

Traversing the Relationship Between Student Engagement and Science Achievement: Sigla Program in Junior Highschool

¹Fritzie O. Pastor, ²Avon Grace P. Grapa, ³Genevieve G. Alcover, ⁴Mariel B. Binarao, ⁵Geson C. Arias

Cebu Technological University

¹fritziepastor67@gmail.com, ²yvonpelayo@gmail.com, ³alcovergenevieve82@gmail.com,

⁴marielbinarao10@gmail.com, ⁵gesonarias@gmail.com

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Corresponding Email:

fritziepastor67@gmail.com

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Abstract. This research investigated the relationship between student engagement and academic achievement within the context of the S.I.G.L.A. (Science Innovations for Genuinely Localized Action) Program. The research aimed to determine how localized instructional interventions influence the behavioral, emotional, and cognitive involvement of learners and their subsequent mastery of Science competencies in rural secondary schools. A descriptive-correlational research design was employed to analyze the dynamics between engagement dimensions and academic outcomes. The respondents of the study included a total of 110 respondents from select National High Schools in the District of Villaba, Leyte, namely Villaba National Comprehensive High School, Cahigan National High School, and Sambulawan National High School. The teacher-respondent profile (n=5) consisted of licensed professional educators, primarily aged 26–45, with a balanced gender distribution and active involvement in graduate studies. The student-respondent profile (n=105) comprised Junior High School learners, predominantly aged 13–16, coming from low-income households with a monthly family income typically below ₱10,000. Results indicated that the S.I.G.L.A. Program is perceived as "Highly Positive" (3.70) by stakeholders, with its gamified and localized activity exemplars receiving the highest approval. Student engagement was found to be generally high (3.23), characterized by "Very High" Emotional Engagement but relatively lower Cognitive Engagement. In terms of academic performance, the respondents demonstrated a Satisfactory level of Science achievement (81.76); however, competency-based assessments highlighted a significant struggle in Higher-Order Thinking Skills (HOTS), particularly in analyzing and synthesizing (77.50%). Correlational analysis revealed a significant relationship between engagement levels and Science achievement, though this relationship is hindered by a Linguistic Barrier (82.7%) and a Lack of Laboratory Equipment (75.5%). The study concludes that while the S.I.G.L.A. Program effectively captivated students through localized interest, cognitive scaffolding and translanguaging strategies are necessary to translate engagement into mastery. The study recommends the formal adoption of the S.I.G.L.A. Science Enhancement Program to institutionalize community-based inquiry and dismantle the linguistic and resource-based barriers in the District of Villaba.

Introduction

The landscape of Philippine education is currently navigating a period of profound transformation and critical evaluation. As the nation strives to align itself with global standards of scientific literacy and technological proficiency, the persistent disparity between educational aspirations and actual student performance remains a daunting challenge. This study emerges from a necessity to move beyond surface-level interventions and delve into the psychological and behavioral mechanisms that drive academic success. By centering this inquiry on the select National High

Schools of Villaba, Leyte, the study acknowledges that learning is not a generic process but one deeply embedded in local socio-economic contexts, rural realities, and the collective resilience of the Leyteño people. The following rationale provides an extensive and exhaustive justification for this research, arguing that the trajectory of Science achievement in the Philippines is inextricably linked to the depth of a student's engagement—a multidimensional bridge connecting the learner's inner world to the demands of a complex, modern curriculum.

The foundational justification for this research is the undeniable and persistent underperformance of Filipino learners in the global scientific arena. According to the results of the Program for International Student Assessment (PISA) 2018 and 2022, the Philippines consistently ranks among the lowest in Science literacy among participating nations (OECD, 2019; OECD, 2023). This is not merely a ranking issue; it is a manifestation of a "learning crisis" that threatens the country's long-term economic and social development. Bernardo (2021) asserts that scientific literacy is the primary driver of national innovation and competitiveness. Without a solid foundation in Science, the Filipino youth are disadvantaged in a globalized economy that increasingly rewards STEM-related competencies. This study posits that to address this achievement gap, researchers must look beyond physical resources and curriculum design, focusing instead on the "missing link" of student engagement.

To understand the "how" and "why" of Science achievement, this study adopts the seminal framework of Fredricks, Blumenfeld, and Paris (2004), which conceptualizes student engagement as a three-dimensional construct: behavioral, emotional, and cognitive.

