICOMSE) (Vol. 2215). https://doi.org/10.1063/5.0000645

Hargrove, R. A. (2013). Assessing the long-term impact of a metacognitive approach to creative skill development. International Journal of Technology and Design Education, 23(3), 489–517. https://doi.org/10.1007/s10798-011-9200-6

Henriksen, D., Henderson, M., Creely, E., Ceretkova, S., Černochová, M., Sendova, E., Sointu, E. T., & Tienken, C. H. (2018). Creativity and Technology in Education: An International Perspective. Technology, Knowledge and Learning, 23(3), 409–424. https://doi.org/10.1007/s10758-018-9380-1

Kaufman, J. C. (2016). Creativity 101. Springer Publishing Company. https://books.google.co.id/books?id=RwG-CwAAQBAJ

Kaufman, J. C., Russell, C. M., & Plucker, J. A. (2013a). Models and Methods of Assessing Creativity (D. H. Saklofske, C. R. Reynolds, & V. Schwean, Eds.; Vol. 1). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199796304.013.0025

Kaufman, J. C., Russell, C. M., & Plucker, J. A. (2013b). Models and Methods of Assessing Creativity (D. H. Saklofske, C. R. Reynolds, & V. Schwean, Eds.; Vol. 1). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199796304.013.0025

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Kaufman, J. C., & Sternberg, R. J. (2010). The Cambridge Handbook of Creativity (J. C. Kaufman & R. J. Sternberg, Eds.). Cambridge University Press. https://doi.org/10.1017/CBO9780511763205
Kawuryan, S., Sri Hastuti, W., & Supartinah, S. (2018). The Influence of Traditional Games-Based and Scientific Approach-Oriented Thematic Learning Model toward Creative Thinking Ability. Jurnal Cakrawala Pendidikan, 37(1).
Kimberlin, C. L., & Winterstein, A. G. (2008). Validity and reliability of measurement instruments used in research. American Journal of Health-System Pharmacy, 65(23), 2276–2284. https://doi.org/10.2146/ajhp070364
Kline, R. B. (2016). Principles and practice of structural equation modeling, 4th ed. In Principles and practice of structural equation modeling, 4th ed. Guilford Press.
Ladson-Billings, G. (2009). The dreamkeepers : successful teachers of African American children. 1st ed. San Francisco : Jossey-Bass Publishers, [1994]. https://search.library.wisc.edu/catalog/999734889002121
López, U. H., Vázquez-Vílchez, M., & Salmerón-Vílchez, P. (2024). The Contributions of Creativity to the Learning Process within Educational Approaches for Sustainable Development and/or Ecosocial Perspectives: A Systematic Review. Education Sciences, 14(8), 824. https://doi.org/10.3390/educsci14080824
Mathisen, G. E., & Bronnick, K. S. (2009). Creative self-efficacy: An intervention study. International Journal of Educational Research, 48(1), 21–29. https://doi.org/10.1016/j.ijer.2009.02.009
Matindike, F., & Ramdhany, V. (2024). Incorporating indigenous knowledge perspectives in integrated STEM education: a systematic review. Research in Science & Technological Education, 1–21. https://doi.org/10.1080/02635143.2024.2413675
Moore-Russo Deborahand Demler, E. L. (2018). Linking Mathematical Creativity to Problem Solving: Views from the Field. In S. and J. K. Amado Néliaand Carreira (Ed.), Broadening the Scope of Research on Mathematical Problem Solving: A Focus on Technology, Creativity and Affect (pp. 321–345). Springer International Publishing. https://doi.org/10.1007/978-3-319-99861-9_14
Nachar, N. (2008). The Mann-Whitney U: A Test for Assessing Whether Two Independent Samples Come from the Same Distribution. Tutorials in Quantitative Methods for Psychology, 4(1), 13–20. https://doi.org/10.20982/tqmp.04.1.p013
Nakagawa, S., & Cuthill, I. C. (2007). Effect size, confidence interval and statistical significance: a practical guide for biologists. Biological Reviews, 82(4), 591–605. https://doi.org/10.1111/j.1469-185X.2007.00027.x
Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research. Administration and Policy in Mental Health and Mental Health Services Research, 42(5), 533–544. https://doi.org/10.1007/s10488-013-0528-y
Pallant, J. (2020). SPSS Survival Manual. Routledge. https://doi.org/10.4324/9781003117452
Panos, G. D., & Boeckler, F. M. (2023). Statistical Analysis in Clinical and Experimental Medical Research: Simplified Guidance for Authors and Reviewers. Drug Design, Development and Therapy, Volume 17, 1959–1961. https://doi.org/10.2147/DDDT.S427470
Plucker, J. A., Beghetto, R. A., & Dow, G. T. (2004). Why Isn't Creativity More Important to Educational Psychologists? Potentials, Pitfalls, and Future Directions in Creativity Research. Educational Psychologist, 39(2), 83–96. https://doi.org/10.1207/s15326985ep3902_1
Purnomo, H., Sa'dijah, C., Permadi, H., Anwar, L., & Cahyowati, E. T. D. (2023). Mathematical creative processing abilities of junior high school students' in numeracy tasks. 040012. https://doi.org/10.1063/5.0113667
Runco, M. (2008). Creativity and education. New Horizons in Education, 56, 96–104.
Runco, M. A., & Acar, S. (2012). Divergent Thinking as an Indicator of Creative Potential. Creativity Research Journal, 24(1), 66–75. https://doi.org/10.1080/10400419.2012.652929
Runco, M. A. (2014). Creativity: Theories and Themes: Research, Development, and Practice (2nd edition). Elsevier. https://doi.org/10.1016/C2012-0-06920-7
Runco, M. A., & Jaeger, G. J. (2012). The Standard Definition of Creativity. Creativity Research Journal, 24(1), 92–96. https://doi.org/10.1080/10400419.2012.650092
Saenboonsong, S., & Poonsawad, A. (2024). The Development of Students' Creative Problem-Solving Skills Through Learning Model in Gamification Environment Together with Cartoon Animation Media. Journal of Education and Learning, 13, 138. https://doi.org/10.5539/jel.v13n2p138
Saura, S. C., & Zimmermann, A. C. (2021). Traditional Sports and Games: Intercultural Dialog, Sustainability, and Empowerment. Frontiers in Psychology, 11. https://doi.org/10.3389/fpsyg.2020.590301
Sawyer, R. K., & Henriksen, D. (2023). Defining Creativity Through Assessment. In Explaining Creativity (pp. 41–68). Oxford University PressNew York. https://doi.org/10.1093/oso/9780197747537.003.0003
Schmidt, F. L. (1996). Statistical significance testing and cumulative knowledge in psychology: Implications for training of researchers. Psychological Methods, 1(2), 115–129. https://doi.org/10.1037/1082-989X.1.2.115
Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). Experimental And Quasi-Experimental Designs For Generalized Causal Inference. Houghton Mifflin Company Boston New York.
Shih, Y.-H. (2022). Designing Culturally Responsive Education Strategies to Cultivate Young Children's Cultural Identities: A Case Study of the Development of a Preschool Local Culture Curriculum. Children, 9(12), 1789. https://doi.org/10.3390/children9121789
Tabachnick, B. G. ., Fidell, L. S. ., & Ullman, J. B. . (2019). Using multivariate statistics. Pearson.
Tesfaw, B. K., Ayele, M. A., & Wondimuneh, T. E. (2024). Context-based problem-posing and solving instructional approach and students' engagement in learning data handling. Cogent Education, 11(1). https://doi.org/10.1080/2331186X.2024.2389486

