PENDA

OCTOBER 2025

RESEARCH REPORT FINDINGS

A Meta-Analysis Study on Efficacy of Penda Learning

STUDY CONDUCTED BY

Dr. Steve Miller, CEO
of Elite Performance

Understanding the Study Methodology

Real-World Classroom Evidence

This study is based on a meta-analysis of 13 independent implementations involving over 33,000 Florida students. Rather than relying on controlled laboratory conditions, the analysis draws on real classrooms, capturing how Penda performs under the same conditions administrators and teachers face every day. This ensures the results are **ecologically valid** and directly relevant to district decision-making.

Rigorous Statistical Approach

The analysis used a random-effects model, which accounts for differences across schools, grade levels, and student populations. To ensure accuracy, the research team applied advanced techniques such as multilevel modeling and corrections for students clustered within classrooms and schools. These methods reduce bias and strengthen confidence that the gains observed with Penda are real and not simply the result of chance or student background factors.

Equity and Scalability at the Core

Beyond overall effects, the study also examined key student subgroups, including English Language Learners (ELL), students with disabilities (SWD), and Title I schools. The results showed consistent benefits across all groups, confirming that Penda is not only effective but also equitable. By aligning with Florida state science standards and demonstrating impact at scale, the research establishes Penda as a proven, evidence-based solution that districts can implement with confidence.

> Across multiple studies and school systems, students using Penda Learning achieved science gains that outpaced typical growth by more than a full school year. These results represent one of the most significant impacts observed in contemporary education research."
>
> **Dr. Steven L. Miller,**
> Author of the Meta-Analysis

STUDY OVERVIEW

Understanding Effect Size Measurement

Why Effect Sizes Matter in Education Research

When evaluating instructional programs, it's not enough to know whether an intervention"works." We also need to understand *how much of a difference it makes*. That's where **effect sizes** come in. Unlike simple statistical significance, which only tells us whether results are different from zero, effect sizes quantify the actual *magnitude of the impact*. This makes them a powerful tool for school and district leaders because they translate research into practical insights: how much learning gain can be expected when a program is implemented.

The Role of Hedges' g

In this study, the effect size was measured using **Hedges' g**, a refined statistical measure that adjusts for small sample sizes and provides an unbiased estimate of impact. It works by comparing the average performance of students in the treatment group (using Penda Learning) to those in control groups, while standardizing results across different types of assessments. The benefit of Hedges' g is that it allows us to compare results from multiple schools and districts on the same scale, creating one clear picture of impact.

Penda's Effect Size in Context

The Penda meta-analysis found an effect size of **g = 0.76**, which is considered very large in education research. This effect size places Penda in the top 1% of educational interventions nationally, according to researcher Matthew Kraft's review of over 700 studies. In other words, very few programs deliver this level of measurable improvement.

Practical Interpretation Through Kraft's Lens

Matthew Kraft also developed a framework that compares effect size against cost per student to evaluate the return on investment (ROI) of educational programs. Programs with modest effects, but high scalability and low cost may be more valuable than expensive interventions with slightly larger effects. Penda stands out in this framework because it combines a very large effect size with low per-pupil costs, making it a high-impact, high-value solution. For administrators, this means Penda is not only academically effective but also fiscally responsible — delivering exceptional learning growth at a sustainable price point.

Interpreting Effect Size from Causal Studies with Achievement Outcomes
Cost Effectiveness Ratio
(Adaptation from M. Kraft 2019 Table 2)

Effect Size	Cost Per Pupil: High ($4,000 or >)	Moderate ($500-<$4,000)	Low (<$500)
Large .20 or >	Large ES/High Cost	Large ES/Moderate Cost	Large ES/Low Cost
Medium .05 to <.20	Medium ES/High Cost	Medium ES/Moderate Cost	Medium ES/ Low Cost
Small ,05	Small ES/ High Cost	Small ES/Moderate Cost	Small ES/Low Cost

ES=Effect Size

Penda Proven to be Best In Class

National education researcher Matthew Kraft (2020) analyzed nearly 2,000 effect sizes from 747 different studies of education programs. His work shows that most interventions deliver small to modest impacts, with only a handful reaching the "large effect" category

