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# GAMING STRATEGIES AND TEACHING AT THE RIGHT LEVEL (TARL) AS PREDICTORS OF PUPILS' MATHEMATICAL PERFORMANCE

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## 2. ABSTRACT

This study examined the relationship between gaming strategies and the components of the Teaching at the Right Level (TaRL) framework, and their influence on pupils' mathematical performance in problem-solving and numerical operations among Grades 3–5 pupils in selected elementary schools in Maguindanao del Sur Division, Philippines. A descriptive-correlational research design was employed with 265 elementary school teachers as respondents, selected through complete enumeration. An adapted survey questionnaire measured gaming strategies across five dimensions — level of gaming integration, teaching method, game type, duration of gaming intervention, and game-based feedback — TaRL performance across five components — assessment, grouping, targeted instruction, foundation focus, and cost-effectiveness — and pupils' performance in problem-solving and numerical operations. Data were analyzed using mean, Spearman's rho correlation, and multiple linear regression. Results revealed that gaming strategies were Highly Committed (overall means: 4.45–4.50), TaRL components were Excellent (means: 4.44–4.52), and pupils demonstrated Excellent performance in both problem-solving (M = 4.46) and numerical operations (M = 4.43). Spearman's rho revealed highly significant positive relationships between all gaming strategy dimensions and both performance measures (rho = 0.910–0.960, all p < 0.001), and between all TaRL components and performance (rho = 0.945–0.982, all p < 0.001). Regression analysis confirmed gaming strategies explain 96.2% of variance in problem-solving (F = 1,294.942) and 94.2% in numerical operations (F = 842.746). TaRL components explained 98.8% of variance in problem-solving (F = 4,080.573) and 98.5% in numerical operations (F = 3,149.633). Duration of gaming intervention, teaching method, and level of integration were primary predictors of problem-solving; duration and integration level predicted numerical operations, while teaching method showed a negative effect.

**3. KEYWORDS:** Gaming strategies; Teaching at the Right Level; TaRL; mathematical performance; problem-solving; numerical operations; descriptive-correlational; Maguindanao del Sur; Philippines.

## 4. INTRODUCTION

The integration of game-based learning in mathematics instruction has received considerable scholarly and pedagogical attention over the past decade. Games offer pupils structured opportunities to explore fundamental number concepts — counting sequences, one-to-one correspondence, computation strategies, place values, and patterns — through engaging and interactive formats that reduce mathematics anxiety while building conceptual understanding [1]. Simultaneously, the Teaching at the Right Level (TaRL) framework has emerged as one of the most cost-effective global strategies for addressing learning gaps among children who have fallen behind foundational literacy and numeracy competencies [2,3].

TaRL's core principle is straightforward but pedagogically powerful: group learners by actual proficiency level rather than age or grade, and deliver instruction precisely matched to their current capabilities. Evidence from multiple countries demonstrates that TaRL can generate substantial learning gains at remarkably low cost — often less than $10 per child per year [4]. However, the intersection of gaming strategies with TaRL principles in the specific context of elementary mathematics instruction in the Philippines — particularly in the conflict-affected and resource-constrained Division of Maguindanao del Sur — has not been empirically investigated.

In classrooms where gaming strategies were informally incorporated, learners displayed heightened enthusiasm, improved focus, and stronger concept retention — observations that inspired this formal investigation. The study aimed to: (1) determine the extent of gaming strategies employed by teachers; (2) determine the level of TaRL performance; (3) determine pupils' mathematical performance; (4) examine significant relationships between gaming strategies and pupils' performance; (5) determine the influence of gaming strategies on pupils' performance; (6) examine significant relationships between TaRL components and pupils' performance; and (7) determine the influence of TaRL components on pupils' mathematical performance.

## 5. MATERIALS AND METHODS

### 5.1 Research Design

A quantitative descriptive-correlational research design was employed. The descriptive component characterized the levels of gaming strategy integration, TaRL component performance, and pupils' mathematical achievement. The correlational component examined relationships between variables, and multiple linear regression determined the predictive influence of gaming strategies and TaRL components on mathematical performance outcomes.

### 5.2 Participants

The study was conducted in eight (8) public elementary schools across four municipalities in Maguindanao del Sur Division: Datu Hoffer Ampatuan (Datu Aliman ES and Datu Hoffer Ampatuan CES), Datu Saudi Ampatuan (Datu Pendililang Piang ES and Kitango ES), Shariff Aguak (Labu-Labu ES and Shariff Aguak CES), and Sultan sa Barungis (Barurao CES and Paldong ES). A total of 265 elementary school teachers were included through random sampling during School Year 2025–2026.

