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STATPRO in Rural Education: Disrupting Math Achievement or Deepening Inequality? Unpacking Gender, Class, and Parental Education Effects on Academic Self-Regulation

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Abstract

This study examines the effectiveness of the STATPRO game-based learning on mathematics achievement and investigates the factors that influence the formation of self-regulated learning (SRL) among senior high school students in rural areas. Recognizing SRL as a critical factor influencing academic success, creativity, and lifelong learning, this research examines the roles of gender, class, and parental education level in shaping SRL. Employing a quantitative pre-post design using the Wilcoxon-Signed and Friedman test for mathematics achievement and three-way multivariate analysis of variance (MANOVA) for SRL evaluation. Data were collected from cluster-randomized samples across classes 8A to 8C using standardized mathematics tests and the Academic Self-Regulated Learning Questionnaire (ASLQ). Results indicate that class ($p = 0.016$) and gender ($p = 0.001$) significantly affect mathematics achievement, while parental education level has no direct impact ($p = 0.623$). However, SRL development is significantly influenced by the interaction of class, gender, and parental education ($p=0.004$). These findings highlight the necessity of integrated support from both schools and families to cultivate the students' self-regulated learning, thereby enhancing students' cognitive and academic outcomes, especially within resource-limited rural contexts.

Keywords: Mathematics achievement; Rural; STATPRO; Self-Regulated Learning.

Abstrak

Penelitian ini mengevaluasi efektivitas intervensi pembelajaran berbasis permainan STATPRO dalam meningkatkan pencapaian matematika serta mengkaji faktor-faktor yang memengaruhi kemampuan pengelolaan dalam belajar yang diatur sendiri (self-regulated learning, SRL) pada siswa sekolah menengah atas di wilayah pedesaan. Mengingat peran krusial SRL dalam menunjang keberhasilan akademik, perkembangan kreativitas, dan pembelajaran seumur hidup, studi ini meneliti kontribusi gender, kelas, dan tingkat pendidikan orang tua dalam membentuk SRL. Dengan menggunakan desain kuantitatif pra-pasca menggunakan Wilcoxon-Signed and Friedman untuk evaluasi pencapaian matematika dan analisis varians multivariat tiga arah (MANOVA) untuk evaluasi SRL. Data dikumpulkan melalui sampel acak klaster dari kelas 8A hingga 8C, menggunakan tes matematika standar dan Kuesioner SRL berupa Academic Self-Regulated Learning Questionnaire (ASLQ). Hasil analisis menunjukkan bahwa variabel kelas ($p=0.016$) dan gender ($p=0.001$) secara signifikan mempengaruhi prestasi matematika, sedangkan tingkat pendidikan orang tua tidak memberikan pengaruh langsung ($p=0.623$). Dilain sisi, perkembangan SRL secara signifikan dipengaruhi oleh interaksi antara kelas, gender, dan pendidikan orang tua. Temuan ini menegaskan pentingnya dukungan kolaboratif yang berkelanjutan dari sekolah dan keluarga dalam mengembangkan SRL siswa, yang pada akhirnya diharapkan dapat meningkatkan hasil kognitif dan akademis siswa, khususnya dalam konteks pedesaan dengan keterbatasan sumber daya.

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Kata kunci: *Prestasi matematika; Rural; STATPRO; Self-Regulated Learning.*

INTRODUCTION

Education plays a pivotal role in shaping human capital, with the junior high school stage serving as a foundational period for cognitive and character development. This phase is critical, as it lays the groundwork for students' future academic progression and social integration. As such, strategic efforts to enhance educational quality at this level are essential for fostering long-term individual and societal advancement.

Mathematics education, as a core component of the foundational sciences, is often regarded as a key indicator of overall educational quality. However, when mathematics instruction fails to engage learners or address their evolving learning needs, it may contribute to heightened levels of mathematics anxiety. Such affective responses can, in turn, undermine students' motivation and negatively affect their academic performance in the subject.

