BLENDED INSTRUCTION

Measuring the impact of technology-enhanced, student-centered learning on the academic engagement, skills acquisition, and achievement of underserved students

Frank LaBanca, Youn Joo Oh, Mhora Lorentson, Yueming Jia, Bernadette Sibuma, Margot Snellback
EDUCATION CONNECTION and Education Development Center, Inc.
ABOUT THE NELLIE MAE EDUCATION FOUNDATION

The Nellie Mae Education Foundation is the largest philanthropic organization in New England that focuses exclusively on education. The Foundation supports the promotion and integration of student-centered approaches to learning (SCL) at the high school level across New England—where learning is personalized; learning is competency-based; learning takes place anytime, anywhere; and students exert ownership over their own learning. To elevate student-centered approaches, the Foundation utilizes a four-part strategy that focuses on: building educator ownership, leadership and capacity; advancing quality and rigor of SCL practices; developing effective systems designs; and building public understanding and demand. Since 1998, the Foundation has distributed over $210 million in grants. For more information about the Nellie Mae Education Foundation, visit nmefoundation.org.

ABOUT EDUCATION CONNECTION

EDUCATION CONNECTION is one of Connecticut’s six Regional Service Centers, which works collaboratively with school districts to provide educational and related services. EDUCATION CONNECTION’s mission is to promote the success of school districts and their communities. EDUCATION CONNECTION provides services and programs focused on early childhood, adults and community, teaching and learning, student services, and school services.

ABOUT EDUCATION DEVELOPMENT CENTER

Education Development Center, Inc. (EDC) designs, implements, and evaluates programs to improve education, health, and economic opportunity worldwide. Collaborating with both public and private partners, EDC strives for a world where all people are empowered to live healthy, productive lives.

EDC is committed to education that builds knowledge and skill, makes possible a deeper understanding of the world, and engages learners as active, problem-solving participants. While the issues EDC addresses are diverse, all that it does is united by its conviction that learning is the liberating force in human development.
Executive Summary

Digital technology is here to stay, with new tools and media for learning finding their way into schools and young people’s lives each year. But even as interest in technology-enhanced instruction grows, many educators struggle with how to use technology in ways that promote student engagement and achievement. One promising approach, blended instruction, combines web-based learning with face-to-face classroom interaction. When used in student-centered ways, blended instruction allows students to explore and master content at their own pace, form strong, technology-enhanced connections with peers and teachers, and become more self-directed and confident learners.

Because blended instruction is a relatively new innovation, research on its impact remains sparse. EDUCATION CONNECTION, a Connecticut-based nonprofit, set out to address this gap with an examination of the STEM21 (Science, Technology, Mathematics, and Engineering for the 21st Century) Academy approach to blended instruction. Through a mixed-methods study of students in 12 participating high schools, the researchers asked:

1. At the end of 9th-grade, do STEM21 Academy students demonstrate greater levels of engagement in science and mathematics than their peers?
2. Have their 21st century skills grown more than their peers’?
3. Do they achieve greater academic gains as measured by standardized assessments?
4. Which specific practices do students and teachers believe contribute to increased engagement, skills acquisition, and academic achievement?

The researchers were particularly interested in understanding the impact of blended instruction on the engagement, skills, and achievement of traditionally underserved students. In this brief, we offer highlights and themes from the study; we encourage you to read the full paper for more details.
The STEM 21 blended instruction model consists of four major components:

1. **Technology-enhanced learning**: Through an online platform, students can access standards-aligned learning activities, post assignments, communicate with the teacher, and participate in tutorials and discussion forums. The learning management system (LMS) supports differentiation by offering flexible, developmentally appropriate tasks. The teacher serves primarily as a facilitator, supporting students via messaging, online posts, and discussion forums, as well as one-on-one time in the classroom. The LMS provides several options for student interaction as well; students can work together through online forums, blogs, wikis, chats, video conferences, and in virtual worlds.