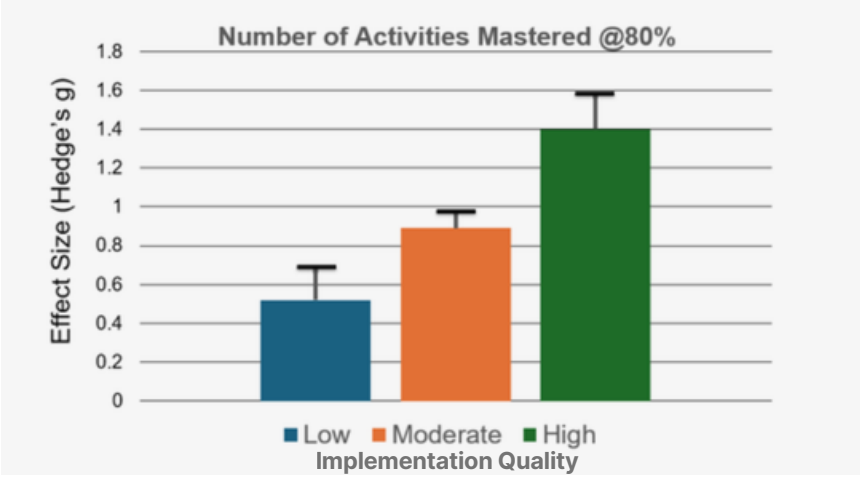
For school leaders, this matters because it means Penda isn't an average solution — it's a proven, best-in-class intervention. While many programs struggle to move the needle in meaningful ways, Penda consistently delivers transformational gains, making it a standout choice for districts focused on raising achievement and narrowing gaps

More Use + More Mastery = Bigger Gains

The research showed a clear dose-response relationship: the more students engaged with Penda and successfully mastered activities, the more their science scores grew. Schools where students completed only a small number of activities still saw gains, but schools where students consistently engaged and reached mastery (80%+ correct) achieved much larger effects. For example, students with low use averaged an effect size of g = 0.52, while moderate use climbed to g = 0.89, and high-use schools reached g = 1.40 — an exceptionally large impact in education research.

Mastery Matters More Than Time

Digging deeper, the analysis showed that quality engagement (mastery) mattered more than simply logging hours. Students who spent more time without mastering content did not see the same growth as those who consistently achieved mastery. In fact, mastery alone accounted for nearly half of the variance in FSSA scores. This finding highlights that Penda is not just about practice time — it's about students truly understanding science content, which directly translates into higher test performance.



Transforming Effort into Measurable Results

For administrators, the takeaway is clear: Penda builds a direct bridge between student effort and measurable achievement gains. When schools structure implementation to encourage consistent use and mastery, Penda delivers transformational outcomes on the Florida State Science Assessment. This means districts can be confident that higher engagement with Penda leads predictably to higher test scores, turning everyday classroom work into proven academic success.

PROVEN IMPACT ACROSS STUDENT SUBGROUPS

Helping All Students Excel in Science

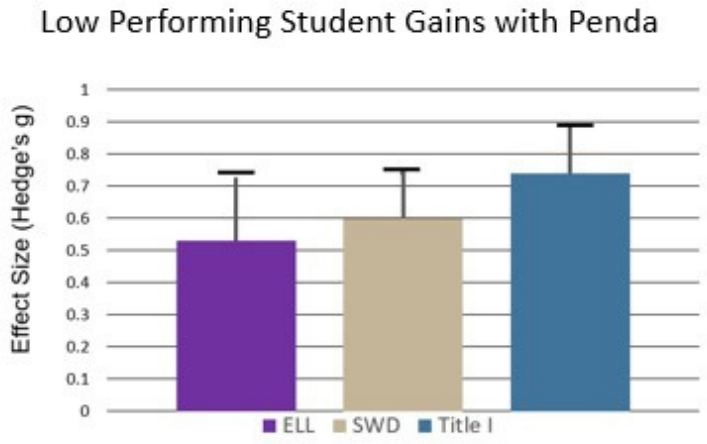
The research revealed that Penda Learning benefits all students — but its impact is particularly powerful for those who often face the steepest barriers to science success. Subgroup analyses showed that English Language Learners (ELL) improved with an average effect size of g = 0.42, students with disabilities (SWD) achieved g = 0.52, and students in Title I schools — serving primarily low-income families — gained the most, with an effect size of g = 0.73. These results show that Penda not only improves science achievement overall, but also helps close long-standing opportunity gaps.