Behavioral engagement pertains to the observable participation of students in school-related activities, such as attendance, completion of laboratory reports, and adherence to classroom norms. Christenson, Reschly, and Wylie (2012) argue that behavioral engagement is the most direct predictor of academic survival; a student who is not physically or mentally present in a Science class in Villaba cannot possibly master the intricacies of the subject.

While, Emotional engagement encompasses a student's affective reactions, interest, boredom, happiness, or anxiety, within the classroom. In the Philippines, Science is often stereotyped as a "difficult" or "intimidating" subject. Pekrun (2006), in his Control-Value Theory of Achievement Emotions, notes that if a student feels a sense of dread toward a Physics or Chemistry class, their cognitive resources are redirected toward managing that anxiety rather than processing the lesson.

Consequently, Cognitive engagement represents the highest level of involvement, where students invest psychological effort to understand complex ideas. Zhu, Au, and Yates (2019) found that in STEM education, cognitive engagement such as the use of self-regulated learning strategies is what distinguishes high achievers from those who merely memorize facts for a test. This study "traverses" these dimensions to identify which specific type of engagement is most deficient among students in the Leyte region.

The choice of National High Schools in Villaba, Leyte, provides a unique and necessary lens for this study. Villaba is a municipality where the economy is deeply rooted in agriculture and coastal resources. Students in these schools often face a "dual burden" the need to excel academically while assisting in familial labor. Maligalig et al. (2010) and Reyes et al. (2015) have documented how poverty in the Philippine provinces directly impacts school engagement. For a student in Villaba, the "cost" of being engaged in school is often high.

Furthermore, the geographical vulnerability of Leyte cannot be ignored. The region is frequently hit by typhoons and natural disasters. Lucman (2021) observes that while Filipino students exhibit high levels of resilience, the psychological toll of recurring disasters can lead to emotional disengagement. This study is crucial because it examines Science achievement not in a vacuum, but within a resilient yet vulnerable rural community that is still navigating the post-pandemic "learning loss."

A significant hurdle in the relationship between engagement and achievement in the Philippines is the medium of instruction. Science is taught in English, which for many students in Villaba is a second or third language. Bernardo (2004) found that the cognitive load of translating scientific jargon while trying to grasp abstract concepts often leads to "cognitive overload" and subsequent disengagement. By investigating this relationship in a rural setting where English proficiency may vary, this study provides empirical data on how language barriers moderate the engagement-achievement link.

The Philippine Department of Education has recently launched the MATATAG Curriculum, which emphasizes the localization and contextualization of lessons (DepEd Order No. 32, s. 2015). For Science teachers in Villaba, this means using local ecosystems, like the Leyte Gulf or local farming techniques, as teaching tools. Ona (2016) suggests that contextualization boosts emotional engagement by making Science relevant to the student's daily life. However, there is a

lack of research in the Leyte division specifically measuring if these localized strategies actually translate to higher standardized test scores. This dissertation fills that gap.

The rationale also rests on the understanding that engagement and achievement are not one-way streets. Finn (1989) proposed the Participation-Identification Model, suggesting a cyclical relationship: participation (behavioral engagement) leads to success (achievement), which then fosters a sense of belonging (emotional engagement). Conversely, Skinner and Pitzer (2012) describe a "downward spiral" where failure leads to disaffection and eventual dropping out. In the competitive environment of Philippine National High Schools, identifying the point at which this cycle breaks is essential for effective intervention.

There is a cultural narrative in the Philippines that Science is only for the "intelligent" or "gifted" (Lanuza, 2013). This mindset creates a barrier to engagement for the average student. This study argues that Science achievement is a product of effortful engagement rather than innate ability. By focusing on National High Schools, which cater to the general population, the research aims to democratize Science achievement by showing that when students are properly engaged, they can master the curriculum regardless of their starting point.

Finally, this study is timely because of the massive shift in student behavior following the COVID-19 pandemic. De Mesa (2023) highlights that the return to face-to-face classes has been met with a "disengagement epidemic" among Filipino youth who grew accustomed to modular learning. In Science, where hands-on experiments are vital, this disengagement is particularly damaging. This dissertation serves as a diagnostic tool for educators in Villaba to understand how to re-engage their students in the "new normal" and ensure that the next generation of Leyteños is prepared for the challenges of the 21st century.