2. **Experiential learning**: During structured off-campus meetings, students collaborate with professionals and observe how technology and 21st century skills are used in practice. Back in the classroom, students interact with mentors through online video chat services and forums, in-person interviews, guest lectures, and other interactive learning opportunities. At an end-of-year exposition, students present their work to professionals and receive their feedback.

### Table 1: STEM21 Academy Scope and Sequence

<table>
<thead>
<tr>
<th>DOMAIN</th>
<th>9TH-GRADE</th>
<th>10TH-GRADE</th>
<th>11TH GRADE</th>
<th>12TH GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>Earth and Energy Essentials (E3)</td>
<td>Biology21</td>
<td>Chemistry21</td>
<td>Physics21</td>
</tr>
<tr>
<td>Technology</td>
<td>Skills21</td>
<td>Digital Media &amp; Movie Making or Research, Design, &amp; Development</td>
<td>Game Design &amp; Development or E-commerce Entrepreneurship</td>
<td>Capstone Experience</td>
</tr>
<tr>
<td>Mathematics</td>
<td>Algebra21</td>
<td>Geometry21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The numeral “21” indicates courses taught in a 21st century context (e.g., biology in the context of biotechnology, or chemistry in the context of material science). In addition to their STEM21 coursework, students take classes in other subject areas (e.g., English, social studies) as dictated by individual school’s course of study and graduation requirements.
3. **Digital portfolios:** A tool for reflection and sharing, the digital portfolio allows students to document and showcase their work via a personal website. Students use the online portfolio to demonstrate knowledge and skills, define their interests and areas of developing expertise, communicate ideas and personal values, and celebrate growth. Students may share the digital portfolio with peers, parents, prospective employers, and college admissions officers.

4. **Proficiency assessments:** Every STEM21 course is comprised of standards-aligned units centered around a set of essential questions, and each unit concludes with a capstone Unit Performance Assessment. These authentic, project-based assessments are intentionally flexible, allowing for student choice and self-direction. Every course culminates in a larger Challenge Project that poses an authentic, open-ended question. Students work in teams to develop and implement a solution; they share their research and final product with peers and professionals at a competitive, end-of-year Student Innovation Expo.
STUDY DESIGN

This study compares outcomes of STEM21 Academy 9th-grade students with their peers in 12 urban high schools in Connecticut and Massachusetts.

Participants:

Total: 500 9th-grade students
Treatment group: 223 students enrolled in STEM21 courses
Comparison group: 277 students with similar demographic backgrounds enrolled in comparable courses in the same schools

Quantitative data sources:

Science achievement: Terra Nova science assessment (once in fall, once in spring).
Engagement and 21st century skills: Online survey in which students rate their learning habits, attitudes, and skills (once in fall, once in spring).
Demographics: Individual data on gender, race, free/reduced lunch eligibility (as a proxy for income), special education and English language learner status; school-level data on percentage receiving free/reduced lunch.

Quantitative analysis:

• Created matched subsamples of students with equivalent baseline Terra Nova scores (n: 216) and equivalent baseline survey results (n: 128).
• Created a composite “underserved” variable for individual students, based on gender, race, and free/reduced lunch status.
• Used hierarchical linear modeling to estimate the impact of the STEM21 participation on engagement, 21st century skills, and achievement, controlling for baseline scores, special education and English language learner status, underserved status, and school SES composition.
• Conducted additional analysis for students from traditionally underserved populations.

Interviews:

• Conducted 15-minute, semi-structured interviews with three 9th-grade students from each of the 12 participating schools (total of 36 interviews), asking what they perceived to be the impact of STEM21 Academy’s blended instruction approach.
• Conducted 12 additional 15-minute interviews with 10th-grade students.
• Held six focus groups with STEM21 Academy teachers.
• Conducted a content analysis of all interview data, using NVivo software to search for word and phrase patterns.

Please see the full report for additional details on the study design.
STUDY FINDINGS

Quantitative and qualitative analyses of the STEM21 Academy’s blended instruction model resulted in four major findings:

1. Participation in the STEM21 Academy significantly increased student achievement in science and marginally increased their 21st century and inquiry skills.

