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Effects of Tactical Game Model on Multidimensional Developmental Domains: A Systematic Review and Meta-Analysis

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INTRODUCTION

Physical Education (PE) constitutes an essential element within a comprehensive educational framework, playing a crucial role in promoting physical fitness as well as cognitive, psychological, and social development (Gallahue & Donnelly, 2007). Throughout the years, a multitude of teaching models and methodologies have been utilized to augment the educational experience within the PE settings (Metzler, 2017; Mosston & Ashworth, 1990), where the quest for inventive and captivating pedagogical approaches has resulted in the emergence of the Games Centered Approach —GCA— (Harvey et al., 2016). The GCA is an educational methodology that employs a deliberate integration of video games and game-like activities within the learning process, establishing the game as the focal point of the educational experience (Miller, 2015). This approach capitalizes on the captivating and interactive nature of games to enhance education and training, ultimately leading to improved learning outcomes (Harvey et al., 2016; Miller, 2015).

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The GCA encompasses transformative concepts, including Teaching Games for Understanding (TGfU) (Werner et al., 1996), Play Practice (Launder & Piltz, 2006), Game Sense (Light, 2006), and the Tactical Game Model (TGM) (Griffin et al., 1997; Griffin & Sheehy, 2004; Mitchell et al., 2020), among others. Complementing the GCA, the TGM brings a comprehensive framework that combines teaching, gaming, and mentoring to enhance the learning process, acknowledging that games alone are not a fundamental solution, but rather an integral part of a holistic educational experience (Mitchell et al., 2020). It emphasizes the role of teachers as facilitators and mentors who guide students through game-based learning (Chatzipanteli et al., 2016; Michael Hodges et al., 2018). The mentoring aspect of TGM highlights the importance of providing students with individualized feedback, encouragement, and support, ensuring their growth and progress (Mitchell et al., 2013). Furthermore, the TGM aims to develop students' abilities to think critically, problem-solve, and apply their knowledge in dynamic and unpredictable contexts (Gurvitch & Metzler, 2013).

When incorporating the TGM into the PE settings, it is crucial to consider the concept of developmental domains (Mitchell et al., 2020). The developmental domains refer to the multifaceted growth and progress students experience across various dimensions, including physical, cognitive, affective, and social domains (Sgro et al., 2021). The TGM, with its focus on decision-making and game-related challenges, offers an ideal platform that goes beyond traditional physical activities for students to enhance their skills and competencies within each of these domains (Griffin & Sheehy, 2004; Hodges et al., 2018; S. Mitchell et al., 2020). The effectiveness of the TGM has been increasingly recognized by scholars. For example, Brocklehurst (2016) and Chatzipanteli et al. (2016) indicated a significant increase in the proportion of students demonstrating high levels of metacognition when the TGM was implemented in the PE setting. Rodríguez-Negro and Yanci (2020) posited that employing the TGM among various teaching models could be particularly advantageous in enhancing affective valence, especially for students in advanced courses. Furthermore, numerous authors hypothesized that there would be a superior quality of motivation observed among students during the TGM in comparison to direct instruction lessons (Mandigo et al., 2008;

Smith, Harvey, et al., 2014). Nevertheless, when examining the psychomotor domain in the context of PE, the TGM has exhibited a substantial influence on motor learning, skill acquisition, and movement proficiency among students (Ferudun Dorak et al., 2018; Michael Hodges et al., 2018).

While there is a vast majority of previous studies supporting the effectiveness of the TGM, there remains a need for a comprehensive analysis of these studies through a meta-analysis. Thus, this study aimed to conduct a systematic review and meta-analysis to investigate the effects of the TGM on multidimensional development within the domain of PE. In this regard, conducting a comprehensive systematic review and meta-analysis can provide a clearer understanding of the holistic effectiveness of the TGM across various PE settings, determine the overall effect sizes of the TGM, and investigate potential moderators or mediators of its effectiveness. The findings of this present study will provide valuable insights for educators, policymakers, and researchers interested in utilizing the TGM as a teaching model to enhance students' product outcomes and promote holistic development in PE settings.

Methodology

The current systematic review and meta-analysis adhered to the guidelines outlined by the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA) (Page et al., 2021). It is an evidence-based minimum set of items for reporting in systematic reviews and meta-analysis. The PRISMA statement, consisting of a 27-item checklist and a four-phase flow diagram, was developed to facilitate transparent and complete reporting of systematic reviews and meta-analysis.

