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Using Stanford University's Education Program for Gifted Youth (EPGY) to Support and Advance Student Achievement

METROPOLITAN CENTER FOR RESEARCH ON EQUITY AND THE TRANSFORMATION OF SCHOOLS

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Foreword

The Metropolitan Center for Research on Equity and the Transformation of Schools at New York University has conducted a thorough examination of the research on Stanford University's Education Program for Gifted Youth (EPGY). The findings in the report are clear and unequivocal: EPGY is a ***powerful tool with enormous potential for assisting schools in meeting the needs of individual students.*** Moreover, I found each of the studies that underlie the report's findings to have been conducted with a high level of thoughtfulness and rigor.

What I find most impressive about Stanford's EPGY is its versatility. While the tool was specifically designed for academically advanced students, the research shows quite clearly that it can be used effectively with any student population, particularly those who are furthest behind academically. At a time when many schools are struggling to find ways to address the academic needs of educationally disadvantaged students, such a resource will be invaluable.

Additionally, EPGY continues to be an unparalleled support and means of academic advancement for those students whose gifts and talents may place them at a level beyond what their schools may ordinarily be able to provide. Having access to a tool like EPGY will significantly enhance the ability of parents and educators to meet the learning needs of a broad range of students.

As you know, the Metropolitan Center for Research on Equity and the Transformation of Schools has several ongoing collaborative relationships with school districts throughout the United States. We are happy to recommend Stanford University's Education Program for Gifted Youth as a learning tool that can assist schools in meeting the challenge of educating all students.

Sincerely,

Pedro Noguera
Peter L. Agnew Professor of Education, Steinhardt School of Culture, Education and Development
Executive Director, Metropolitan Center for Research on Equity and the Transformation of Schools
New York University

Education Program for Gifted Youth (EPGY)

Report Summary

EPGY for Gifted and Talented Students	• *EPGY allows for individualization of the curriculum* • *EPGY is effective with students across several demographic groups* • *A high percentage EPGY students take and excel at Advanced Placement (AP) exams*
EPGY as support in Title I settings	• *EPGY has a positive effect on achievement for K-8 students in both mathematics and English language arts* • *Schools can use EPGY data to help identify struggling learners who may need additional interventions*

Program Description

The Educational Program for Gifted Youth (EGPY) is a computer-based instructional resource developed by Stanford University that uses multimedia lessons to introduce and illustrate math, science, and English language arts concepts, and exercises to guide students' learning and mastery of the concepts, and built-in tutorial support for struggling learners.

The exercises are designed to give students an opportunity to practice what they have learned through activities that range from answering simple knowledge-based questions to conducting virtual experiments, and responding to open-response questions. The software has a diagnostic component that assesses the student work and provides immediate feedback in the form of tutorial help designed to mimic the behavior and support an expert tutor might give – guiding the student towards the correct answer without directly stating it – and providing additional exercises.

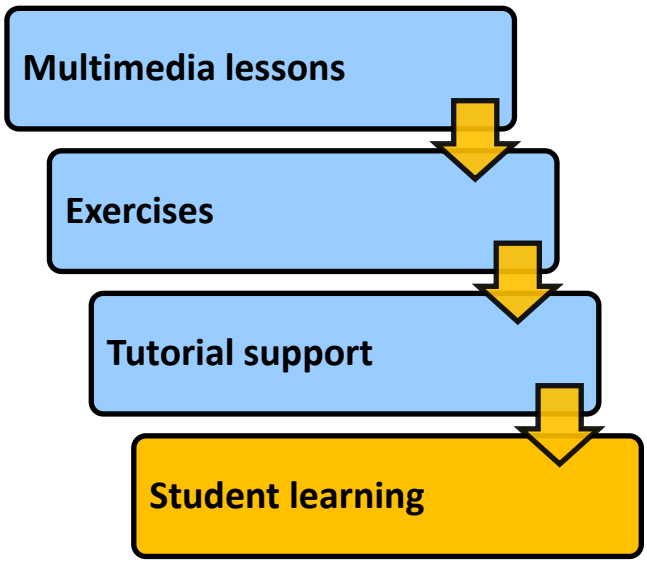
Using the Education Program for Gifted Youth (EPGY) to Support and Advance Student Achievement

This brief describes the value in utilizing EPGY curricula in two specific contexts: (1) as an accelerated program for gifted and talented students, and (2) as a means of effective supplemental instruction for students from low-income backgrounds in schools receiving Title I support. ***The findings presented in brief are drawn from a thorough review of published and unpublished research on the EPGY program.***

Overview of EPGY

EPGY is a computer-based instructional resource developed by Stanford University that uses multimedia lessons to introduce and illustrate math, science, and English language arts concepts and exercises to guide students' learning and mastery of the concepts, and built-in tutorial support for struggling learners.

