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EVALUATING THE EFFECTIVENESS OF "STATPRO" IN ENHANCING SELF-REGULATED LEARNING AND MATH PERFORMANCE IN RURAL SECONDARY EDUCATION

Getut Pramesti[1*], Sri Widodo[2], Amalia Putri Utami[3], Anita Khoiru Nisa[4], Izzatil Ulya[5], Kandhi Tri Winarsih[6], Alifia Wahyu Nur Rakhma[7]

[1,3,4,5,6,7] Universitas Sebelas Maret, Surakarta, Indonesia
[2] SMPN 3 Gondangrejo Karanganyar, Indonesia
*Corresponding author. Jl. Ir. Sutami 36A, Surakarta, Indonesia.
E-mail: *getutpramesti@staff.uns.ac.id*[*)]

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Abstract

This study examines the effectiveness of the STATPRO game-based learning on mathematics achievement. It 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. A quantitative pre–post research design was employed, wherein the Wilcoxon Signed-Rank test and the Friedman test were utilized to assess mathematics achievement. At the same time, a three-way multivariate analysis of variance (MANOVA) was conducted to evaluate self-regulated learning (SRL). Data were collected from cluster-randomized samples across classes 8A to 8C using standardized mathematics tests and the Academic Self-Regulated Learning Questionnaire. Results indicate that class and gender significantly affect mathematics achievement, while parental education level has no direct impact (e.g., p =0.016, 0.001, 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 dan Kuesioner SRL berupa Academic Self-Regulated Learning Questionnaire. Hasil analisis menunjukkan bahwa variabel kelas dan gender secara signifikan mempengaruhi prestasi matematika, sedangkan tingkat pendidikan orang tua tidak memberikan pengaruh langsung (p =0.016, 0.001, 0.623) *(p=0.623). Dilain sisi, perkembangan SRL secara signifikan dipengaruhi oleh interaksi antara kelas, gender, dan pendidikan orang tua* (p=0.004). *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.*

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

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INTRODUCTION

Education plays a critical role in shaping human capital and fostering individual and societal progress. The junior high school stage is a pivotal period for cognitive and character development, laying the foundation for future academic success and social integration. Ensuring quality education during this phase is essential for long-term individual and societal advancement. Mathematics education, as a core subject, serves as a key indicator of overall educational quality and is vital for developing scientific literacy.

Research highlights the importance of engaging and supportive pedagogical approaches in mathematics education to prevent negative affective responses such as mathematics anxiety, which can hinder motivation and achievement. Self-regulated learning (SRL), defined as learners' autonomous management of cognition, motivation, and behavior, has been widely studied and linked to superior academic outcomes. See key scholars such as Zimmerman (2002), Panadero and Alonso-Tapia (2014), Bembenutty et al. (2013), Zimmerman and Schunk (2013), Cleary and Kitsantas (2017), and also Aviory et al. (2025) for the SRL references

Conceptualizes SRL as a multi-faceted process involving goal-setting, strategic planning, self-monitoring, and reflection (Panadero, 2017). Previous findings that SRL is influenced by gender and metacognitive skills (Guo et al., 2023; Li et al., 2018). Active parental involvement rather than just educational attainment, was identified as a key factor in fostering SRL, underscoring the role of home support in student learning (Choe, 2020; Daniel et al., 2016). The critical role of family engagement in developing SRL (Vos et al., 2025).

Academic self-regulation also plays a crucial role in fostering healthy psychological development (Nodoushan, 2012). Interactive digital tools like Canva have shown promise in enhancing engagement and learning outcomes across various subjects (Azizah & Ratnaningrum, 2025); (Putri, 2025); (Santoso & Istiqomah, 2022) and (Indriyani et al., 2024). Despite these theoretical advances, a significant gap remains in the effective cultivation of SRL and interactive learning in rural Indonesian junior high schools. Observations in Gondangrejo, Karanganyar, reveal that mathematics instruction predominantly employs traditional, teacher-centered methods with minimal use of interactive media. Additionally, students' use of technology often centers on non-educational activities, limiting its potential to support learning. These factors contribute to low student engagement, limited conceptual understanding, and underdeveloped SRL skills in rural contexts (Li, 2024).