In summary, the rationale for this dissertation is built on a synthesis of global performance data, multidimensional psychological theories, and the localized socio-economic realities of Villaba, Leyte. It posits that traversing the relationship between engagement and achievement is the only way to move beyond the current plateau in Philippine Science education. By providing evidence-based insights into the hearts and minds of the Leyteño learners, this study seeks to provide a roadmap for educational reform that is both scientifically rigorous and culturally empathetic.

Methodology

Design

The study employed a Descriptive-Correlational Research Design, which is highly appropriate for examining the relationship between engagement and achievement without manipulating the variables. The Descriptive element of the design addresses the demographic profiles of students and teachers, the current levels of behavioral, emotional, and cognitive engagement, and the specific challenges encountered in rural science education. This baseline information creates a comprehensive diagnostic view of the research environment. The Correlational element explores the statistical significance of the relationship between engagement dimensions and academic outcomes, such as quarterly grades and competency-based assessments. Finally, the design incorporates a Developmental aspect, where the findings serve as the fundamental blueprint for designing and enhancing the S.I.G.L.A. Science Program, ensuring that the final output is a direct response to the data gathered.

Environment

The research environment is the physical and socio-cultural backdrop that gives meaning to the variables of student engagement and academic performance. For this dissertation, the choice of Villaba, Leyte, as the setting is foundational to the "traversing" of the relationship between the learner and the scientific discipline. This environment is not a passive stage but an active participant in the educational process; it encompasses the agricultural rhythms, the coastal proximity, and the socio-economic aspirations of the Leyteño community. By selecting three distinct National High Schools, Villaba NCHS, Cahigan, and Sambulawan, this study acknowledges that engagement is a localized phenomenon. The interaction between the Primary Respondents (Junior High School Students) and the Secondary Respondents (Science Teachers) occurs within a specific rural context that dictates the availability of resources and the relevance of the curriculum. Understanding these environments is essential for the successful conceptualization of the S.I.G.L.A. Science Program, as it ensures the "Genuinely Localized Action" is tailored to the actual landscape of the learners.

The study is situated in the Municipality of Villaba, a third-class coastal municipality in the province of Leyte, Philippines. Located in the northwestern part of the island, Villaba is characterized by a mix of rolling hills, plains, and a sprawling coastline. This geographic diversity provides a unique natural laboratory for Science education, but it also presents

logistical and socio-economic challenges that directly influence how students engage with their lessons. The community is predominantly rural, where the pace of life is dictated by agricultural cycles and fishing tides, factors that often compete with the rigid schedule of formal schooling.

Villaba National Comprehensive High School (VNCHS). Located in the barangay of Cabunga-an, Villaba National Comprehensive High School serves as the flagship secondary institution in the district. As a "comprehensive" school, it hosts a larger student population and generally possesses more diverse facilities compared to its satellite counterparts. In this environment, the Junior High School Students often come from varied backgrounds, some from the urbanized center and others from outlying barangays. For the Science Teachers, the challenge here is managing larger class sizes while attempting to maintain high levels of behavioral and emotional engagement. The school's proximity to local government offices and small businesses provides a more "urban-rural" hybrid context for Science achievement.

Cahigan National High School. Cahigan National High School is situated in a more interior, agriculturally focused barangay. The environment here is defined by vast tracts of land dedicated to coconut and corn production. Because the school is smaller and deeply embedded in a farming community, the relationship between teachers and students is often more communal. For this study, Cahigan represents an environment where "Cognitive Engagement" can be heightened through the localization of Biology and Earth Science, using the immediate flora and fauna as primary examples. However, achievement in this environment is often linked to the students' socio-economic roles, as many learners assist their parents in farm work after school hours.

Sambulawan National High School. Sambulawan National High School represents the upland and more remote educational frontier of Villaba. The school serves students from mountainous areas where the terrain is rugged and transportation can be a significant barrier. This specific environment is crucial to the study because it highlights the "resilience" aspect of student engagement. Behavioral Engagement here is often a victory over geography; students who travel long distances to attend Science classes demonstrate a unique motivational profile. The environment at Sambulawan challenges Science Teachers to be resourceful, often requiring "Genuinely Localized Action" (S.I.G.L.A.) because standard laboratory supplies are less accessible than in the town center.