Figure 1: EPGY Instructional Model



These lessons tend to be more visual than ordinary classroom lectures and are purposefully short. Students using the program can also pause and re-watch lessons as often as they wish. The exercises are designed to give students an opportunity to practice what they have learned through activities that range from answering simple knowledge-based questions to conducting virtual experiments, and responding to open-response questions. The software has a diagnostic component that assesses the student work and provides immediate feedback in the form of tutorial help designed to mimic the behavior and support an expert tutor might give – guiding the student towards the correct answer without directly stating it – and providing additional exercises (Figure 1).

This structure allows for an individualized and self-paced curriculum that rises to meet each student's needs as he or she uses the computer program[1]; students who master a particular concept quickly are able to move on to different and more advanced concepts, while struggling students are provided the additional time and support they need to master the same concept.

EPGY has a course management and reporting system that provides detailed reports on students' progress, strengths, and weaknesses. The program also allows teachers to review specific problems from EPGY with students.

Using program data and standardized assessment data, numerous published and unpublished studies have evaluated the potential impact of EPGY, showing that its tailored and targeted use can support and advance student achievement.

EPGY for Gifted and Talented Students

Research shows that online programs such as EPGY fill a critical need for gifted and talented youth, providing access to advanced courses for students who desire challenging courses but who enrolled in schools where such courses might not be available[2]. Moreover, several studies of the performance trajectories for students in a variety of EPGY courses have demonstrated that EPGY is a valuable resource because it allows students to accelerate their academic pursuits through an independently driven program. These studies indicate that:

- ***EPGY allows for individualization of the curriculum***
- ***EPGY is equally effective with students across several demographic groups***
- ***A high percentage EPGY students take and excel at Advanced Placement (AP) exams***

EPGY allows for individualization of the curriculum

The EPGY program allows individual learners to move at their own pace through the curriculum to successfully complete each course. There was significant variability in trajectories through the courses. Given the high successful course completion rates, the studies suggest that this variation demonstrates that EPGY allows an individualization of the curriculum that is necessary for gifted and talented students.

Four separate studies looking at different EPGY programs each tracked EPGY students' trajectory on several different parameters including time spent on each course, acceleration and deceleration through the courses, error rates, and time spent on each question. All of the studies found that while the students in the program were at the upper limits of academic performance for their age groups, there was significant variability in trajectories through the courses, indicating that *students were able to advance through their courses at their own speed necessary for their learning the content areas*[3] (see Figure 2 and Figure 3).

Figure 2: Connect Time for EPGY Courses

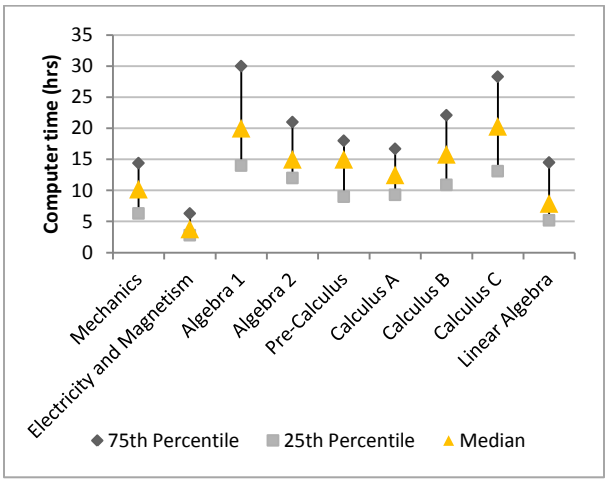
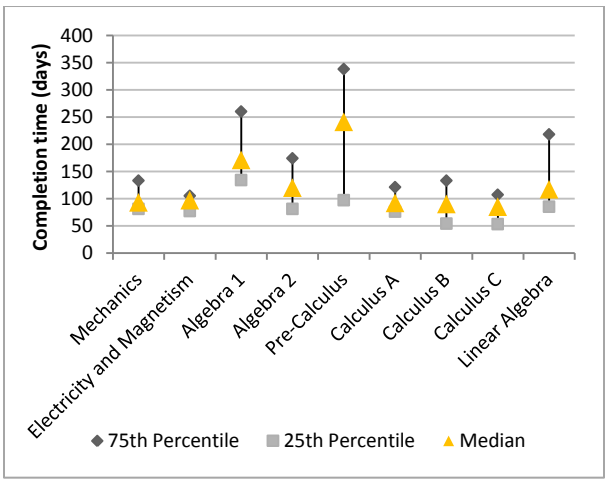