Data Collection

Scientific articles, master's theses, and doctoral dissertations constitute the primary data sources for this systematic review with a meta-analysis, which investigates the effects of using the TGM on students' multidimensional developmental domains. National (ULAKBİM and YÖK) and international (Google Scholar, ERIC, EBSCOhost, and Web of Science) databases were utilized to access relevant studies. The systematic review and meta-analysis applied the following criteria for selecting studies:

- Sources of inclusion encompassed published and unpublished materials, including scientific articles, master's theses, and doctoral dissertations.
- Studies had to adhere to appropriate research methodology, specifically employing an experimental design specific to the TGM. This ensured the acquisition of effect sizes and maintained consistency in study procedures.
- Sufficient numerical data, such as means, standard deviations, and sample sizes, were necessary for calculating effect sizes, enabling the meta-analysis of the TGM.
- The analysis included studies published between 2000 and 2023.

These criteria were employed to ensure the selection of relevant and suitable studies for the systematic review and meta-analysis. In this meta-analysis study, the PRISMA (Preferred Reporting Items for systematic reviews and meta-analysis) directive shown in Figure 1 was adopted during the data collection process.

The descriptive characteristics of the individual studies included in the current systematic review and meta-analysis are reflected in Table 1. Additionally, some of these variables (education level, country, publication type, duration of intervention, year of intervention, and sample size) were examined within the scope of moderator analysis. The current research encompasses distinct developmental domains: (a) cognitive, regarding intellectual processes and knowledge acquisition; (b) affective, concerning emotional and attitudinal aspects, and (c) psycho-motor, addressing physical and motor skill development. This delineation allows for a comprehensive examination of the multifaceted influences on the observed phenomena within the study.

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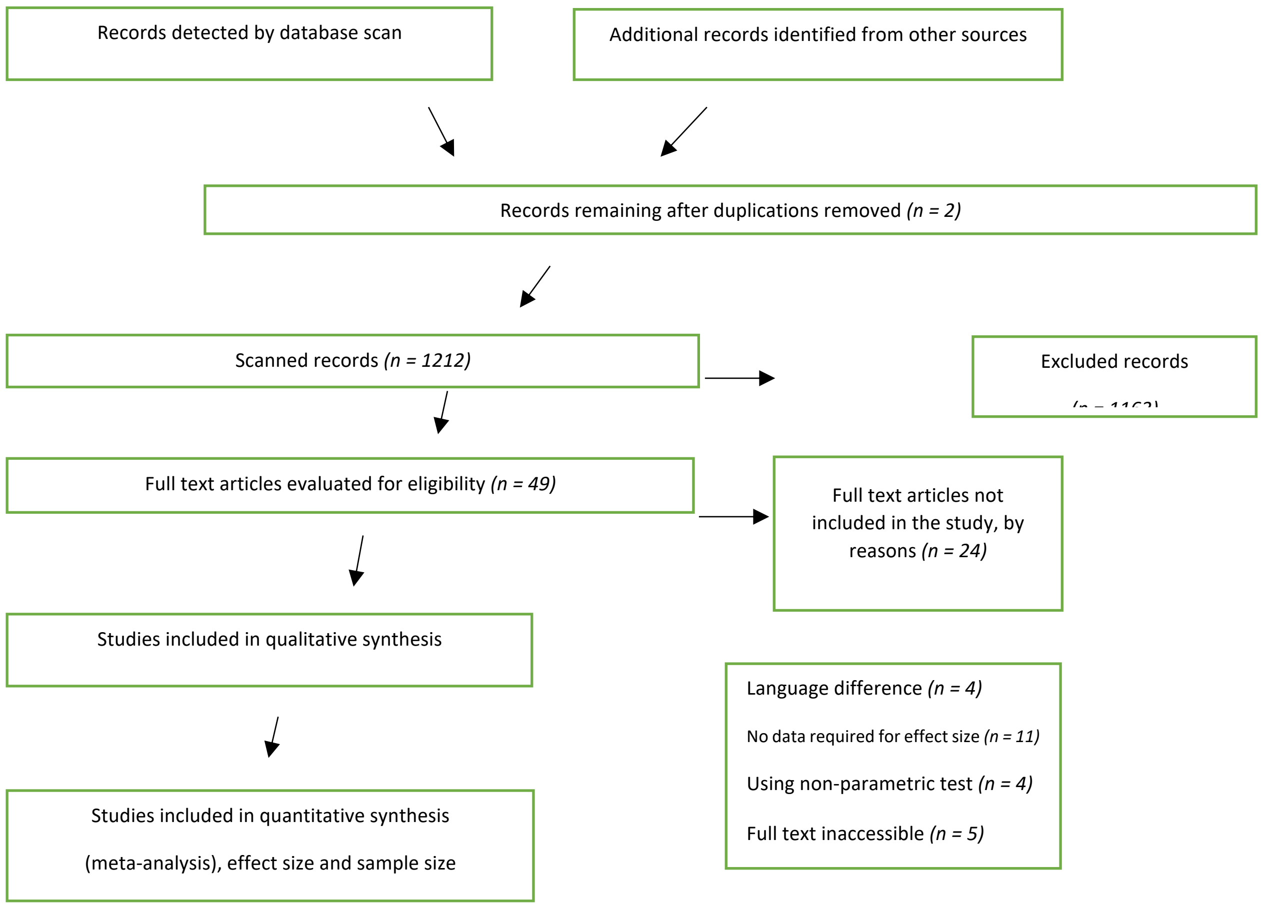