Public junior high schools in rural areas, namely, Gondangrejo, Karanganyar, face challenges including limited infrastructure, scarce teaching personnel, and diverse student needs, which complicate effective instruction. The prevailing conventional teaching approach in mathematics, coupled with insufficient integration of interactive digital tools, results in reduced active participation, diminished motivation, and hindered development of critical learning skills. These conditions negatively impact students' academic performance and long-term educational trajectories.

This study proposes the implementation of the interactive STATPRO (Statistics and Probability) game as a Canva-based educational tool focused on statistics and probability, as

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an innovative strategy to enhance mathematics instruction in rural junior high schools. STATPRO aims to increase student engagement through real-time quizzes, polls, and dynamic visual content, while promoting responsible and purposeful use of technology. This approach seeks to shift teaching from passive, lecture-driven methods to participatory, student-centered learning tailored to diverse rural classrooms (Santoso & Istiqomah, 2022; Azizah & Ratnaningrum, 2025; Putri, 2025).

The study expects to provide evidence that the use of the STATPRO game will significantly improve students' mathematics achievement and self-regulated learning skills. Additionally, the research will explore how factors such as class level, gender, and parental education influence SRL capacities. Overall, the findings are anticipated to offer valuable insights into the effectiveness of interactive digital media in rural education and inform more equitable and adaptive pedagogical practices in Indonesian junior high schools.

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, Junior High School in Gondangrejo, Karanganyar. A total of 91 subjects were included in the research from the total population (n=274). There are two interval scale response variables, namely mathematics achievement and academic self-regulated learning.

Student mathematics achievement was systematically measured using pre- and post-test assessments surrounding the integration of the STATPRO game into the eighth-grade mathematics curriculum. The intervention specifically addressed the Statistics and Probability unit and was implemented over a one-month instructional period. This methodological approach provided a robust framework for evaluating the efficacy of the STATPRO game in improving student learning outcomes and engagement within the mathematics classroom

The scale of SRL 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, 2002). In the subsequent analysis, the study will examine the influence of the identified research variables on each distinct phase of the SRL cycle.

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, namely 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

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focuses on implementing the 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), 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 (CA) 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 & Ismail, 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 achievement, as measured by pre- and post-test 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. Multivariate analysis of variance was utilized in this study because it allows for the simultaneous examination of multiple dependent variables. Specifically, the analysis focused on two key outcome measures: academic performance, operationalized through mathematics achievement scores, and self-regulated learning. Employing MANOVA enabled a comprehensive assessment of the intervention's effects on both cognitive achievement and metacognitive learning processes, thereby providing a more holistic understanding of student outcomes. A significance threshold of 0.05 was applied throughout the analyses.

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RESULTS AND DISCUSSION

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

Observe 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 Mathematics 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.

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.

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 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.

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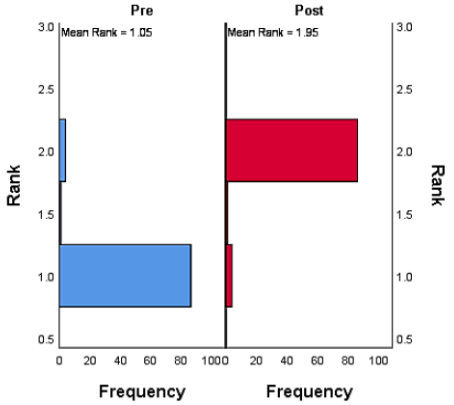

Figure 1. Related-Samples Friedman's Two-Way Anova by Ranks

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	Sig.
Math Ach.	8.297	0.016

Observe Table 7. The Asympt. 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 Mathematics achievement based on class.

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

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

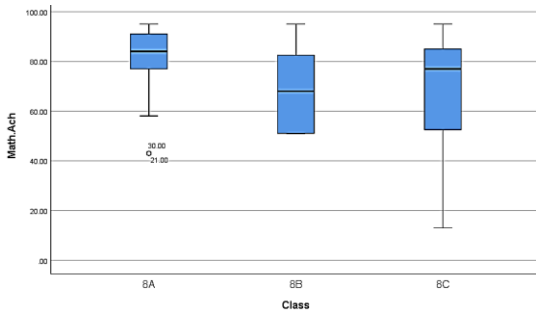

Figure 2. Mathematics achievement across the class

Figure 2 reveals that students ranked 21 and 30 demonstrate the lowest mathematics achievement scores. These students have been identified as statistical outliers, warranting targeted instructional interventions and ongoing monitoring to address their atypical performance and support their academic development effectively.