Figure 3: EPGY Course Completion Time



EPGY is equally effective with students across several demographic groups

The studies generally showed low correlations between course outcomes and particular students' demographics such as age, PSAT scores, and sex, indicating a democratizing effect.

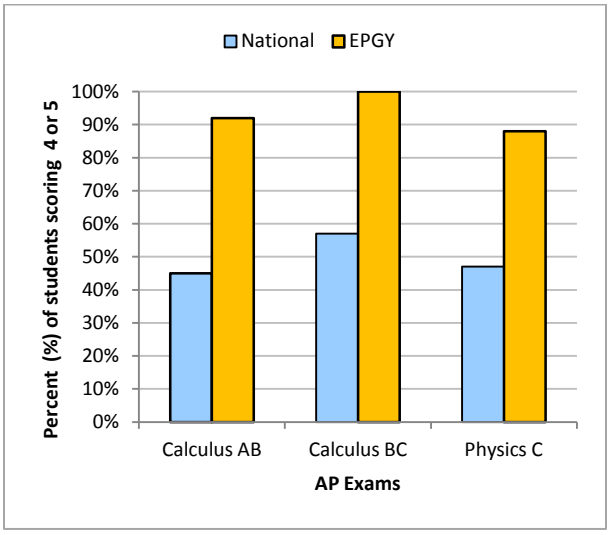
One study looking at EPGY Calculus and Physics courses found that there were no discernible differences between the sexes of the students and their outcomes. Moreover, there was a one-to-one ratio of boys to girls who met the criteria for the program. The researchers posit that this balance between male and female students was possibly due to the program's use of standardized criteria, thus mediating potential gender-biased perceptions of teachers in referring students to gifted programs.

A high percentage EPGY students take and excel at Advanced Placement (AP) exams

Studies of performance outcomes found that EPGY students had high rates of sitting for the AP exams as well as high levels of performance. One study examined the outcomes of 27 gifted students enrolled in the EPGY Calculus and Physics programs, reporting that EPGY students received a score of 4 or 5 on their Calculus AB, Calculus BC, and Physics exams at a rate nearly double the national average. The Calculus students were in grades 7 through 10, and the physics students were in grades 8 through 12. The findings showed that 92% of those students taking Calculus AB exam, 100% of those having taken Calculus BC exam, and 88% of those having taken Physics C exam received a score of 4 or 5. This is significant when compared to the national percentage of students scoring a 4 or 5 in these exams (45% for Calculus AB, 57% for Calculus BC, and 47% for Physics C). Lastly, the authors note that that EPGY had a low attrition rate with 87% of students in the Calculus AB completing the course. Only one student completed their Physics class but did not take the AP test (Figure 4).

Thus, this research demonstrates EPGY's ability to help students prepare for and excel at Advanced Placement exams.

Figure 4: AP Exams, EPGY vs. National



EPGY in Title I settings

EPGY studies involving students in schools receiving Title I funding focused on the relationship between various EPGY outcome measures and students' performance on standard academic achievement measures. This allowed for an evaluation of the capacity of EPGY to act as predictor of future student performance as well as its overall impact on student performance. All of these studies examined large student samples and thus were able to apply complex statistical techniques to support their findings. In total, the studies demonstrate that:

- ***EPGY has a positive effect on achievement for K-8 students in both mathematics and English language arts***
- ***Schools can use EPGY data to help identify struggling learners who may need additional interventions***

EPGY has a positive effect on achievement for K-8 students in both mathematics and English language arts

Studies using students' EPGY exercise response data relative to their performance on standardized mathematics and English language arts exams demonstrate that EPGY is an effective supplemental learning tool for boosting student achievement. The analyses from these studies show that, on average, students in grades K through 8 who work carefully and in a sustained fashion – i.e., are engaged in the EPGY program – experience improved outcomes on standardized achievement tests. EPGY is particularly effective for students who begin using EPGY as low-achieving students.