Figure 1. Flow Diagram for the Systematic Review Process According to PRISMA statements

Table 1. Descriptive Characteristics of the Studies Included in the Systematic Review and Meta-Analysis

Author (year)	Development area	Exper. Mean	Exper. Sd.	Exper. Sam.	Control mean	Control sd.	Control sam.	Education level	Country	Publication type	Time (week)	Year	Number of samples
Alvurdu, 2017 (a)	Cognitive	11.5	1.69	8	4.5	1.3	8	Unknown	Turkey	Thesis	8	2017	8
Alvurdu, 2017 (b)	Psychomotor	3.91	.83	8	1.19	.81	8	Unknown	Turkey	Thesis	8	2017	8
Birsen, (2017)	Cognitive	95.4	14.54	30	89.03	12.38	30	Elementary	Turkey	Thesis	9	2017	30

Dorak et al., 2018 (a)	Cognitive	38.32	7.2	25	37.67	8.52	18	University	Turkey	Article	12	2018	43
Dorak et al. 2019 (b)	Psychomotor	.88	.07	25	.83	.08	18	University	Turkey	Article	12	2018	43
González-Espinosa et al., (2021)	Psychomotor	1.916	.199	20	1.746	.176	20	Elementary	out Turkey	Article	-	2021	40
Gouveia et al., (2019)	Psychomotor	.68	.28	41	.6	.24	21	Elementary	out Turkey	Article	8	2019	62
Nur Göksoy, 2021(a)	Affective	85.58	5.69	17	67.64	12.95	17	Elementary	Turkey	Thesis	10	2021	17
Nur Göksoy, 2021 (b)	Cognitive	60.47	5.25	17	48.17	9.91	17	Elementary	Turkey	Thesis	10	2021	17
Gray & Sproule, 2011 (a)	Psychomotor	19	10.68	27	11	10.3	25	Elementary	out Turkey	Article	12	2011	52
Gray and Sproule, 2011 (b)	Cognitive	2.04	.55	27	2.3	0.41	25	Elementary	out Turkey	Article	13	2011	52
Gül et al., (2019)	Psychomotor	65.16	3.57	8	57.96	27.9	8	University	Turkey	Article	8	2019	16
Hodges et al., (2018)	Psychomotor	9.63	4.08	123	7.2	2.65	123	High School	out Turkey	Article	10	2018	123
Karakaya, 2018 (a)	Psychomotor	32.43	9.57	9	25.1	9.4	9	High School	Turkey	Thesis	4	2018	9
Karakaya, 2018 (b)	Cognitive	10.22	1.092	9	8.11	2.027	9	High School	Turkey	Thesis	5	2018	9
Kayhan, 2019 (a)	Cognitive	15.4	.69	24	9.4	2.7	24	High School	Turkey	Thesis	10	2019	24
Kayhan, 2019 (b)	Psychomotor	33.1	25.78	24	30.9	22.63	24	High School	Turkey	Thesis	11	2019	24
Kayhan, 2019 (c)	Affective	106.1	2.25	24	103.85	3.15	24	High School	Turkey	Thesis	12	2019	24
Korur, (2021)	Cognitive	292.6	25.19	30	274.7	24.94	24	University	Turkey	Thesis	8	2021	54
Rodríguez-Negro & Yanci, (2020)	Affective	3.72	2.09	125	3.57	2.31	131	Elementary	out Turkey	Article	8	2020	256
Savaş, (2018)	Psychomotor	350.93	68.72	74	327.64	60.99	74	Elementary	Turkey	Thesis	12	2018	74
Şahin, 2007 (a)	Cognitive	6.71	3.17	14	4.75	1.95	12	Elementary	Turkey	Thesis	6	2007	26

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Şahin, 2007 (b)	Psychomotor	2.63	1.69	14	2.33	1.33	12	Elementary	Turkey	Thesis	6	2007	26
Gün, 2019 (a)	Cognitive	202.05	27.99	40	191.85	28.39	40	Elementary	Turkey	Thesis	5	2019	40
Gün, 2019 (b)	Psychomotor	.71	.11	40	.33	.14	40	Elementary	Turkey	Thesis	5	2019	40
Yimez, 2021 (a)	Cognitive	3.87	.29	12	1.42	.23	12	Unknown	Turkey	Thesis	10	2021	12
Yimez, 2021 (b)	Psychomotor	.8	.04	12	.26	.052	12	Unknown	Turkey	Thesis	10	2021	12