Observations and analyses conducted at a public junior high school in Gondangrejo, Karanganyar, between February and May 2025 reveal that the mathematics instruction predominantly adheres to conventional, teacher-centered approaches. Furthermore, the integration of learning media remains minimal and lacks interactivity, failing to align with the digital contexts familiar to contemporary students. This pedagogical approach is likely contributing to diminished student engagement, reduced active participation, and limited conceptual understanding, as well as underdeveloped self-regulated learning skills

Self-regulated learning (SRL) refers to the process by which learners autonomously manage their educational experiences through active engagement in metacognitive strategies, motivation, and deliberate planning (Zimmerman, 1989). Extensive research over the past few decades (e.g., Pintrich et al., 1993; Zimmerman, 1986) has conceptualized Self-Regulated Learning (SRL) as a multifaceted construct encompassing cognitive, motivational, and emotional components (Panadero, 2017). Central to SRL is the formulation of goals, the development of strategic plans, and the implementation of tactics designed to achieve academic objectives. Through ongoing self-assessment and reflection, students continuously refine their learning approaches (Zimmerman & Moylan, 2009). The efficacy of SRL is well documented; learners who employ SRL strategies consistently demonstrate superior academic outcomes throughout childhood and adolescence (Dent & Koenka, 2016).

Academic self-directed learning ers to an active approach in which learners take charge of their own learning by managing their thoughts, actions, and motivation to enhance learning outcomes. Self-regulation plays a key role in this process, involving the ability to manage impulses, emotions, behaviors, and focus. The ability to exert self-control is particularly important for fostering healthy psychological development (Abar & Loken, 2016). Self-Regulated Learning (SRL) or academic self-regulation is one of the six aspects of self-regulation. It alludes to learning that is guided by metacognition, strategic action, and inspiration to learn.

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See Nodoushan (2010) and Pintrich & Groot (1990) for the references. Further, Academic self-regulation is a unified learning approach that includes cultivating positive behaviors which actively shape and support an individual's learning process (Zimmerman, 1990).

Research indicates that students exhibiting high levels of these behaviors effectively manage the tasks through practice, adapt their learning strategies, develop deeper understanding, and invest effort to improve academic performance, ultimately fostering educational success (Panadero, 2017). Self-regulated learning empowers students to cultivate effective study habits, enhance their academic competencies, systematically monitor their progress, and critically evaluate their outcomes (Zumbrum et al, 2015). Moreover, especially for rural junior high schools with the unique shape of these habits, showing a decline from grade 7 to 8, followed by a sharp increase from grade 8 to 9 (Li, 2024).

Public junior high schools in rural areas such as Gondangrejo encounter significant challenges in delivering quality education. Constraints, including limited infrastructure, restricted access to technology, and a shortage of teaching personnel, hinder the provision of effective and diverse instructional approaches. Moreover, the heterogeneous nature of student characteristics further complicates the teaching and learning dynamics. These conditions necessitate the adoption of flexible and adaptive pedagogical strategies capable of addressing the unique needs of individual learners.

Practical application often reveals widespread misuse, with students predominantly engaging with gadgets for non-educational purposes rather than academic activities. This underscores an urgent need to channel technological use toward more constructive and purposeful ends, particularly to effectively support learning within the school context.

Given these challenges, there is a pressing need for innovative approaches in mathematics education that integrate technology with interactive pedagogies. One promising strategy is the incorporation of interactive platforms such as Canva in teaching mathematical concepts, particularly in data analysis and probability topics. Canva is increasingly adopted as an educational tool, enabling educators to create engaging learning experiences through real-time quizzes, polls, and dynamic visual content, thereby fostering greater student participation and active learning. Santoso and Istiqomah (2022) developed innovative e-learning modules on the topic of circle equations, utilizing the Canva platform to deliver visually appealing and interactive content. Similarly, Putri and Rusnilawati (2025) investigated the integration of the Learning model with Canva demonstrating positive effects on the mathematics achievement of second-grade elementary students. Furthermore, Azizah and Ratnaningrum (2025) found that Canva-based interactive learning media are both effective and practical in enhancing students' ability to identify main ideas, streamlining the learning process, and boosting motivation in Indonesian language classes.

The implementation of the interactive STATPRO (Statistics and Probability) game is anticipated to enhance the engagement, effectiveness, and contemporary relevance of mathematics instruction at public junior high school Gondangrejo. Using STATPRO with Canva's media initiative also seeks to promote

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responsible and productive technology use among students while facilitating a shift from traditional teaching methods toward more innovative, participatory approaches that accommodate the diverse learning needs characteristic of rural schools with limited resources. Consequently, the interactive media in mathematics learning has the potential to improve student achievement. Beyond evaluating the effectiveness of interactive media on mathematics outcomes, this study will also examine how factors such as class level, gender, and parental education influence students' self-regulated learning.