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.

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Mathematics achievement across gender

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.

Table 10. Gender Independent-Samples Test.

Source	K-S	Sig.
Math Ach.	1.913	0.001

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 Mathematics 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.

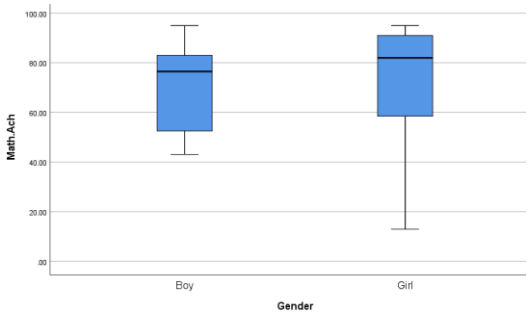

Figure 3. Mathematics achievement across genders

Math achievement across parental educational level (PEL)

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

Table 12. PEL Independent-Samples Test.

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

The Asympt. Sig. in Table 12, namely 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.

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

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.

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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, 14, and Figure 4, 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.

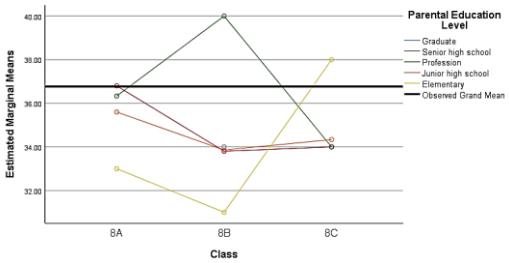

Figure 4. Estimated Marginal Means of Forethought at Boys' students.

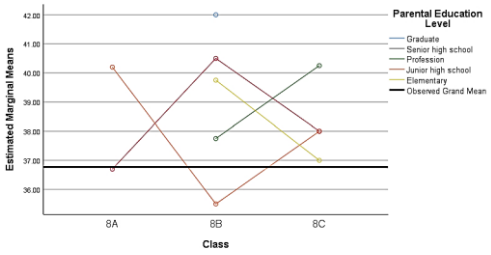

Figure 5. Estimated Marginal Means of Forethought for Girls students

As indicated in Tables 13 and 14, and illustrated in the accompanying Figure 5, 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.

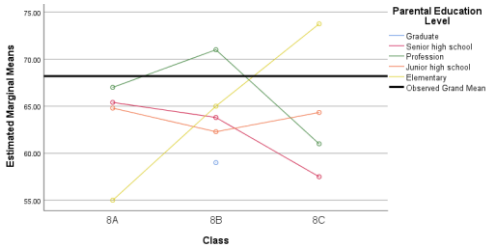

Figure 6. Estimated Marginal Means of Performance for Boys students

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.

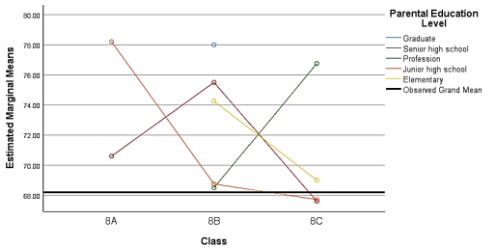

Figure 7. Estimated Marginal Means of Performance for girls' students.

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As presented in Tables 13 and 14 and illustrated in Figure 7, the highest performance scores are observed among female 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.

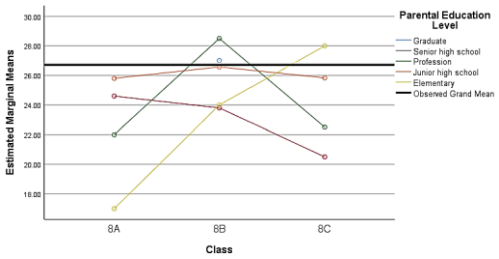

Figure 8. Estimated Marginal Means of Self-Reflection for boys' students.

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.