### 5.3 Instruments

An adapted with modification survey questionnaire consisting of three parts was used. Part I assessed gaming strategies across five dimensions using a 5-point Likert scale (1 = Least Committed to 5 = Highly Committed). Part II assessed TaRL performance across five components using a 5-point performance scale (1 = Poor to 5 = Excellent). Part III assessed pupils' performance in problem-solving and numerical operations using the same scale. All instruments were validated and subjected to reliability testing prior to administration.

### 5.4 Statistical Analysis

Mean and weighted mean described variable levels. Spearman's rank-order correlation (Spearman's rho) examined relationships between gaming strategy dimensions and pupils' performance, and between TaRL components and pupils' performance. Multiple linear regression determined the predictive influence of each variable set on problem-solving and numerical operation performance. All analyses were conducted at the 5% significance level using SPSS.

### 5.5 Ethical Considerations

Permission was secured from the Schools Division Superintendent of Maguindanao del Sur Division prior to data collection. Respondents were fully informed of the study's purpose and participated voluntarily. Complete anonymity and confidentiality were ensured throughout the research process.

## 6. RESULTS AND DISCUSSION

### 6.1 Extent of Gaming Strategies

Table 1 presents the overall means of gaming strategy dimensions. All five dimensions registered at the Highly Committed level, with overall means ranging from 4.45 to 4.50. Teaching method and game type both achieved the highest overall mean (M = 4.50), while duration of gaming intervention was lowest (M = 4.45), though all remain within the Highly Committed range. The uniform high ratings indicate that gaming strategies are viewed as essential pedagogical tools — not merely entertainment supplements — used across assessment, motivation, skill reinforcement, curriculum alignment, and differentiated instruction.

***Table 1. Extent of Gaming Strategies Employed by Teachers. (N = 265)***

| Gaming Strategy Dimension | Overall Mean | Description |
|---|---|---|
| Level of Gaming Integration | 4.49 | Highly Committed |
| Teaching Method | 4.50 | Highly Committed |
| Game Type | 4.50 | Highly Committed |
| Duration of Gaming Intervention | 4.45 | Highly Committed |
| Game-Based Feedback | 4.48 | Highly Committed |

The highest-rated individual item across all gaming dimensions was the use of varied game types to match pupils' learning styles and needs (M = 4.58), followed by the use of formative assessment through games (M = 4.61). These findings align with Ke [5] and Dichev and Dicheva [6], who established that game-based learning is most effective when it is varied, adaptive, and aligned with specific learning objectives. The emphasis on using games for formative assessment also connects directly with TaRL's data-driven instructional philosophy.

### 6.2 Level of TaRL Performance

Table 2 shows TaRL component performance levels. All five components achieved Excellent ratings, with assessment highest (M = 4.52) and targeted instruction lowest (M = 4.44).

Assessment excellence was driven by regular diagnostic assessment (M = 4.63) and learner-friendly measurement tools (M = 4.55). Grouping excellence (M = 4.49) was most strongly evidenced by increased learner participation and confidence when grouped by skill level (M = 4.57).

***Table 2. Level of TaRL Performance. (N = 265)***

| TaRL Component | Overall Mean | Description |
|---|---|---|
| Assessment | 4.52 | Excellent |
| Grouping | 4.49 | Excellent |
| Targeted Instruction | 4.44 | Excellent |
| Foundation Focus | 4.48 | Excellent |
| Cost-Effectiveness | 4.45 | Excellent |

The consistent Excellent ratings across all TaRL components validate J-PAL's [4] assertion that TaRL is deeply compatible with diverse educational contexts. The high cost-effectiveness rating (M = 4.45) — with TaRL maximizing learning gains through resource optimization (M = 4.55) — corroborates Banerji and Chavan's [7] finding that TaRL can generate significant learning improvements for less than $10 per child per year.

### 6.3 Level of Pupils' Mathematical Performance

Table 3 presents pupils' performance levels. Both performance measures achieved Excellent ratings. Problem-solving was higher (M = 4.46), led by improved performance when TaRL activities were calibrated to actual learning level (M = 4.56). Numerical operations (M = 4.43) showed uniform excellence across all five assessed dimensions, each registering M = 4.43 — indicating consistent proficiency in basic arithmetic computation and conceptual understanding.