STATISTICAL ANALYSIS

In this study, the statistical software package Comprehensive Meta-Analysis (CMA) version 4 and The Jamovi Project 1.2.22 were used for conducting meta-analysis, including the calculation of effect sizes, variances, and group comparisons for each study. The SPSS software package was utilized to assess Cohen's kappa coding reliability (Cohen, 1988) and perform outlier tests. Due to the fixed-effects model only accounting for the error variation influenced by sample size in the final analysis (Cooper, 2017), the random-effects model was proposed to consider both the true random variance and sampling error variation from each study (Koutsimani et al., 2019). However, both effect models were reported in this study. Additionally, Cohen's (1988) classification of effect sizes was employed, where values greater than 0.8 were considered 'large', values between 0.5 and 0.8 were classified as 'moderate', and values between 0 and 0.5 were categorized as 'small'. The experimental group comprised students who received education through the TGM, while the control group comprised those who did not receive the TGM (e.g., traditional teaching models, traditional teaching methods, skill-focused instructional models, and methods, etc.). Therefore, a positive effect size indicates a favorable outcome for the TGM, while a negative effect size suggests an advantage for students who did not receive the TGM. Given that a significance level of .05 was adopted in the included studies, a significance level of .05 was also set for the statistical analysis in this study.

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Categorization of Outcome Variables and Level of Evidence

In some cases, it is desirable to merge two or more subgroups reported in a study into a single group. For instance, this may occur when a study presents sample sizes, means, and standard deviations separately for males and females. In such cases, the data can be combined within a single sample size and used to merge the means and standard deviations for each intervention group. In this research, data from certain studies (e.g., Gouveia et al., 2019; Gül et al., 2019; Kayhan, 2019) were obtained using the Cochrane data merging formula (Shuster, 2011). Additionally, the most relevant dimension data about the examined developmental domain from studies with multiple dimensions were included in the study.

Criteria for Assessment of Study Quality

To ensure reliability, coding control was conducted during data analysis, and intercoder agreement was assessed to determine the adequacy of coding consistency. Interview data from four randomly selected participants were coded by a second researcher. The intercoder agreement was calculated using the formula 'Agreement = (number of categories with agreement) / (total number of categories with agreement and disagreement),' resulting in a value of .88. Values above .70 for interrater agreement between two different coders are considered sufficient for coder reliability (Miles & Huberman, 1994). Establishing coding protocol reliability is a crucial step in the meta-analysis process (Card, 2012; Petitti, 2000). Therefore, in this study, the coding was independently completed by two domain experts (Ph.D. holders in PE and faculty members, who teach related programs in sports sciences faculties). Subsequently, they met to reach a consensus on any inconsistent coding. A 92% agreement was observed between the coders. Some researchers have suggested that considering chance factors and the limited options in intercoder frequency data, Cohen's kappa statistic could provide greater reliability (Card, 2012). The resulting interrater reliability index was found to be .93, indicating nearly perfect agreement between the coders (Cohen, 1960; Landis & Koch, 1977; Viera & Garrett, 2005).

Hunter and Schmidt (2004) emphasize the importance of paying attention to studies that have substantially different effect sizes during the outlier detection process and state that a poor dataset cannot be corrected without excluding these studies. Hedges and Olkin (1985) suggest that if a study is determined to be an outlier, it should be removed from the dataset without affecting the overall mean, under the condition that it improves model fit. They propose various methods for identifying outliers. According to these methods, studies showing relatively extreme deviations on the forest plot axes should be considered outliers. In this study, the inclusion or exclusion of studies as outliers was examined using forest plots, standardized residuals, z-scores [Skewness: 2.62 (.44); Kurtosis: 6.96 (.87)], and heterogeneity tests (Q_{BET}=257.343; $p < .001$).

