In the following report, Hanover Research provides an overview of new classroom design trends and their impact, before discussing recommendations for designing active learning spaces.
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EXECUTIVE SUMMARY AND KEY FINDINGS

INTRODUCTION

In high schools across the United States, classrooms have traditionally featured rows of student desks where students take notes as teachers lecture at the front of the room. However, the “traditional classroom layout is becoming obsolete,” as today’s students require learning environments that support collaboration and technology-enabled work. According to a report from Princeton University, “classrooms should be profound places of revelation and discovery. Well-designed space has the ability to elevate discourse, encourage creativity, and promote collaboration.” Therefore, rather than traditional classrooms, schools are creating innovative spaces designed to promote active learning.

The following report provides an overview of trends in new classroom design, examines the impact of these innovative designs, and provides recommendations for design features and project-based learning in active learning classrooms. The report comprises the following two sections:

- **Section I: Overview of New Classroom Designs** discusses trends in new classroom designs and presents research on the impact of classroom design on student outcomes.

- **Section II: Best Practices in New Classroom Designs** examines recommended classroom design features, provides an overview of project-based learning as an instructional approach for active learning spaces, and discusses case profiles of three active learning spaces.

KEY FINDINGS

- **Trends in new classroom designs include designing spaces to support active, inquiry-based, hands-on learning in a technology-rich environment.** Such spaces require a versatile layout and flexible furniture that can change to allow for different types of learning activities. These new classroom designs promote collaboration, emphasize flexibility, and support the development of 21st century skills such as problem-solving, critical thinking, and technology skills.

- **Studies of redesigned learning spaces show that active classroom designs can positively impact student outcomes, including student engagement and...”

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Research also supports the benefits of active learning instructional approaches, which are commonly used in new learning spaces.

- For example, innovative classrooms often use a collaborative, active learning approach to instruction, such as project-based learning (PBL). In PBL, students develop content knowledge by investigating complex problems and creating a product that showcases their learning. Projects typically last a few weeks and should focus on developing students’ key academic content knowledge and skills.

- When designing new learning spaces, school leaders should start by identifying the student outcomes that they wish to see from the new space, as well as the instructional techniques and activities that teachers will use to promote these outcomes. Using student and instructional outcomes to inform the design ensures that the physical space supports teachers’ pedagogical strategies and goals. In addition to teaching and learning outcomes, schools should also consider elements such as reducing noise and promoting student participation when designing the new space.

- Schools should choose flexible furniture so that students and teachers can easily move around and reconfigure for a variety of teaching and learning purposes. The ability to quickly and easily rearrange furniture allows students to collaborate and work together. Flexible furniture includes chairs, desks, and tables on wheels to facilitate ease of movement, as well as technology and whiteboards that all students can easily access. Furniture and storage spaces on wheels also provide adaptability to meet the needs of different courses and academic subjects that will be taught in the classroom.

- The classroom layout should support a variety of learning formats and environments by providing a space for students to work collaboratively in small groups, independently, or as a whole class. Teachers can create flexible “zones” that divide the classrooms into multiple learning environments. Additionally, the classroom should support 360-degree learning that includes whiteboards or interactive technology on the surrounding classroom walls. Two of the active learning spaces profiled in this report include a 360-degree design in which students have access to whiteboards on all or most walls.
SECTION I: OVERVIEW OF NEW CLASSROOM DESIGNS

The following section discusses trends in new classroom designs and presents research on the impact of classroom design on student outcomes.

TRENDS IN NEW CLASSROOM DESIGNS

As instruction moves from direct lecture to collaborative, project-based learning (PBL), schools are beginning to re-think how they design classrooms to best support student learning needs. In addition to core content knowledge, students increasingly require 21st century skills, such as communication and information literacy skills, interpersonal and self-directional skills, problem-solving skills, and the skills to use new technologies. As instruction shifts to provide students with the skills necessary to succeed post-graduation, classroom design is also shifting to better fit new ways of teaching and learning. Bob Pearlman, a scholar of 21st century school design and implementation, explains that:

Schools supporting 21st century learners realize that new pedagogies - project-based learning and active student use of technology and making tools - are what enables and activates these learners. Existing classrooms inhibit "makers" from "making" and learners from collaborating. New learning environments linking the new pedagogies and space are needed to support 21st century learners.