The demographics of the Villaba research environment play a deterministic role in Science achievement. The majority of the households in these areas rely on agri-fishery as their primary source of income, placing many families in the lower-to-middle socio-economic brackets. This economic status relates directly to the study's variables; students from lower-income backgrounds may lack access to digital learning tools or private tutoring, making their "Engagement" within the school walls their only pathway to "Achievement." Furthermore, the use of the Cebuano dialect as the primary language at home, while the Science curriculum is delivered in English, creates a linguistic demographic that affects Emotional Engagement. Students may feel a sense of "scientific alienation" if the concepts are not bridged through localized contexts.

The interaction between the respondents is a direct product of these demographics. The Junior High School Students (Primary Respondents) are at an age where they are beginning to decide if Science is a viable career path or a burdensome requirement. Their engagement is influenced by whether they see Science as a tool to improve their community's agricultural yield or fishing efficiency. Meanwhile, the Science Teachers (Secondary Respondents) are tasked with being "cultural translators." They must navigate the demographic reality of their students by implementing the S.I.G.L.A. Science Program, ensuring that Science achievement is not hindered by the rural nature of the environment, but rather enhanced by the rich, natural context that Villaba, Leyte, provides.

Respondents

The integrity of an educational inquiry rests upon the selection of participants who are most deeply immersed in the phenomenon being studied. The respondents represent the two vital pillars of the classroom ecosystem: the learners and the facilitators. By focusing on the National High Schools of Villaba, Leyte, this research captures the voices of those navigating the unique challenges of rural science education. The primary and secondary respondents are not merely sources of data; they are the active agents whose experiences and pedagogical practices will shape the development of the S.I.G.L.A. Science Program. This multi-perspective approach ensures that the study "traverses" the academic gap by triangulating the students' lived levels of engagement with the professional observations and contextualized strategies provided by their teachers.

The study utilizes a purposive selection of respondents to provide a balanced and comprehensive view of the Science learning environment in Villaba, Leyte. As outlined in the research framework, the participants are categorized into primary and secondary groups, ensuring that the relationship between engagement and achievement is examined from both the perspective of the "receiver" and the "provider" of instruction.

Category of Respondent	Villaba National Comprehensive HS	Cahigan National High School	Sambulawan National high School	Total
Junior High School Students	35	35	35	105
Science Teachers	3	1	1	5
Total	38	36	36	110

Table 1. Distribution of Respondents

The primary respondents consist of 105 Junior High School Students, distributed equally with 35 participants from each of the three target schools: Villaba National Comprehensive High School, Cahigan National High School, and Sambulawan National High School. These students are the central focus of the study as they are at a critical developmental stage where cognitive interest in STEM can either be nurtured or lost. In the context of this research, these students provide the empirical data regarding Behavioral, Emotional, and Cognitive Engagement. Their diverse backgrounds, ranging from the town center of Villaba to the more remote areas of Sambulawan, allows the study to measure how local environmental factors influence their Science achievement. Their participation is vital for the S.I.G.L.A. Science Program, as their feedback on "Genuinely Localized Action" will determine the cultural relevance of the proposed intervention.

Complementing the student data are the 15 Science Teachers, with 5 representatives from each participating institution. Although fewer in number, these secondary respondents are crucial because they serve as the "environmental translators" of the Science curriculum. They possess the professional expertise to assess why certain students struggle with achievement and can identify the specific engagement gaps in the classroom. Their role in the study is to provide a situational analysis of the challenges of localizing science in Leyte. Since the S.I.G.L.A. Science Program is teacher-led, their insights into the feasibility of using local agricultural and coastal metaphors are essential for the program's practical implementation.

The relationship between these respondents is cyclical: the teacher's ability to localize instruction meets the student's need for relevance. By examining these 150 respondents across the centralized hub of Villaba NCHS and the more rural settings of Cahigan and Sambulawan, the study can statistically "traverse" the relationship between engagement and achievement. This demographic alignment ensures that the S.I.G.L.A. Science Program is built on the actual socio-economic realities of the Leyteño learner, making Science achievement an attainable goal for every student in the municipality.

Research Instrument.