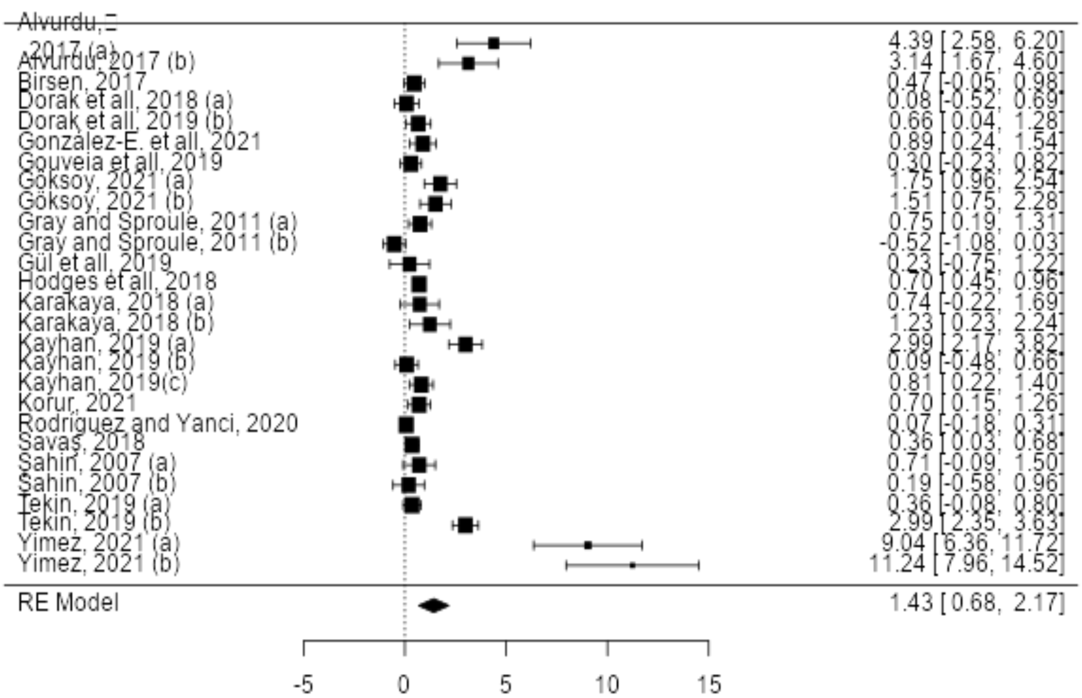

Figure 2. Uncombined Effect Sizes and Forest Chart Built with some Outlier Study Data

Considering the aforementioned explanations as a whole, six studies [Alvurdu, 2017 (a); Alvurdu, 2017 (b); Yimez, 2021 (a); Yimez, 2021 (b); Kayhan, 2019 (a); Gün, 2019 (b)] that were deemed to be outliers were not included in the systematic review and meta-analysis (Figure 2). Finally, the analysis was conducted using 21 studies.

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RESULTS

To address the research problem, analysis were conducted on the relevant data from the studies included in the systematic review and meta-analysis. The findings of these analysis, including publication bias, fixed effects model results, homogeneity test, evidence of the random effects model, and moderator analysis, are presented in this section.

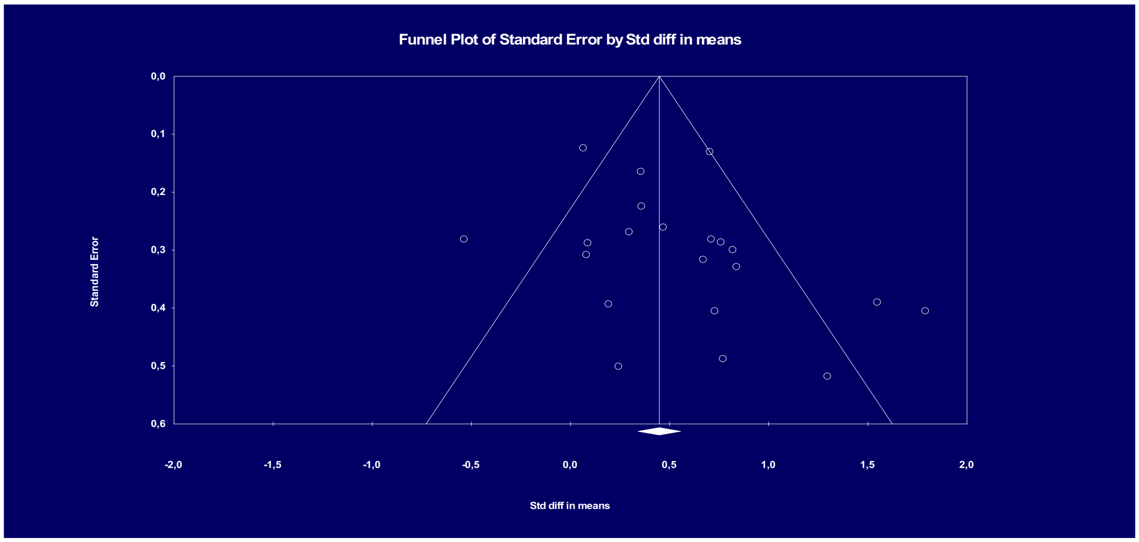

Figure 3. Funnel Scatter Plot of Studies Containing Effect Size Data of Using TGM on Multidimensional Development of Students

In Figure 3, the majority of individual effect sizes of the studies included in the systematic review and meta-analysis are gathered within the funnel and displayed symmetrically. Additionally, Figure 3 shows that the individual effect sizes of the studies are clustered around the middle line, indicating the overall effect size. According to the funnel plot, it can be stated that the twenty-one included studies do not exhibit publication bias. However, considering that not all individual effect sizes of the studies are symmetrically located within the funnel, it is necessary to also examine the publication bias statistics. The confidence tests and results indicate the bias status of the included studies in Table 2.