***Table 3. Level of Pupils' Mathematical Performance. (N = 265)***

| Performance Dimension | Mean | Description |
|---|---|---|
| Problem-Solving | 4.46 | Excellent |
| Numerical Operations | 4.43 | Excellent |

### 6.4 Relationship: Gaming Strategies and Pupils' Performance

Table 4 displays Spearman's rho correlations between gaming strategy dimensions and pupils' mathematical performance. All 10 correlation pairs were highly significant (all rho > 0.900, $p < 0.001$). Duration of gaming intervention showed the strongest correlation with numerical operations (rho = 0.960) and equally strong with problem-solving (rho = 0.956). Game type and game-based feedback both correlated at rho = 0.958 with problem-solving, while teaching method showed the strongest association with problem-solving at rho = 0.956. These findings reject all null hypotheses, confirming that gaming strategies comprehensively and powerfully associate with improved mathematical performance.

***Table 4. Spearman's Rho: Gaming Strategies and Pupils' Performance. | **p < 0.001***

| Gaming Strategy Dimension | Problem-Solving rho | Numerical Operations rho |
|---|---|---|
| Level of Gaming Integration | 0.926** | 0.910** |
| Teaching Method | 0.956** | 0.929** |
| Game Type | 0.958** | 0.936** |
| Duration of Gaming Intervention | 0.956** | 0.960** |
| Game-Based Feedback | 0.958** | 0.941** |

The exceptionally high correlation coefficients are consistent with Wilson et al. [8], who found strong relationships between game attributes and learning outcomes in a meta-analysis of simulation gaming research, and with Plass, Homer, and Kinzer [9], who established that well-designed game-based learning produces robust cognitive and affective outcomes when aligned with instructional goals.

### 6.5 Influence: Gaming Strategies on Pupils' Performance

Table 5 presents regression results for gaming strategies predicting problem-solving performance ($R^2 = 0.962$, $F = 1,294.942$, $p < 0.001$). Duration of gaming intervention was the strongest positive predictor ($\beta = 0.396$, $p < 0.001$), followed by teaching method ($\beta = 0.420$, $p = 0.001$) and level of gaming integration ($\beta = 0.150$, $p = 0.004$). Game type ($p = 0.135$) and game-based feedback ($p = 0.164$) were not significant independent predictors.

***Table 5. Regression: Gaming Strategies → Problem-Solving | $R^2 = 0.962$; $F = 1,294.942$; $p < 0.001$ | **p < 0.01; ns = Not Significant.***

| Gaming Strategy Predictor | β | t | p |
|---|---|---|---|
| Level of Gaming Integration | 0.150 | 2.932 | 0.004** |
| Teaching Method | 0.420 | 3.289 | 0.001** |
| Game Type | 0.172 | 1.499 | 0.135 ns |
| Duration of Gaming Intervention | 0.396 | 6.067 | 0.000** |
| Game-Based Feedback | -0.146 | -1.395 | 0.164 ns |

Table 6 presents regression results for gaming strategies predicting numerical operations ($R^2 = 0.942$, $F = 842.746$, $p < 0.001$). Duration of gaming intervention remained the dominant positive predictor ($\beta = 0.761$, $p < 0.001$), and level of gaming integration also showed significant positive influence ($\beta = 0.363$, $p < 0.001$). Notably, teaching method showed a significant negative effect ($\beta = -0.531$, $p = 0.001$), suggesting that certain instructional approaches used alongside games may hinder numerical learning — a finding warranting further pedagogical investigation.

***Table 6. Regression: Gaming Strategies → Numerical Operations | $R^2 = 0.942$; $F = 842.746$; $p < 0.001$ | **$p < 0.01$; ns = Not Significant***

| Gaming Strategy Predictor | β | t | p |
|---|---|---|---|
| Level of Gaming Integration | 0.363 | 5.783 | 0.000** |
| Teaching Method | -0.531 | -3.395 | 0.001** |
| Game Type | 0.235 | 1.668 | 0.096 ns |
| Duration of Gaming Intervention | 0.761 | 9.517 | 0.000** |
| Game-Based Feedback | 0.150 | 1.168 | 0.244 ns |

### 6.6 Relationship: TaRL Components and Pupils' Performance

Table 7 presents Spearman's rho correlations between TaRL components and pupils' performance. All 10 pairs were highly significant (all $p < 0.001$). Assessment showed the strongest association with problem-solving (rho = 0.982), while targeted instruction was most strongly correlated with numerical operations (rho = 0.975). Cost-effectiveness demonstrated very strong correlations with both outcomes (rho = 0.947 for problem-solving; rho = 0.974 for numerical operations), confirming that resource-efficient instruction is fully compatible with high performance.