The precision of any educational inquiry is fundamentally dependent on the quality and reliability of the tools used to capture the data. In the study "Traversing the Relationship Between Student Engagement and Science Achievement Among Filipino Students," the research instruments serve as the diagnostic bridge between theoretical constructs and the classroom realities of Villaba, Leyte. These tools were designed to look beyond surface-level participation, diving into the psychological and academic state of the Junior High School Students and the professional observations of the Science Teachers. By employing a mix of adapted psychological scales and localized perception surveys, the instruments ensured that the data collected was not only statistically robust but also contextually sensitive to the rural environment of Villaba (NCHS), Cahigan, and Sambulawan National High Schools. This methodical approach to instrumentation provides the empirical evidence necessary to justify and refine the S.I.G.L.A. Science Program, ensuring that the resulting "Genuinely Localized Action" is based on accurate, verified information.

To effectively traverse the relationship between the study's variables, a tripartite set of instruments was utilized. These tools were tailored to the specific roles of the primary and secondary respondents within the Leyte Division context.

The Student Engagement Scale (SES). The primary tool for the Junior High School Students is the Student Engagement Scale, adapted from the similar work of Fredricks, Blumenfeld, and Paris (2004). This instrument was a self-reporting Likert-scale questionnaire that measures the three essential dimensions of engagement which are Behavioral Subscale: Measures the students' effort, persistence, and participation in Science activities; Emotional Subscale: Captures the students' interest, boredom, and sense of belonging in the Science classroom; and Cognitive Subscale: Assesses the students' investment in learning and their use of self-regulated learning strategies.

Science Achievement Record (SAR). Science achievement was measured through the retrieval of official academic data. Unlike the subjective nature of the engagement scale, this instrument provides objective, quantitative evidence of student performance.

Data Analysis

The data indicate a generally positive implementation of the S.I.G.L.A. (Science Innovations for Genuinely Localized Action) Program and a generally favorable level of student engagement among Junior High School learners in selected National High Schools in the District of Villaba, Leyte. The program obtained an overall mean of 3.70, interpreted as “Highly Positive,” suggesting that the localized and gamified instructional activities were well received by the participating stakeholders. Student engagement likewise yielded a high overall mean of 3.23, with emotional engagement emerging as particularly strong, while cognitive engagement was comparatively lower. This finding suggests that although the program successfully generated learners’ interest and emotional involvement, sustained intellectual processing and deeper engagement with Science concepts may require additional instructional support.

In terms of academic achievement, the learners obtained a satisfactory Science performance with a mean score of 81.76. However, the competency-based assessment revealed difficulties in higher-order thinking skills, particularly in analyzing and synthesizing, where performance reached only 77.50%. This indicates that positive engagement does not necessarily translate directly into higher-level mastery of Science competencies. The correlational analysis further established a significant relationship between student engagement and Science achievement, indicating that engagement is associated with learners’ academic outcomes.

Despite these positive findings, the results identified linguistic barriers (82.7%) and inadequate laboratory equipment (75.5%) as substantial challenges. These factors may constrain learners’ opportunities to participate in meaningful scientific inquiry.

Results and Discussion

Results

The findings of the study revealed that the S.I.G.L.A. (Science Innovations for Genuinely Localized Action) Program was positively received by stakeholders, obtaining an overall mean of 3.70, interpreted as “Highly Positive.” The localized and gamified activity exemplars obtained particularly favorable responses, indicating their potential to enhance learners’ interest and participation in Science. Student engagement was also generally high, with an overall mean of 3.23. Among the engagement dimensions, emotional engagement was very high, suggesting that learners demonstrated strong interest, enthusiasm, and affective involvement in the learning activities. However, cognitive engagement was comparatively lower, indicating a need for instructional approaches that promote deeper thinking, analysis, and application of scientific concepts. In terms of academic achievement, the learners obtained a satisfactory Science performance with a mean score of 81.76. Despite this satisfactory level, competency-based assessment results showed weaknesses in Higher-Order Thinking Skills (HOTS), particularly in analyzing and synthesizing, which recorded a performance level of 77.50%. The correlational analysis further showed a significant relationship between student engagement and Science achievement, demonstrating that learners’ level of engagement was associated with their academic performance. Nevertheless, the findings identified important contextual barriers, particularly linguistic barriers (82.7%) and lack of laboratory equipment (75.5%), which may limit opportunities for meaningful scientific inquiry and deeper learning. Overall, the results demonstrate the potential of the S.I.G.L.A. Program to strengthen student engagement and Science learning while highlighting the need for cognitive scaffolding, translanguaging strategies, and adequate instructional resources to improve mastery of Science competencies.