In Table 2, the results of Rosenthal's Fail-Safe N Test demonstrate that the systematic review and meta-analysis outcome is statistically significant ($p = .00$), indicating that there is evidence of a meaningful effect. For the significance of this result to be eliminated, that is, for $p > .05$, an additional 378 studies with an effect size value of zero are required.

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Table 2. Confidence Tests and Results Showing the Bias of the Studies Included in the Meta-Analysis

Reliability Tests	Reliability Test Data	
Rosenthal's Safe N Test	Z-value for observed studies	8.53
	p-value for observed studies	.00
	Alpha	.05
	Tails	2
	Z value for alpha	1.95
	Number of observed studies	21
	Number of missing studies that would bring p value to > alpha	378
Begg and Mazumdar Rank Correlations	Tau	.23
	z value for tau	1.47
	p value (1 tailed)	.06
	p value (2 tailed)	.13
Egger's Linear Regression	Standard error	.87
	%95 lower limit (2 tailed)	-.41
	%95 upper limit (2 tailed)	3.24
	t value	1.62
	df	19
	p value (1 tailed)	.06
	p value (2 tailed)	.12

The lack of statistical significance of Kendall's Tau coefficient obtained from the Begg and Mazumdar Rank Correlations (.23 and $p = .06$) serves as an indication that there is no publication bias. Furthermore, based on the results of Egger's Linear Regression method ($p = .06 > .05$), it can be confidently stated with 95% confidence that there is no publication bias.

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Table 3. Combined Findings of the Effect Size Meta-Analysis of Using TGM on Students' Multidimensional Development according to Fixed and Random Effects Model and Homogeneity Test

Model	Effect size and 95% confidence interval						Null Hypothesis		Heterogeneity			
	Number of studies	Effect Size	Standard error	Variance	lower limit	upper limit	Z value	p	Q_{BET} value	df (Q)	p	I^2
Fixed	21	.448	.05	.00	.34	.55	8.17	.00	57.49	20	.00	65.21
Random	21	.528	.10	.01	.32	.72	5.17	.00				

Table 3 presents the data from the 21 studies included in the systematic review and meta-analysis, indicating that students who were exposed to the TGM, in the fixed effects model, demonstrated higher levels of multidimensional development compared to those who were not exposed. The effect size value of .50 suggests a moderate effect, according to Cohen's classification (Cohen et al., 2011).