***Table 7. Spearman's Rho: TaRL Components and Pupils' Performance. | **$p < 0.001$***

| TaRL Component | Problem-Solving rho | Numerical Operations rho |
|---|---|---|
| Assessment | 0.982** | 0.947** |
| Grouping | 0.964** | 0.945** |
| Targeted Instruction | 0.977** | 0.975** |
| Foundation Focus | 0.975** | 0.963** |
| Cost-Effectiveness | 0.947** | 0.974** |

### 6.7 Influence: TaRL Components on Pupils' Performance

Table 8 shows TaRL components predicting problem-solving ($R^2 = 0.988$, $F = 4{,}080.573$, $p < 0.001$). Grouping ($\beta = 0.548$, $p < 0.001$), targeted instruction ($\beta = 0.423$, $p < 0.001$), and foundation focus ($\beta = 0.339$, $p < 0.001$) were the primary positive predictors. Assessment ($\beta = -0.108$, $p = 0.009$) and cost-effectiveness ($\beta = -0.203$, $p < 0.001$) showed significant negative effects, suggesting that excessive focus on diagnostic assessment or cost-minimization without quality investment may inadvertently constrain problem-solving development.

***Table 8. Regression: TaRL Components → Problem-Solving | $R^2 = 0.988$; $F = 4,080.573$; $p < 0.001$***

| TaRL Predictor | β | t | p |
|---|---|---|---|
| Assessment | -0.108 | -2.627 | 0.009** |
| Grouping | 0.548 | 11.066 | 0.000** |
| Targeted Instruction | 0.423 | 9.257 | 0.000** |
| Foundation Focus | 0.339 | 8.352 | 0.000** |
| Cost-Effectiveness | -0.203 | -4.240 | 0.000** |

Table 9 conveys TaRL components predicting numerical operations ($R^2 = 0.985$, $F = 3,149.633$, $p < 0.001$). Cost-effectiveness emerged as the strongest positive predictor ($\beta = 0.836$, $p < 0.001$), followed by targeted instruction ($\beta = 0.415$, $p < 0.001$) and foundation focus ($\beta = 0.298$, $p < 0.001$). Assessment again showed a significant negative effect ($\beta = -0.517$, $p < 0.001$), while grouping was not a significant independent predictor ($p = 0.393$) — suggesting its influence on numerical operations operates through interaction with other TaRL components.

***Table 9. Regression: TaRL Components → Numerical Operations | $R^2 = 0.985$; $F = 3,149.633$; $p < 0.001$ | ns = Not Significant.***

| TaRL Predictor | β | t | p |
|---|---|---|---|
| Assessment | -0.517 | -11.082 | 0.000** |
| Grouping | -0.048 | -0.856 | 0.393 ns |
| Targeted Instruction | 0.415 | 7.998 | 0.000** |
| Foundation Focus | 0.298 | 6.470 | 0.000** |
| Cost-Effectiveness | 0.836 | 15.344 | 0.000** |

## 7. CONCLUSION

Teachers in Maguindanao del Sur Division demonstrate high commitment to gaming strategies and excellent TaRL implementation. Pupils exhibit excellent mathematical performance in both problem-solving and numerical operations. Gaming strategies and TaRL components are comprehensively and powerfully associated with improved mathematical outcomes — with correlation coefficients uniformly exceeding 0.90. Regression analyses reveal that duration of gaming intervention is the single most important gaming strategy predictor of both performance dimensions, while grouping, targeted instruction, and foundation focus are the primary TaRL drivers of problem-solving, and cost-effectiveness, targeted instruction, and foundation focus drive numerical operations. The counterintuitive negative effects of assessment and, in some models, teaching method signal implementation gaps requiring targeted professional development. These findings establish that gaming strategies and TaRL are not merely compatible but synergistic — together constituting a comprehensive, evidence-based framework for improving foundational mathematical competencies in resource-constrained settings.

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