Building on the challenges outlined, this study aims to evaluate the effects of STATPRO games in mathematics courses and study more about the impact of gender, grade level, and parental education on students' self-regulated learning capacities. Through this comprehensive analysis, the research seeks to contribute valuable insights for improving rural secondary education in Indonesia, offering an in-depth quantitative understanding of the effectiveness of using STATPRO games on mathematics learning, and also, the factors shaping academic self-regulated learning among rural students.

METHODS

The participants for the study were 91 junior high school students in the age range of 13-14 years selected using a cluster random sampling technique from different classes, namely 8A, 8B, and 8C. There are two interval scale response variables, namely mathematics achievement and academic self-regulated learning.

This scale is theoretically informed by Zimmerman's cyclical model of self-regulated learning, providing a structured lens for examining students' self-regulatory behaviors (Garner, 2009), a foundational framework developed by one of the field's leading scholars. Zimmerman's model conceptualizes self-regulated learning as a dynamic process encompassing three interdependent phases: the forethought phase, the performance or volitional control phase, and the self-reflection phase (Zimmerman, 1990). In the subsequent analysis, the study will examine the influence of the identified research variables on each distinct phase of the SRL cycle.

Mathematics achievement was assessed through pre- and post-tests associated with the STATPRO game intervention in mathematics learning. SRL data were collected using the Academic Self-Regulated Learning Questionnaire (ASLQ) of Nambiar et al. (2022). The construct of self-regulated learning is operationalized across three distinct yet interconnected phases—Forethought (F), Performance or Volitional Control (P), and Self-Reflection (S)—and assessed using a five-point Likert scale. The Forethought phase represents the preparatory stage, involving goal setting, planning, and strategies to minimize uncertainty while fostering a positive mindset and mitigating distractions. The Performance phase focuses on implementing strategy, managing time effectively, sustaining motivation, and handling interruptions during learning activities. Finally, the self-reflection phase entails post-performance evaluation, including self-assessment of outcomes, reflection on goal attainment, and appraisal of strategy effectiveness and time management.

The Academic Self-Regulated Learning Questionnaire (ASLQ) comprises 36 items distributed across three dimensions: 10 items for Forethought (F), 19 for Performance (P),

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and 7 for Self-reflection (S). Validity and reliability analyses were performed, with validity tests confirming statistically significant item correlations at the 1% and 5% significance levels. The reliability assessment yielded Cronbach's Alpha values detailed in Table 1.

Table 1. Reliability test results of ASQL

Number of questions	Number of respondents	CA
36	91	0.735

As shown in Table 1, the pilot study findings indicate that the questionnaire demonstrates acceptable internal consistency, with Cronbach's alpha coefficients exceeding the threshold of 0.6 across all subscales. For a detailed methodology on the reliability testing procedures, see Arof et al. (2018) for reference.

The STATPRO learning framework employs a game-based approach utilizing Canva as the interactive learning medium. Termed the STATPRO game, this platform facilitates engagement with statistical data exploration and probability content. A pre-test was administered before the intervention. Concurrently, demographic variables—including gender and Parental Education Level (PEL), categorized as Graduate, Professional, Senior High School (SHS), Junior High School (JHS), and Elementary School (ES)—were collected through a structured questionnaire.

This study aimed to evaluate the effectiveness of the STATPRO game in enhancing mathematics learning, as measured by pre- and post-test achievement scores across three classes. In addition to academic performance, the investigation also examined students' self-regulated learning concerning gender, grade level, and parental educational background. To address the research objectives, both non-parametric and parametric statistical methods were employed. Non-parametric analyses were utilized when data violated parametric assumptions. Specifically, the Wilcoxon Signed-Rank and Friedman tests assessed the significance of pre- and post-test mathematics achievement. To examine the effects of gender, grade level, and parental education level on self-regulated learning, a three-way multivariate analysis of variance (MANOVA) was conducted. A significance threshold of 0.05 was applied throughout the analyses.

RESULTS AND DISCUSSION (70%)

Before performing the three-way MANOVA, assumptions were evaluated through preliminary analyses, namely Box's M and Levene's test for homogeneity of variance; Kolmogorov-Smirnov for normality test. The results of Box's Test of Equality of Covariance Matrices for each SRL component—Forethought (F), Performance (P), and Self-reflection (S)—are presented in Table 2.

Table 2. Test of Equality of Covariance Matrices of SRL.