Indeed, the language used to describe where students learn is evolving alongside the changing learning spaces and instructional techniques. Pearlman explains that “In 21st century schools, students become makers and learners, teachers become facilitators and activators, and classrooms become learning studios and learning commons.” New terminology for “the classroom” includes terms such as learning environments, learning studios, and active learning spaces.

Recognizing the trend of shifting classroom designs, the New Media Consortium (NMC) and the Consortium for School Networking (CoSN) include “Redesigning Learning Spaces” as one of two key long-term trends in their 2016 Horizons report charting five-year trends in K-12 education. The authors note that schools across the country are “redesigning learning spaces to accommodate more immersive, hands-on activities” that support 21st century learning, provide flexibility and technology access, and include environmental consciousness and

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8 Ibid.
economic viability. Nationwide Construction, which notes that “modern schools are demanding different spaces and learning environments than they used to,” details the top five trends that the company has observed across new school designs:

- **Small Classrooms:** Today’s architectural push in schools is all about small spaces and intimate classrooms. Designs must facilitate better student learning and performance. These scaled-down classrooms make each lesson a bit more personal for students and teachers.

- **Tech Labs:** Today, innovative classrooms are tending toward distance-learning programs. These methods make use of advanced tech labs with cutting-edge equipment. These labs are meant to serve as “maker spaces” where students can learn about things like artificial intelligence and computer programming. When it comes to construction, these tech labs require custom desk units, community tables, and lighting to facilitate quality learning.

- **Atypical Learning Environments:** As schools seek to become more innovative and sensitive to their students’ needs, atypical learning environments are cropping up left and right. Lounge-like “classrooms” and outdoor patios are becoming popular school design trends around the country, and they benefit students and teachers alike. Because of this, many school systems are looking to qualified construction companies to help them design and build outdoor or indoor spaces that contribute to enhanced, unique learning methods.

- **Open Floor Plans:** In addition to making a space feel airy and inviting, open floor plans are also being used as a security measure in schools around the country. Because open floor plans and small furniture allow school officials to spot a potential threat early, they are becoming popular as a means to keep schools and the students within them safer.

- **Eco-Building:** Modern schools everywhere are beginning to push for sustainability and environmental friendliness. This is evident in modern school design trends, like decreased electricity consumption, passive solar, and green building materials. As schools push for sustainability, they impart lessons of “going green” on the students who attend them and the community at large.

**New, innovative classroom designs now focus on promoting and supporting active student learning.** While traditional classrooms with rows of desks can inhibit active learning, active learning spaces promote collaboration and participatory learning between and among students, and between students and teachers. In an article on “The Latest Trends in Classroom Design,” Winske discusses how “educators now flip their classrooms, encourage active, project-based learning and increasingly use online tools to deliver a more personalized education experience.”

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require classrooms that can adapt to better support active teaching and learning. However, what active learning spaces look like in practice can vary widely. One article explains:

... in some [active learning spaces] the emphasis is on the use of technology as an agent of this active approach, whilst in some the emphasis is on the layout of the room and the kind of furniture and AV equipment provided.

Despite variations in specific design, new, active classrooms emphasize flexibility to support a range of pedagogical techniques. In fact, in her article on the “Latest Trends in Classroom Design,” Winske calls flexibility a “hallmark of modern learning spaces.” For example, the California Department of Education (CDE) states that, “As districts move forward in building and modernizing California’s school facilities, it is essential to provide flexible learning environments that support diverse teaching and learning needs.”