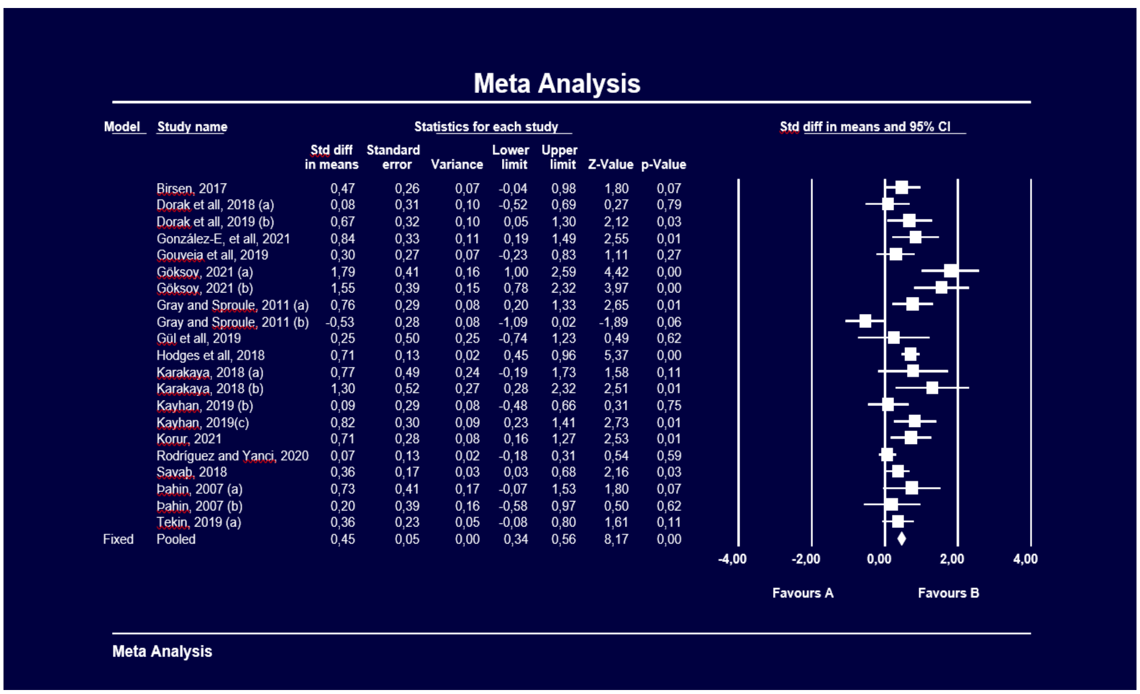

Figure 4. Forest Chart for Included Studies

As shown in Figure 4, the homogeneity test, also known as the Q_{BET}-statistic, was calculated as Q_{BET}=57.49. According to the chi-square distribution table, with 20 degrees of freedom at a 95% significance level, the critical value was found to be 31.41. Since the Q_{BET} statistic value exceeds the critical value of the chi-square distribution, the null hypothesis of homogeneity regarding the distribution of effect sizes is rejected in the fixed effects model. This implies that the distribution of effect sizes exhibits a heterogeneous characteristic according to the fixed effects model. I^2, which is a complementary measure to the Q_{BET} statistic, provides a clearer result regarding heterogeneity (Petticrew & Roberts, 2005; Yildirim, 2014). I^2 represents the proportion of total variance related to the effect size. Unlike the Q_{BET} statistic, the I^2 statistic is not influenced by the number of studies. In terms of interpretation, I^2 indicates low heterogeneity at 25%, moderate heterogeneity at 50%, and high heterogeneity at 75% (Borenstein, 2009). Based on the homogeneity tests (Q_{BET} and I^2) conducted for the multidimensional developmental domains of students through TGM intervention, moderate heterogeneity was found among the studies. Therefore, the model was transformed into a random effects model for the pooling process. The results of the moderator analysis (mixed effects analysis), conducted to identify the factors contributing to this heterogeneity, are provided in Table 4.

Borenstein et al. (2009) emphasized the need for conducting moderator analysis to identify potential sources of heterogeneity among studies. Therefore, to explore the reasons behind the heterogeneity, analysis were performed on behalf of certain moderators.

Table 4. Categorical Moderator Results on Students' Multidimensional Developments for the Use of the TGM

Moderator	**k**	**d**	**SE**	**%95 CI**	Q_{BET}	***p***

Publication type	21				2.62	.10
Master Thesis	12	0.58	0.08	0.415; 0.747		
Article	9	0.35	0.07	0.211; 0.493		
Education level	21				0.754	.68
Primary education	12	0.51	0.14	0.214; 0.486		
High-school	5	0.65	0.15	0.458; 0.874		
University	4	0.47	0.16	0.151; 0.796		
Country	21				1.306	.25
Turkey	15	0.614	0.096	0.384; 0.843		
Outside of Turkey	6	0.351	0.197	-0.036; 0.738		

*Significance level: $p < .05$

Upon examining Table 4, the results of the conducted moderator analysis revealed that certain variables (educational level, country, publication type) did not serve as moderators for the calculated average effect size. To determine if the year of the study served as a moderator, a meta-regression analysis was performed. It was found that over the years, the effect sizes associated with the use of the TGM in favor of students showed a slight upward trend, but this result was not statistically significant (coefficient = [.04]; $p = .09$). Additionally, a meta-regression analysis was conducted to determine if the sample size acted as a moderator. It was observed that there was no significant difference in terms of sample size between students exposed to the TGM and those who were not. This indicated that there was no statistically significant difference in the results (coefficient = [-.003]; $p = .07$). Furthermore, a meta-regression analysis was performed to ascertain whether the duration of the intervention acted as a moderator. It was found that there was no significant difference in terms of intervention duration between students who were exposed to the TGM and those who were not, and this result indicated a lack of statistically significant difference (coefficient = [-.02]; *p = .48*).