A randomized treatment experiment (RTE) conducted in three Title I elementary schools matched over 2,000 students with similar prior achievement levels in order to examine the impact of EPGY. Students were paired based on prior scores on standardized mathematics exams (CST06), with each half of the pair being assigned to either the treatment group (participating in the EPGY program) or the control group (provided the normal mathematics curriculum). The following year, the researchers looked at the standardized mathematics exam (CST07) scores for students in the EPGY program compared to those in the control, finding that those students in the EPGY program who worked carefully and in a sustained fashion (as measured by the number of correct first answers in the EPGY program) showed larger gains in their performance on their standardized mathematics exams compared to their matched participants in the control group[4]. Students in grades 3 through 5, who worked carefully and in a sustained fashion in the EPGY program scored on average 12.54 points higher on their standardized mathematics exams compared to peers. Similarly, 2nd grade students who worked carefully and in a sustained fashion in the EPGY program scored on average 28.25 points higher on their standardized mathematics exams compared to peers. For both groups, as the students' levels of work in the EPGY program increased, so too did their comparative performance on the standardized mathematics exams compared to their peers (Figure 5 and Figure 6).

Figure 5: Mean of CST07 Difference for Each Pair (Grades 3-5)

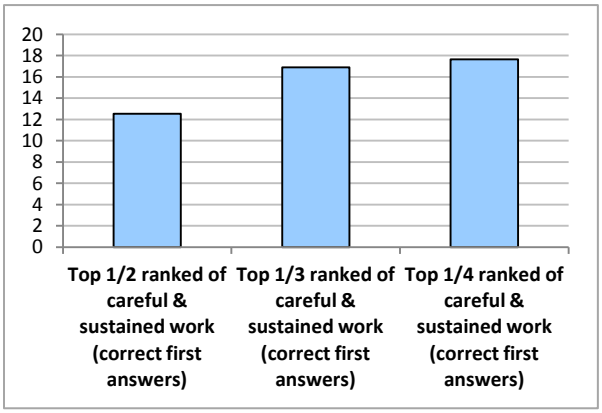
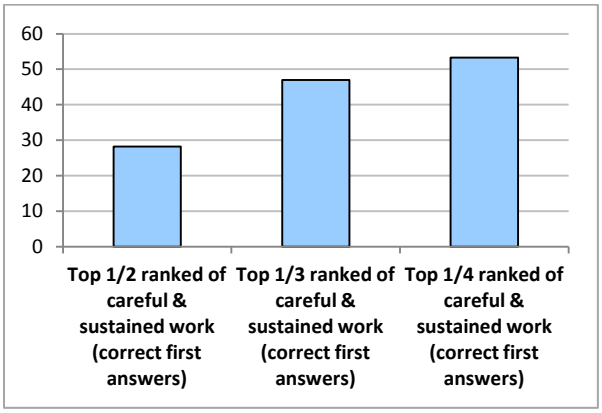
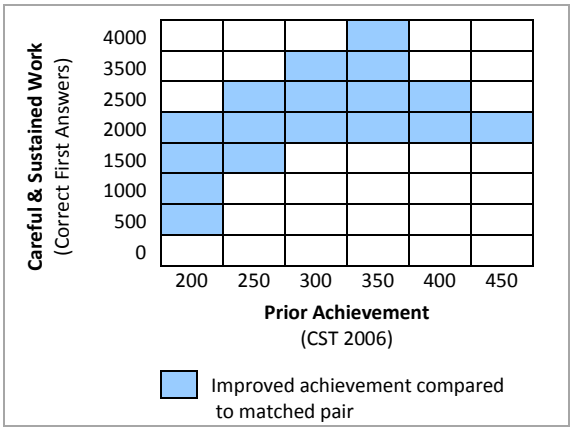


Figure 6: Mean of CST07 Difference for Each Pair (Grades 2)



This finding was corroborated by hierarchical linear model (HLM), which also showed that teachers can help improve achievement outcomes for students in EPGY programs. Using this information, a zone of program effectiveness becomes clear (Figure 7). The average student with low prior achievement (between 200 and 250) participating in the EPGY program experienced significant achievement gains over his or her peers not participating in the EPGY program. Additionally, the average student who participated in the EPGY program and engaged in careful and sustained work (2000 correct first answers or greater) experienced significant achievement gains over his or her peers not participating in the EPGY program.