Source	Value
Box's M	141.894
F	1.215
Sig.	0.100

As shown in Table 2, the assumption of equality of covariance matrices for SRL is satisfied, given that the significance level (p=0.100) exceeds the 0.05 threshold.

Table 3. Levene's Test of Equality of Error Variances.

Source	Levene	Sig.
F	1.103	0.369
P	1.016	0.454
S	1.135	0.341

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As shown in Table 2, Levene's test confirmed that the assumption of homogeneity of variance was met univariately for the Forethought, Performance, and Self-Reflection dimensions of SRL. Conversely, mathematics achievement data violated parametric assumptions and, therefore, were analyzed using nonparametric statistical methods (see Table 4).

Table 4. Normality test of Math achievement.

Source	K-S	Sig.
Math Ach.	0.158	0.000

Before analyzing the effects of interactive media on mathematics learning outcomes, we conducted tests for parametric assumptions both before and after the intervention. As shown in Table 5, the data violated the normality assumption ($\alpha = 0.05 > \text{Sig.} = 0.000$). Consequently, we employed a nonparametric statistical approach—the Wilcoxon Signed (WS) Rank Test—to assess differences in learning performance (see Table 6).

Table 5. Tests of Normality of Mathematics Achievement

	K-S* Stat	Sig.
Pre	0.066	0.200
Post	0.158	0.000

* K-S: Kolmogorov-Smirnov.

Table 6. The effect of the STATPRO game on mathematics Achievement

	Pre-Post	Sig.
WS-Z	-8.066	0.200
WS-Sig	0.000	0.000
Friedman's	74.711	0.000

Table 6 indicates a significant effect of the STATPRO game on mathematics achievement, as evidenced by the Wilcoxon Signed-Rank and Friedman tests, both of which yield significance values of Sig. < 0.05.

Figure 1 presents the comparative mathematics achievement ranks before and after the intervention.

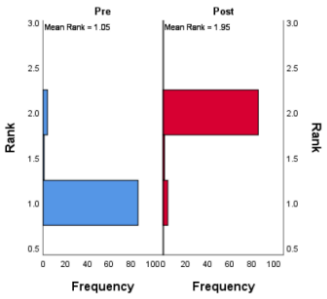

Figure 1. Related-Samples Friedman's Two-Way Anova by Ranks

As shown in Table 6 and corroborated by the accompanying Figure 1, the mean rank of mathematics achievement rose markedly from 1.05 (pre-test) to 1.95 (post-test), indicating a significant enhancement in student performance attributable to the STATPRO game intervention in mathematics learning.

Math achievement across classes

Table 7 presents the impact of the STATPRO game implementation on students' mathematics achievement across individual classes

Table 7. Classess Independent-Samples Test.

Source	K-S	Asym. Sig.
Math Ach.	8.297	0.016

As shown in Table 7, the Asymp. Sig. ($p=0.016<0.05$) indicates a statistically significant difference in mathematics achievement among students in classes 8A, 8B, and 8C, with mean ranks shown in Table 8. Thus, students' mathematics achievement in 8A is the best.

Table 8. Mean ranks of Math achievement based on class.

	Class	Mean Rank
Math. Ach	8A	57.64
	8B	40.39
	8C	40.73

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In alignment with the findings presented in Table 8, Figure 2 provides a visual representation of the average mathematics achievement for each class.

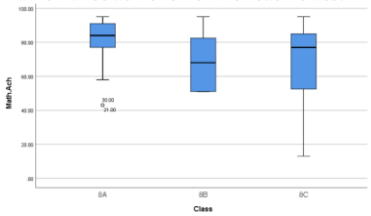

Figure 2. Mathematics achievement across the class

Table 9. Pairwise comparisons of math. Achievement across the class

	Test. Stat	Adj. Sig
8B-8C	-0.339	1.000
8B-8A	17.251	0.034
8C-8A	16.912	0.039

As indicated in Table 9, students in class 8A demonstrate the highest mathematics achievement compared to those in classes 8B and 8C. However, Figure 2 reveals two notable outliers—students 21 and 30—whose markedly low performance suggests the need for targeted intervention, even within the highest-performing group.

Math. achievement across gender

Table 10. Gender Independent-Samples Test.

Source	K-S	Asym. Sig.
Math Ach.	1.913	0.001

Table 10 reports an Asymp. Sig. value of 0.001 ($p < 0.05$), indicating a statistically significant difference in mathematics achievement between male and female students. Moreover, the mean ranks of mathematics achievement for female students are better than those for male students (See Table 11).