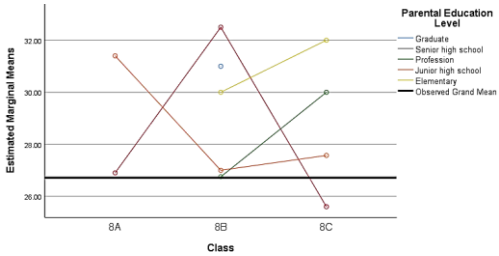

Figure 9. Estimated Marginal Means of SR for girls' students.

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 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.

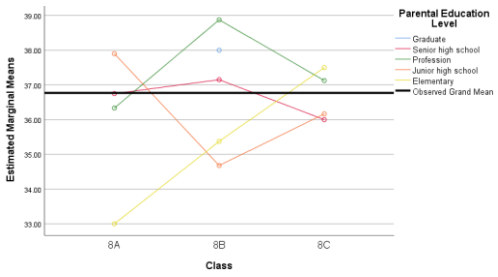

Figure 10. Estimated marginal means of Forethought based on Class*PEL.

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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.

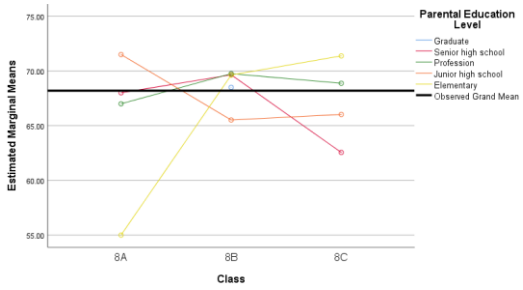

Figure 11. Estimated marginal means of P based on Class*PEL.

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.

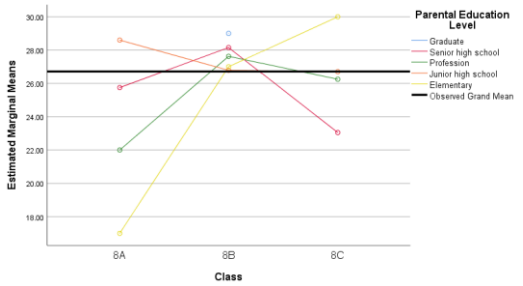

Figure 12. Estimated marginal means of S based on Class*PEL.

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 16 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	S.E
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

Then, let us observe the visualization of Figures 13 until 15.

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Figure 13. Estimated marginal means of Forethought across gender

As demonstrated in Tables 13, 14, and 16, as well as Figures 13-15, 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).

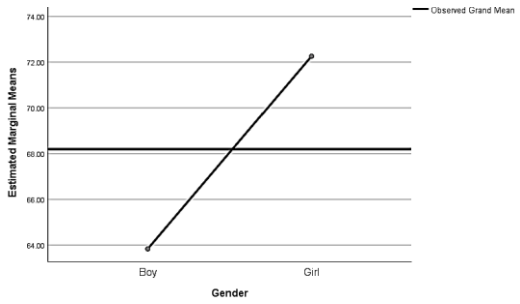

Figure 14. Estimated marginal means of P across gender.

Moreover, female students consistently outperform their male counterparts, with these differences reaching statistical significance at the 95% confidence level.

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

Education is central to the development of human capital, with the junior high school level serving as a critical phase for students' cognitive and character formation. At this stage, learners begin to build foundational academic skills while also forming habits of independent and reflective learning. In rural areas such as Gondangrejo, Karanganyar, however, public junior high schools face multiple challenges including outdated instructional methods, limited use of technology, and resource constraints. Observations from February to May 2025 reveal that mathematics instruction in this context remains predominantly teacher-centered, lacking interactivity and failing to resonate with the digital experiences of students. This instructional gap contributes not only to reduced student engagement and limited understanding of mathematical concepts but also to the underdevelopment of self-regulated learning (SRL) capacities. Furthermore, insufficient integration of technology perpetuates student gadget use for non-educational purposes, underscoring the urgent need to reframe digital tools toward purposeful learning.

This study addresses these challenges by introducing STATPRO, an interactive, game-based learning media focused on data and probability topics in mathematics. The results demonstrate that STATPRO significantly improves students' mathematics achievement. The Wilcoxon Signed-Rank and Friedman tests confirmed a statistically significant increase in performance from pre-test to post-test, with mean rank scores rising from 1.05 to 1.95. The impact was particularly notable among students in class 8A, and across gender, female students consistently outperformed males in mathematics achievement.