Figure 7: Zone of EPGY Effectiveness



A subsequent and larger study recently published in the journal *Computers and Education* expanded on these findings, examining the impact of the EPGY's Mathematics and English Language Arts programs on students in grades K through 8 enrolled in Title I school districts in Tennessee and California[5]. The analysis showed that on average, the greater number of correct first attempts a student has on EPGY exercises (relative to incorrect attempts), the larger the increases that student experiences on standardized math and English language arts assessment. This suggests that the more correct first attempts a student makes while using EPGY, the greater the measured impact of the program on his or her achievement outcomes.

Overall, these findings demonstrate that EPGY is effective for engaged learners regardless of prior academic achievement. Moreover, the research suggests that EPGY can be effective for all students in Title I schools provided that the students are encouraged by supportive teachers.

Schools can use EPGY data to help identify struggling learners who may need additional interventions

EPGY data can also be used to help identify struggling learners, thus extending its utility beyond that of a supplemental education program. Two studies examined the degree to which EPGY curriculum-based variables predicted student performance on the California Standards Test (CST) and assessed the usefulness of EPGY in identifying students who may need instructional intervention. Both studies used regression analysis to create an equation that would predict standardized math assessment scores using EPGY test data, student demographics, and past performances on standardized math assessments[6]. Both studies found that various data in the EPGY report system could be used to predict students' future performance on standardized mathematics assessments, thus demonstrating its ability to aid in identifying struggling students in need of early interventions.

Based on these results, it appears that if a student does well on particular EPGY measures, he or she is likely to do well on the CST, and if a student does poorly on particular EPGY measures, he or she is likely to do poorly on the CST. *As such, EPGY data can be used as a predictor of future performance on standardized exams, allowing teachers to identify struggling students and provide them with supplemental support prior to these exams.*

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[1] Cope, E. W., & Suppes, P. (2002a); Cope, E. W., & Suppes, P. (2002b); Stillinger, C., & Suppes, P. (1999); Suppes, P., & Ager, T. (1994); Suppes, P., Liang, T., Macken, E. E., & Flickinger, D. P. (2014); Tock, K., & Suppes, P. (2002)
[2] Olszewski-Kubilius, P., & Lee, S. (2004); Thomson, D. L. (2010)
[3] Cope, E. W., & Suppes, P. (2002); Stillinger, C., & Suppes, P. (1999); Suppes, P., & Ager, T. (1994)
[4] Suppes, P., Holland, P. W., Hu, Y., & Vu, M. (2009); Suppes, P., Holland, P. W., Hu, Y., & Vu, M. (2013)
[5] Suppes, P., Liang, T., Macken, E. E., & Flickinger, D. P. (2014)
[6] Shen, X., Haertel, E., & Suppes, P. (2005); Suppes, P., Holland, P. W., Hu, Y., & Vu, M. (2009); Suppes, P., Holland, P. W., Hu, Y., & Vu, M. (2013)

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Suppes, P., Holland, P. W., Hu, Y., & Vu, M. (2013). Effectiveness of an individualized computer-driven online math K-5 course in eight California Title I elementary schools. *Educational Assessment, 18*(3), 162-181.

Suppes, P., Liang, T., Macken, E. E., & Flickinger, D. P. (2014). Positive technological and negative pre-test-score effects in a four-year assessment of low socioeconomic status K-8 student learning in computer-based math and language arts courses. *Computers & Education, 71*, 23-32.

Thomson, D. L. (2010). Beyond the classroom walls: Teachers' and students' perspectives on how online learning can meet the needs of gifted students. *Journal of Advanced Academics, 21*(4), 662-712.

Tock, K., & Suppes, P. (2002). *The high dimensionality of students' individual differences in performance in EPGY's K6 computer-based mathematics curriculum.*