Table 11. Mean ranks of Math achievement across gender.

Source	Gender	Mean Rank
Math Ach.	Boy	39.83
	Girl	51.78

Consistent with the results presented in Tables 10 and 11, as depicted in Figure 3, female students exhibit higher average mathematics achievement scores compared to their male peers. However, the greater variability observed among female students suggests a wider achievement gap within this group, highlighting the need for educators to address individual learning differences more effectively.

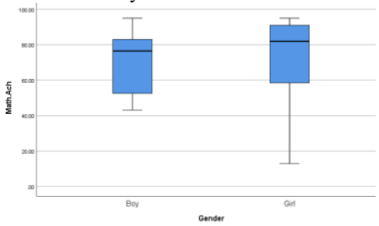

Figure 3. Mathematics achievement across genders

Math achievement across parental educational level (PEL)

After class and gender, we analyze the last effects of parental education level on mathematics achievement.

Table 12. PEL Independent-Samples Test.

Source	K-W	Asym. Sig.
Math Ach.	2.624	0.623

As shown in Table 12, the Asymp. Sig. value of 0.623 ($p > 0.05$) indicates that PEL does not exert a statistically significant influence on students' mathematics achievement.

Following this analysis, attention turns to the Self-Regulated Learning (SRL) variable, which comprises three key components: Forethought (F), Performance (P), and Self-Reflection (S). Accordingly, each component is analyzed individually to assess its contribution to SRL.

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Table 13. Multivariate Test on SRL.

Source	Value	Sig.
Class	0.090	0.125
Gender	0.339	0.000
PEL	0.198	0.295
Class*Gender	0.032	0.556
Class*PEL	0.265	0.013
Gender*PEL	0.113	0.122
Class*Gender*PEL	0.251	0.004

Description: shows variables that are significant to SRL.

Table 13 presents the significance of the independent variables affecting SRL, identifying Gender, the interaction between Class and PEL, and the three-way interaction among Class, Gender, and PEL as significant predictors. Detailed results from the univariate analysis are provided in Table 14.

Table 14. Test of Between-Subjects Effects.

Source	SRL		
	F	P	S
Class	0.977	0.768	0.176
Gender	0.001	0.000	0.000
PEL	0.583	0.674	0.364
Class*Gender	0.616	0.925	0.824
Class*PEL	0.402	0.142	0.013
Gender*PEL	0.823	0.598	0.582
Class*Gender*PEL	0.018	0.025	0.019

Based on the results in Table 14, the analysis focuses on variables that significantly influence the SRL through its phases, i.e., F, P, and S. Given the presence of a significant interaction effect, priority is given to examining the interaction terms before interpreting the main effects.

Class*Gender*PEL

From Table 13, Table 14, and Figure 4 above, it appears that the highest Forethought ability is in male students in class 8B with a professional parental education background. Conversely, the lowest Forethought ability is in male students in class 8B with a parental background of ES.

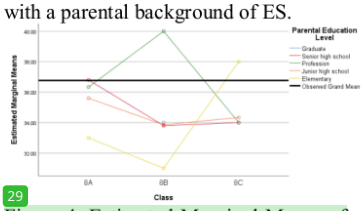

Figure 4. Estimated Marginal Means of Forethought at Boys' students.

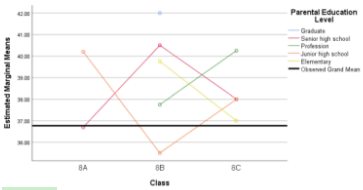

Figure 5. Estimated Marginal Means of Forethought for Girls students

As indicated in Tables 13 and 14, and illustrated in the accompanying figure, the highest forethought scores are observed among female students in class 8B whose parents hold a graduate-level education. In contrast, the lowest forethought scores are found among female students in the same class whose parents have only a junior high school educational background.

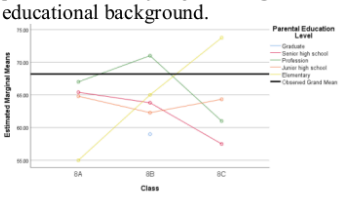

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Figure 6. Estimated Marginal Means of Performance at Boys students

As shown in Tables 13 and 14, and illustrated in Figure 6, the highest performance scores are exhibited by male students in class 8C, while the lowest are observed among male students in class 8A. Notably, both groups share a common parental educational background at the elementary school (ES) level.