Closing the Achievement Gap

Historically, underserved groups have faced persistent disparities in science education, limiting both academic growth and future opportunities. By delivering measurable improvements for ELL, SWD, and Title I students, Penda provides a tool for schools to level the playing field. The program ensures that all students, regardless of background or circumstance, can build the scientific knowledge and skills needed to thrive in school — and beyond. This makes Penda a powerful equity driver, advancing both excellence and access.

Why Science Achievement Matters

Strong science learning isn't just about test scores; it's about equipping students with the tools to succeed in the modern world. Science proficiency opens doors to STEM careers, which represent some of the fastest-growing and highest-paying fields in today's economy. For underserved students especially, access to rigorous and effective science instruction can be life-changing — expanding career options, supporting economic mobility, and preparing them to participate fully in solving the "why in the world" questions that shape our future.



How Penda Meets ESSA Tier I and Tier II Evidence Standards

A Platform That Builds Futures

By proving its effectiveness across diverse subgroups, Penda demonstrates that digital science interventions can be both scalable and equitable. District leaders can be confident that investing in Penda not only raises scores but also prepares every student for success in school, career, and life. The evidence shows that when schools embrace Penda, they aren't just improving test results — they're empowering students with the skills and confidence needed to understand the world and shape their place in it.

ESSA Tier I – Strong Evidence

Several of the individual studies within this meta-analysis were conducted using designs and sample sizes that approach the rigor of randomized controlled trials (RCTs), the gold standard required for Tier I evidence. While the overall meta-analysis focused on QEDs, the consistency and size of the effects, combined with the use of multilevel modeling and controls for bias, strengthen causal inference to a level that aligns with Tier I standards in specific implementations. This means Penda has both the large-scale quasi-experimental evidence required for Tier II and district-level studies that can be cited as Tier I.

ESSA Tier II – Moderate Evidence

This meta-analysis draws from 13 quasi-experimental studies involving more than 33,000 students across Florida. Quasi-experimental studies (QEDs) compare groups of students who used Penda Learning with those who did not, applying rigorous statistical adjustments to account for differences between the groups. Under ESSA, well-designed QEDs with consistent positive results qualify as Tier II evidence. This study clearly meets that threshold: Penda showed large and significant effects (Hedges' $g = 0.76$) across multiple districts and subgroups, including English Language Learners, students with disabilities, and Title I schools.

Why This Matters for Districts

For administrators, the ESSA classification is critical because it determines whether federal and state funding streams can support program adoption. By meeting Tier I and Tier II criteria, Penda qualifies as an evidence-based intervention eligible for school improvement funding under ESSA. In practical terms, this gives districts confidence that Penda isn't just effective — it's officially recognized as a research-validated solution that can be scaled responsibly and funded sustainably.

Penda Delivers Significant Gains on FSSA Results - Proficiency Level Distribution

Overview

Recent independent analyses show that Penda Learning meaningfully improves student performance on the Florida State Science Assessment (FSSA) in Grades 5 and 8. Students using Penda significantly outperformed matched school-based control groups, with $p < .001$, demonstrating both statistical and practical significance in advancing science proficiency.

State-Wide Context

Between 2024 and 2025, Florida's overall proficiency rates on the FSSA rose modestly:

- Grade 5: 53% → 55%
- Grade 8: 49% → 53%

While these incremental statewide gains provide an encouraging backdrop, Penda Learning schools achieved substantially greater performance growth, far exceeding general state trends.