2. Underserved students also experienced a positive increase in achievement relative to their non-STEM21 Academy peers.

3. One year of STEM21 Academy exposure did not result in a significant increase in academic engagement.

4. Students and teachers overwhelmingly reported positive impacts on learning as a result of STEM21’s blended instructional approach. Students were most positive about the experiential learning components of the program and extended Challenge Projects. There was a less favorable feedback related to the program’s Unit Performance Assessments.

Science achievement: a significant increase

The most important finding of our study was related to academic achievement. The TerraNova exam assesses understanding of science theory and methods, with an emphasis on core concepts and the application of scientific inquiry skills. At the end of 9th-grade, students in the STEM21 Academy group had an average score of 695.8, compared with an average score of 683.7 in the comparison group. This represents a difference of .25 standard deviations, a statistically significant effect. A subgroup analysis of underserved students revealed similarly positive results.

21st century skills: a moderate increase

Students rated themselves on a range of skills related to non-routine problem solving, communication and interpersonal interaction, and responsible citizenry. At the end of 9th-grade, the average response for students in the STEM21 Academy group was 5.37 on a 7-point scale, and the average score for the comparison group was 5.07, a difference that is marginally significant.

Student engagement: unaffected

Students rated themselves on the degree to which they stayed on top of class assignments, came to class prepared, set high expectations for themselves, persisted in completing tasks, and other questions related to their engagement with science coursework. At the end of 9th-grade, the average student engagement score in the STEM21 Academy group was 5.03 on a seven-point scale (1=“not at all true of me”; 7=“very much true of me”), and the average student engagement rating for the comparison group was 5.04, indicating very similar levels of engagement in both groups.
STUDENT AND TEACHER PERSPECTIVES

Student and teacher feedback was overwhelmingly positive. They reported that STEM21 Academy’s blended instruction approach increased motivation, enhanced learning, and contributed to the development of valuable skills. Highlights from interviews are as follows:

• The long-term Challenge Project was consistently described as a highly valuable learning experience, contributing to the development of collaborative skills and mastery of course content.

• Students provided very positive feedback about the end-of-year Student Innovation Expo as well, reporting that it fostered collaboration, engagement, and personal and professional development, while also giving focus to classroom activities.

• Student perceptions of the short-term, in-class proficiency assessments were more varied and less positive. Some students were unaware of these assessments, and others described them as not relevant to the end-of-course Challenge Project.

![Figure 4: Average self-reported student engagement and 21st century skills at the end of 9th-grade](image-url)
• A small number of participants noted challenges accessing and using technology. Tenth graders and teachers with more experience in the STEM21 program appeared to have surmounted many of these challenges, but the concerns point to the importance of having working technology that is compatible with necessary applications and staff skilled at trouble-shooting problems when they occur.

• Teachers and students told researchers that the students who seem to thrive most in the STEM21 program were those who showed interest in hands-on learning and new challenges and who were less concerned about taking Advanced Placement and honors coursework. Students who responded best to blended instruction also tended to be those who had previously struggled in traditional learning environments.

A PROMISING DIRECTION

Blended instruction can be a powerful means to engage students in collaborative, meaningful learning experiences. The results of this study indicate that a student-centered approach to blended instruction can have a positive impact on achievement and 21st century skills and may narrow the achievement gap for underserved student populations. As educators seek classroom strategies that support deep learning and prepare students for the complexities of the modern, technology-driven economy, blended instruction emerges as a promising option, one deserving of further attention and study.

Figure 5: Average TerraNova scale scores for students at the end of 9th-grade

<table>
<thead>
<tr>
<th></th>
<th>STEM21 Academy</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>All students</td>
<td>695.8</td>
<td>693.8</td>
</tr>
<tr>
<td>science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>achievement</td>
<td>683.7</td>
<td>683.5</td>
</tr>
<tr>
<td>Underserved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>achievement</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES