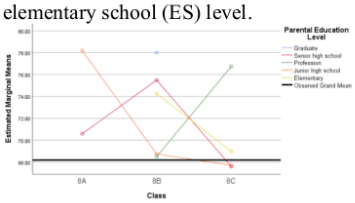

Figure 7. Estimated Marginal Means of Performance for girls' students.

As presented in Tables 13 and 14 and illustrated in Figure 7, the highest performance scores are observed among male students in class 8A whose parents have a junior high school (JHS) educational background. In contrast, female students in class 8C, whose parents have completed either junior high school (JHS) or senior high school (SHS), exhibit the lowest levels of academic performance.

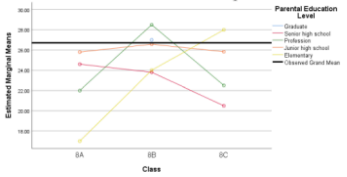

Figure 8. Estimated Marginal Means of Self-Reflection for boys' students.

As shown in Tables 13 and 14 and illustrated in Figure 8, above-average self-reflection scores are observed among male students in class 8B whose parents have professional or graduate-level educational backgrounds. Similarly, elevated self-reflection scores are also noted among male students in class 8C whose parents possess only an elementary school (ES) educational background.

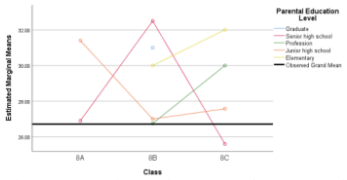

Figure 9. Estimated Marginal Means of SR for girls' students.

As illustrated in Figure 9, a distinct pattern emerges among female students: self-reflection abilities generally trend above average across groups, except for those in class 8C, whose parents have a senior high school (SHS) educational background.

Class*Parental Education Level

Tables 13 and 14 reveal that the interaction between class and parental education level exerts a significant influence solely on the Self-Reflection component of Self-Regulated Learning, emphasizing the critical role of parental educational attainment in fostering students' self-regulatory development.

Table 15. Participants' number

Source	Value Label	N
Class	8A	29
	8B	31
	8C	31
Gender	Boy	44
	Girl	47
PEL	Grad	2
	SHS	29
	Profes	15
	JHS	34
	ES	11

Table 15 reveals that the majority of parents hold a junior high school (JHS) educational background, totaling 34 individuals, whereas the fewest

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number of parents possess a graduate-level education. Figure 10 illustrates the influence of the Forethought (F) component across classes, analyzed in the context of parental educational level (PEL), based on the distribution of participants.

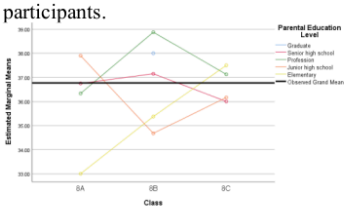

Figure 10. Estimated marginal means of Forethought based on Class*PEL.

As evidenced in Tables 13 and 14 and illustrated in Figure 10, the highest Forethought (F) scores are observed among class 8B students whose parents have a professional educational background. In contrast, the lowest F scores are found among class 8A students whose parents have only an elementary school (ES) level of education.

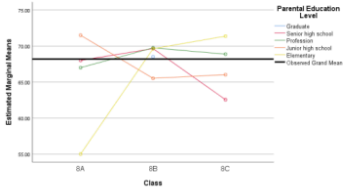

Figure 11. Estimated marginal means of P based on Class*PEL.

Further, as shown in Tables 13 and 14 and illustrated in Figure 11, the highest Performance (P) scores are observed among class 8A students whose parents have a junior high school (JHS) educational background. In contrast, the lowest Forethought (F) scores are found among class 8A students whose parents have only an elementary school (ES) level of education.

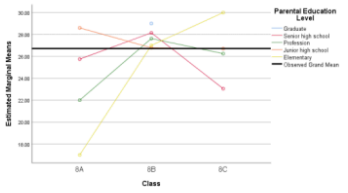

Figure 12. Estimated marginal means of S based on Class*PEL.

As demonstrated in Tables 13 and 14 and illustrated in Figure 12, among students whose parents have an elementary school (ES) educational background, the highest Self-Reflection (S) scores are observed in class 8C, while the lowest are found in class 8A.