Discussion

The present systematic review with a meta-analysis aimed to systematically review the scientific literature about the effects of TGM interventions on students' multidimensional developmental domains, employing a robust and recognized approach (PRISMA) while delivering well-founded deductions derived from the extant body of evidence. The primary finding of this investigation revealed that the utilization of the TGM yielded a noteworthy amelioration across multidimensional developmental domains in contrast to alternative pedagogical approaches and frameworks. Notably, this substantial enhancement was discernible in ten out of the twenty-one scrutinized studies, exhibiting a magnitude that can be categorized as moderate, as indicated by the overall effect size (a total effect size of .53, accompanied by a 95% confidence interval ranging from .33 to .73 and a *p*-value of .00). This finding not only contributes to the existing empirical evidence bolstering the effectiveness of the TGM but also augments our comprehension of the wider-reaching implications of instructional strategies on diverse developmental domains, encompassing facets such as critical thinking (Brocklehurst, 2016; Chatzipanteli et al., 2016), motivation (Mitchell et al., 2020), skill expertise and physical fitness (Hodges et al., 2018; Mitchell et al., 2020) particularly within the context of dynamic and unpredictable game situations (Griffin & Sheehy, 2004).

Consistent with the findings of the current study, Smith et al. (2014) reported a notable augmentation in the levels of moderate-to-vigorous physical activity among students exposed to the TGM as compared to those who received direct instruction. Nevertheless, upon further examination of these findings while considering gender distinctions, notable disparities emerge: specifically, female students who participated in the TGM did not attain the recommended 50% threshold of physical activity levels during PE sessions (Hartwig et al., 2019). Smith et al. (2014) did not identify statistically significant differences in intrinsic motivation among students when comparing various sports implemented with the TGM, indicating that factors such as teacher behaviors and instructional duration may exert influence on these outcomes. As outlined by Miller (2015), the existing body of evidence does not sufficiently support the notion that the development of technical skills, procedural knowledge, and game-play skills related to decision-making and skill execution can be attributed to specific interventions. However, it is noteworthy that intervention volume demonstrates a significant influence on the enhancement of game-based decision-making and skill execution. In particular, there exists a positive association between these outcomes and the implementation of GCA interventions exceeding eight hours in duration. Moreover, Ortiz et al. (2023) asserted that the TGfU intervention exerts a significant influence on game performance, particularly in terms of enhancing decision-making capabilities, skill execution, and tactical proficiency.

Six of the examined studies (Alvurdu, 2017; Gün, 2019; Kayhan, 2019; Yimez, 2021) demonstrated a significant and large effect size in the domains of cognitive and psychomotor development. However, after conducting the outlier analysis, these studies were excluded from the present systematic review and meta-analysis. Alvurdu (2017) conducted a study involving an experimental group of 8 football players exposed to the TGM, while a control group of 8 football players received instruction through a direct teaching model. Both groups underwent an 8-week futsal training program. Gün (2019) examined the impact of the TGM on the cognitive processes of secondary school students. The study included a total of 80 high school students, with 40 participants in the experimental group and 40 participants in the control group. The intervention comprised a 5-week program involving volleyball and table tennis interventions utilizing the TGM. Kayhan (2019) investigated the effects of the TGM on cognitive, psychomotor, affective, and game performance development in students. The study involved a total of 48 participants, with 24 in the experimental group and 24 in the control group, within the PE football unit. The experimental group received lesson programs prepared within the framework of the TGM, while the control group received lesson programs based on a traditional approach. The duration of the lesson programs was 10 weeks for both groups. Yimez (2021) aimed to examine the impact of a 10-week intervention incorporating the TGM on students' problem-solving abilities, technical-tactical game performance, and skill development in tennis. The experimental group received the TGM intervention, while the control group received traditional instruction.

The exploration of moderator variables is expected to offer deeper insights into the robustness of this study. However, the moderator analysis, encompassing variables including educational level, country, publication type, publication year, and sample size, did not produce statistically significant findings. Furthermore, it emphasizes that these variables do not moderate the observed effects, indicating that they do not alter the magnitude of the outcomes associated with TGM usage. Therefore, the moderator-focused findings provide valuable insights into the reliability and generalizability of research findings, it is suggested that future emphasis be placed on individual studies specifically targeting these variables.

Limitations and Future Research Directions

While the systematic review and meta-analysis encompass a range of studies, there remains a need for a more extensive body of individual research, particularly emphasizing the affective developmental domain. A greater number of studies targeting this domain would enhance our understanding of the effect of TGM on affective factors, such as attitudes, motivation, and social-emotional aspects. Another limitation is the language barrier in terms of the inclusiveness of studies (solely Turkish and English).

Conclusion

In conclusion, the TGM has exhibited the potential to effectively influence multidimensional developmental domains, namely cognitive, affective, and psychomotor aspects, within the context of PE when compared to alternative pedagogical approaches mentioned in the individual studies included in this systematic review and meta-analysis. By focusing on refining research methodologies, enhancing teacher pedagogical skills, and fostering collaborative partnerships between researchers and educators, the full potential of TGM can be realized, leading to more comprehensive and effective PE settings. While further research is needed to explore its full potential and address certain limitations, the evidence thus far suggests that the TGM holds promise as an effective pedagogical approach in PE settings.

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