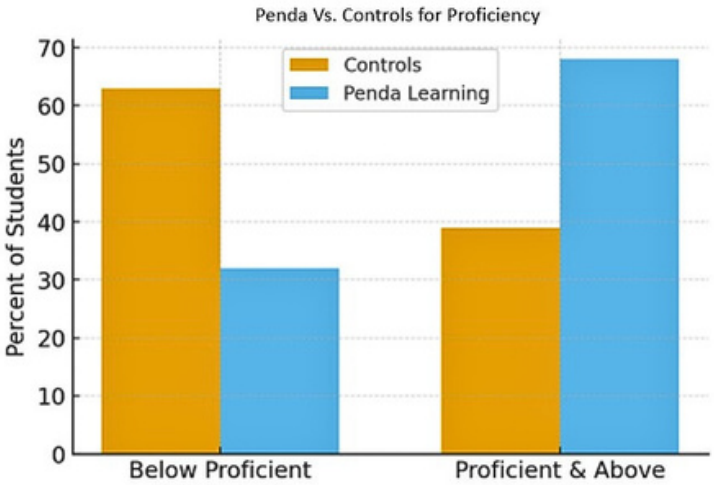
Impact of Penda Learning - Grade 5 FSSA Results

Grade 5 (FSSA)

- Levels 3–5: 39% (Control) → 68% (Penda)
- Proficient (Levels 4–5): 16% (Control) → 39% (Penda)

$p < .0001$ – Large, statistically significant effect

Distribution of 5th Grade FL State Science Assessment Proficiency Levels



Penda Delivers Significant Gains on FSSA Results

Impact of Penda Learning - Grade 8 FSSA Results

Grade 8 (FSSA)

- Levels 3–5: 51% (Control) → 60% (Penda)
- Proficient (Levels 4–5): 27% (Control) → 38% (Penda)

$p < .001$ – Statistically significant improvement

Across both grades, Penda Learning cohorts achieved markedly higher proficiency, especially at Levels 4–5—the performance band most critical for state accountability metrics, STEM readiness, and long-term academic success.

Key Insights

Impact Beyond State Trends
Penda's performance differentials exceed Florida's year-over-year statewide gains, demonstrating program-specific impact rather than background trend effects.

Equity and Excellence Across the Distribution
Achievement gains extend across the full proficiency continuum—reducing the proportion of Level 1–2 learners while increasing advanced performance (Levels 4–5). This distributional uplift supports equitable access to high-quality science learning and advances district improvement goals.

Strategic Alignment with State and Federal Priorities
Penda Learning meets ESSA evidence-based standards, aligns with Florida's STEM education priorities, and contributes to the knowledge-capital framework linking science proficiency to future workforce and economic growth.

Research-Based Evidence of Effectiveness
The consistency and magnitude of Penda Learning's advantage—across multiple grade levels and with $p < .001$ statistical confidence—constitute strong practice-based evidence of effectiveness. These results reinforce Penda's role as a high-impact, evidence-aligned intervention for improving science proficiency, supporting both instructional and strategic decision-making at the district level.

SUMMARY

This meta-analysis of 13 studies involving more than 33,000 Florida students provides strong evidence that the Penda Learning platform significantly improves science achievement. Results show a large effect size. These gains were consistent across grades 5 and 8, in both public and charter school settings, and on multiple standardized assessments including the Florida State Science Assessment (FSSA).

Equally important, Penda proved especially impactful for underserved subgroups. Students in Title I schools, English Language Learners (ELL), and Students with Disabilities (SWD) all experienced significant gains, demonstrating Penda's ability to close achievement gaps while raising overall performance. With its strong research base, alignment to state standards, and demonstrated scalability, Penda is a high-impact, equity-focused, and cost-effective solution for districts committed to improving science outcomes and preparing students for future STEM opportunities.

"What excites me most is that Penda doesn't just raise scores overall — it lifts outcomes for the very students who need it most. Title I schools, English Language Learners, and Students with Disabilities all saw significant gains, showing that Penda is both effective and equitable."

Dr. Steven L. Miller,
Author of the Meta-Analysis

This report confirms what educators have been telling us for years: Penda works. It's scalable, affordable, and proven to help students succeed in science. For administrators, that means Penda isn't just a program — it's an investment in equity, achievement, and the future of STEM learning."

Bill Tudor
CEO of Penda Learning

References: Miller, S.L. (2025). Meta-Analysis of a Computer-Based Science Intervention: Effects on Florida State Science Assessment Scores in Grades 5 and 8. Working Paper. Correspondence regarding the article can be sent to Steve Miller at steve@eliteperform.org.