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However, parental education level (PEL) did not significantly influence mathematics achievement, although it interacted with gender and class to affect SRL outcomes. The analysis of SRL operationalized through its three phases: Forethought, Performance, and Self-Reflection, revealed that female students not only achieved higher SRL scores overall but also demonstrated lower variability, indicating more consistent self-regulation. In contrast, male students exhibited greater variability, suggesting a broader achievement gap and the need for differentiated pedagogical strategies.

Several factors contributed to these outcomes. The interactive nature of the STATPRO game effectively addressed students' need for engaging and contextualized learning, aligning with (Zimmerman, 2002). The theoretical framework of SRL emphasizes metacognitive strategies, goal setting, and reflective practice. Additionally, the significant interaction effects between class, gender, and PEL provide insight into how social and educational backgrounds shape learners' regulatory processes. For instance, male students in class 8B with professionally educated parents exhibited the highest Forethought scores, while their peers with less educated parents performed the lowest. Interestingly, despite these variations, female students consistently scored above average in all SRL components, contradicting earlier findings by Meece et al. (2006), which had suggested that female students were more susceptible to low self-expectation and learned helplessness. This divergence may reflect evolving educational environments or the influence of technology-rich, student-centered interventions like STATPRO.

Methodologically, this study is strengthened by its comprehensive preliminary testing of statistical assumptions using Box's M, Levene's test, and Kolmogorov-Smirnov test. The use of nonparametric tests in response to violations of normality assumptions enhances the validity of the findings. The three-way MANOVA approach further allowed for a nuanced exploration of how demographic variables interact to shape SRL. Nevertheless, the study is limited by its context-specific focus on a single rural school, which restricts its generalizability. Additionally, the lack of qualitative data, such as interviews or classroom observations, restricts deeper interpretation of student experiences. Another limitation lies in the broad categorization of PEL, which may obscure more granular socio-economic insights.

When compared to previous studies, this research affirms the positive outcomes associated with technology-integrated and interactive learning media. The effectiveness of STATPRO aligns with findings from prior studies that utilized Canva-based learning tools in both mathematics (Putri, 2025; Santoso & Istiqomah, 2022) and language subjects (Azizah & Ratnaningrum, 2025). Moreover, the observed trends in SRL across grade levels are consistent with findings by (Li, 2024), who noted a pattern of decline in SRL from grade 7 to 8, followed by recovery in grade 9. In contrast to earlier gender-related SRL studies, this research suggests a contextual shift, with female students now exhibiting stronger and more stable self-regulation.

The implications of this study are twofold. Theoretically, it reinforces the multidimensional construct of SRL and contributes empirical evidence from an

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underrepresented rural context in Indonesia. It also highlights how interactions between individual and environmental variables affect the development of self-regulated learning. Practically, the findings suggest that game-based learning tools such as STATPRO can serve as catalysts for meaningful change in mathematics instruction, particularly in resource-limited settings. Furthermore, the integration of such tools fosters productive use of technology, transforming student interaction with digital devices from passive to academic. These outcomes support the call for innovative pedagogical approaches that are flexible, interactive, and responsive to the diverse needs of learners in rural areas.

CONCLUSION AND SUGGESTION

The study highlights the effectiveness of STATPRO, a game-based learning tool, in improving mathematics achievement among junior high students in rural settings. Despite limited resources, the integration of STATPRO via platforms like Canva proved feasible and beneficial in Gondangrejo Junior High School, enhancing both engagement and conceptual understanding. These findings support the potential of interactive media as a practical solution for under-resourced educational environments.

The research also explores the development of Self-Regulated Learning (SRL), showing how it is influenced by factors such as class level, gender, and parental education. Female students demonstrated stronger SRL and higher math achievement. Importantly, active parental involvement rather than just educational attainment was identified as a key factor in fostering SRL.

In conclusion, the study confirms that interactive, student-centered approaches like STATPRO can bridge educational gaps in rural schools. Future research should consider longitudinal and mixed-methods studies to further explore the long-term impact of such tools and the psychological factors (e.g., grit, resilience) that support SRL across diverse demographics. Strengthening collaboration between schools and families remains vital for cultivating lifelong learners.

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