SRL across Gender

Table 15 reports the descriptive statistics for Self-Regulated Learning (SRL) among male and female students, revealing that female students demonstrate higher average levels of SRL alongside lower variability in their responses compared to male students. This suggests a wider disparity in SRL among male students. The results indicate that female students generally exhibit elevated levels of Self-Regulated Learning (SRL) compared to their male counterparts, alongside more consistent (i.e., less variable) performance scores. In contrast, SRL among male students shows greater dispersion, indicating a wider gap within this group. This contrasts with the findings of Meece et al. (2006), who reported that female students are more prone to low self-expectation and learned helplessness than their male counterparts, suggesting a potential shift or contextual difference in SRL patterns.

Table 16. Estimates the marginal means of SRL across gender.

Source	Mean	Std.Error

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F-Boy	34.979	0.619
Girl	38.695	0.608
P-Boy	63.836	1.199
Girl	72.260	1.179
S-Boy	24.316	0.607
Girl	29.156	0.597

Now, let us observe the visualization of Figures 13-15.

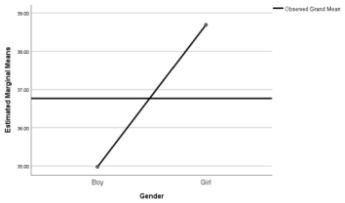

Figure 13. Estimated marginal means of Forethought across gender

Figure 14. Estimated marginal means of P across gender.

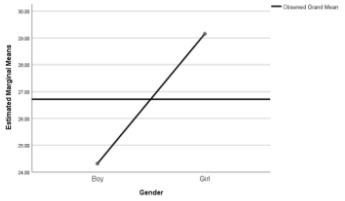

Figure 15. Estimated marginal means of Self-Reflection across gender

As demonstrated in Tables 13, 14, and 16, as well as Figures 1 through 3, female students consistently achieve mean Self-Regulated Learning (SRL) scores above the overall average across all three phases: Forethought (F), Performance (P), and Self-Reflection (S). Moreover, female students consistently outperform their male counterparts, with these differences reaching statistical significance at the 95% confidence level.

CONCLUSIONS AND SUGGESTIONS

The analysis confirms that the integration of STATPRO games significantly improves students' mathematics achievement, with female students consistently outperforming their male counterparts. Furthermore, the Self-Regulated Learning (SRL) abilities of students in rural settings are shaped by a combination of factors, including class level, gender, and parental educational background. These factors influence all three SRL phases—Forethought (F), Performance (P), and Self-Reflection (S). This underscores the multifaceted nature of SRL, which is influenced by both internal and external determinants, such as motivation and grit (Guo et al., 2023), self-regulatory efficacy, psychological need satisfaction, mental well-being (Vos et al., 2025), and the references therein.

The results of this study reveal that self-regulated learning is influenced by multiple contextual and demographic factors, including gender, institutional environment, and parental educational background. Notably, a high level of parental education does not automatically translate into stronger SRL capabilities in students. Rather, the presence—or absence—of active parental support plays a more decisive role. This supports Choe's (2020) assertion that parental involvement is a

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stronger predictor of SRL than parental education level alone. Students exhibiting strong self-regulation typically engage intentionally in diverse SRL strategies—including planning, goal-setting, and critical reflection—that promote learning efficiency and contribute to academic achievement (Li et al., 2018).

The highest levels of SRL among male students were observed in class 8B, particularly those whose parents held professional qualifications. In contrast, the highest SRL among female students in the same class was associated with parental backgrounds, including senior high school and undergraduate education. Despite variations across classes, these findings underscore the critical role of parental influence, regardless of gender, in shaping students' SRL capacities. This influence is particularly evident in the cognitive domain, as reflected in students' mathematics achievement.

The implementation of STATPRO games has been demonstrated to significantly enhance mathematics achievement across various classes and genders. While parental education level alone does not directly influence mathematics performance, a combined interaction effect of class, gender, and parental education level was observed on students' self-regulated learning. Recognizing that self-regulated learning is a vital skill shaping students' knowledge acquisition, academic achievement, creative growth, and lifelong learning trajectories, it is imperative to examine the factors and internal mechanisms that influence this capacity to effectively cultivate students' learning abilities. In light of the findings, it is recommended that educational institutions actively engage parents through collaborative partnerships to support the development and enhancement of students' self-regulated learning competencies. Sustained and coordinated support from both educational institutions and families is essential to advancing students' overall academic development and personal growth. This recommendation is consistent with Daniel et al. (2016), who found that parental involvement indirectly enhances children's numeracy achievement by fostering self-regulated learning behaviors.

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