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Trusty, J., Thompson, B., & Petrocelli, J. V. (2004a). Practical Guide for Reporting Effect Size in Quantitative Research in the Journal of Counseling & Development. Journal of Counseling & Development, 82(1), 107–110. https://doi.org/10.1002/j.1556-6678.2004.tb00291.x

Trusty, J., Thompson, B., & Petrocelli, J. V. (2004b). Practical Guide for Reporting Effect Size in Quantitative Research in the Journal of Counseling & Development. Journal of Counseling & Development, 82(1), 107–110. https://doi.org/10.1002/j.1556-6678.2004.tb00291.x

Verschaffel, L. (2024). Strategy flexibility in mathematics. ZDM – Mathematics Education, 56(1), 115–126. https://doi.org/10.1007/s11858-023-01491-6

Vrbin, C. M. (2022). Parametric or nonparametric statistical tests: Considerations when choosing the most appropriate option for your data. Cytopathology, 33(6), 663–667. https://doi.org/10.1111/cyt.13174

Widjaja, W. (2013). The Use of Contextual Problems to Support Mathematical Learning. Journal on Mathematics Education, 4(2). https://doi.org/10.22342/jme.4.2.413.151-159

Yan, Z., Lee, J. C.-K., Hui, S. K. F., & Lao, H. (2022). Enhancing Students' Self-Efficacy in Creativity and Learning Performance in the Context of English Learning: The Use of Self-Assessment Mind Maps. Frontiers in Psychology, 13. https://doi.org/10.3389/fpsyg.2022.871781

Yazgan, Y., Arslan, Ç., & Gavaz, H. O. (2021). Non-routine problem solving and strategy flexibility: A quasi-experimental study. Journal of Pedagogical Research, 5(3), 40–54. https://doi.org/10.33902/JPR.2021370581

Yi, Z., Chen, Y.-H., Yin, Y., Cheng, K., Wang, Y., Nguyen, D., Pham, T., & Kim, E. (2022). Brief Research Report: A Comparison of Robust Tests for Homogeneity of Variance in Factorial ANOVA. The Journal of Experimental Education, 90(2), 505–520. https://doi.org/10.1080/00220973.2020.1789833