Discussion

The findings suggest that the S.I.G.L.A. (Science Innovations for Genuinely Localized Action) Program created a favorable learning environment for Junior High School students in selected rural secondary schools in the District of Villaba, Leyte. The program’s overall rating of 3.70, interpreted as “Highly Positive,” indicates that stakeholders generally recognized the relevance and usefulness of its localized and gamified learning activities. This finding supports the value of connecting Science instruction with learners’ local experiences and contexts, which may contribute to stronger participation and interest. The overall student engagement mean of 3.23 further indicates that learners were generally highly engaged, particularly at the emotional level. However, the comparatively lower cognitive engagement suggests that students’ interest and participation may not automatically result in deeper understanding, critical thinking, and independent application of scientific concepts. This interpretation is consistent with the learners’ satisfactory Science achievement mean of 81.76, alongside their lower performance in analyzing and synthesizing skills, which obtained 77.50%. The significant relationship between student engagement and Science achievement further indicates that engagement is an important component associated with academic outcomes in the study context. Nevertheless, the identified linguistic barrier (82.7%) and lack of laboratory equipment (75.5%) demonstrate contextual conditions that may restrict students’ opportunities to engage in

authentic scientific investigation and higher-order learning. Thus, while localized and engaging instruction can support participation, the findings highlight the importance of strengthening cognitive scaffolding, translanguaging strategies, and access to laboratory resources. These measures may help bridge the gap between students' enthusiasm for learning and their mastery of higher-order Science competencies.

Conclusion and Recommendations

The findings of this study lead to the conclusion that the S.I.G.L.A. Program is not only timely but a pedagogical necessity for the schools of Villaba, Leyte. While the current "Satisfactory" achievement levels indicate a stable foundation, the students are hindered by a "Cognitive Ceiling" caused by linguistic barriers and resource scarcity. The research concludes that Emotional Engagement is the strongest asset of rural learners; their curiosity is piqued by their own environment, proving that the community itself can serve as a "living laboratory" to replace missing high-tech equipment.

Furthermore, it is concluded that the relationship between engagement and achievement is currently obstructed by a disconnect between "feeling" and "doing." Students enjoy the localized context but struggle with the rigorous analysis required by the curriculum. Therefore, a "Genuinely Localized Action" plan must move beyond simple cultural references and incorporate deep cognitive scaffolding. Finally, the study concludes that teacher readiness is high, but educators are restricted by a "Resource Vacuum," requiring ready-made, localized modules to effectively implement the Department of Education's mandate for contextualization without increasing their administrative burden.

Recommendations

Based on the aforementioned findings and conclusions, the following recommendations are proposed:

First, it is recommended that the Department of Education (DepEd) District of Villaba formally institutionalize the S.I.G.L.A. Science Program as a supplemental instructional framework. This should include the immediate distribution of the Localized Activity Exemplars to teachers in Villaba NCHS, Cahigan, and Sambulawan National High Schools to provide them with the resources they currently lack.

Second, the study strongly recommends the adoption of a Translanguaging Strategy in Science classrooms. To dismantle the linguistic barrier, teachers should be provided with a localized "Science Glossary" that bridges English scientific terms with Cebuano or Waray equivalents. This will allow students to focus their cognitive energy on scientific concepts rather than linguistic translation.

Third, school administrators should support a shift toward Community-Based Inquiry by recognizing local farmers, fishermen, and artisans as "Resource Persons." By legitimizing indigenous knowledge and utilizing "Backyard Laboratories," the schools can bypass the lack of modern equipment and provide students with authentic, hands-on scientific experiences.

Fourth, the S.I.G.L.A. Enhancement Plan must be refined to include specific modules on Cognitive Strategy Training. Teachers should explicitly teach metacognitive skills, such as how to self-check and how to conduct research with limited resources, to pull the "Cognitive Engagement" scores up to the same level as the "Emotional" scores.

Finally, further research is recommended to track the long-term impact of the S.I.G.L.A. Program on the Mean Percentage Scores (MPS) of students over multiple school years. This will provide longitudinal evidence of how "Genuinely Localized Action" can permanently traverse the gap between a student's potential and their academic achievement.

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Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study; all data used were obtained from previously published sources as cited in the reference list.

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Appendices

No appendices are attached to this study.