Flexibility in classroom design allows teachers and students to use the room in multiple ways. Unlike traditional classrooms designed for lectures, flexible learning spaces allow students to easily access and interact with their peers. Students can easily work in groups, individually, or with the teacher. With flexible designs, “every part of the room can be used for something different and it can happen at a moment’s notice.” To increase flexibility, new classroom designs use moveable furniture and technology that allow for easy rearranging, collaboration, and active learning.

Furthermore, in a chapter on designing learning spaces to suit the student experience, Andrew Milne discusses how student learning is becoming less structured and more collaborative, and increasingly integrating technology into the physical classroom design. He notes that new learning spaces “are increasingly conceived as comfortable, flexible spaces in which groups can interact and collaborate.” Figure 1.1 on the following page highlights the six trends Milne identifies in flexible learning spaces.

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14 Ibid.
17 Ibid.
24 Ibid.
Figure 1.1: Trends in Flexible Learning Spaces

Classrooms are not the only form of learning space.
- While the classroom is assumed to be a primary location of learning, data suggest that a majority of student learning activity takes place outside the classroom.

Social interaction is a growing part of learning.
- Evaluation methods and performance metrics emphasize individual effort and achievement, but students increasingly are motivated by social interaction with their peers. Pedagogy is shifting to emphasize team activities and collaborative learning.

Technology is natural.
- Computer and networking technologies that once might have appeared exotic (pervasive wireless networking, iPods, smart phones) or transformative are now considered mainstream. While "digital immigrant" faculty may perceive these technologies as a new part of the educational landscape, "digital native" students see them as a natural component of their lives.

Internet resources can bypass peer review.
- Traditional publication processes involved vetting and validating information, but the Web enables near-instantaneous distribution of information without formal review. It becomes increasingly important, then, for students to interact with one another and with faculty to analyze and critique online resources.

Learning can occur out of sequence.
- Although lectures, books, articles, and other traditional tools present information in a deliberate, sequential manner, today's students are comfortable with overlapping discussion threads and parallel activities that may span different types of media, devices, and communities.

Students construct content rather than just consuming it.
- Students are active authors of content, including video documents, online blogs, and other forms of digital expression. Whether delivering a final report or going online to converse with members of an online community, today's students have a range of digital devices and software tools that allow them to create and shape content.

Source: Learning Spaces

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25 Figure contents quoted verbatim with modification from: Ibid.
Notably, higher education institutions first pioneered innovative, active learning classrooms. For example, two early versions often cited in the literature include the Technology Enabled Active Learning (TEAL) classroom at the Massachusetts Institute of Technology and the Student-Centered Active Learning Environment with Upside-down Pedagogies (SCALE-UP) first pioneered at North Carolina State University.

**IMPACT OF NEW CLASSROOM DESIGNS**

Overall, research shows that aspects of classroom design can positively impact student learning. For example, a recent empirical study conducted by researchers at the University of Salford in England examined the impact of school building design on elementary school student learning. The researchers found that the levels of naturalness, individualization, and stimulation significantly explain up to 25 percent of student learning. The specific aspects that comprise these design categories include:

- **Light**, including the amount of natural light, quality of artificial light, and number of windows;
- **Choice**, including how the design and quality of furniture lead to a sense of ownership;
- **Flexibility**, including the degree to which the room plan allows varied learning methods and activities;
- **Connection**, including clear corridors leading from one space to adjoining spaces;
- **Complexity**, including the degree to which the school provides appropriate diversity and novelty; and
- **Color**.

Additionally, a 2013 systematic literature review of 32 studies on the school environment published in *Thinking Skills and Creativity* found “reasonable evidence” that a creative school and classroom design can have multiple positive effects on student outcomes. Figure 1.2 on the following page highlights these effects.

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29 Bullet points quoted verbatim with significant modification from: ibid., pp. 681-682, 688.
Figure 1.2: Student Outcomes Positively Impacted by Creative Classroom Designs

- Academic attainment.
- Student motivation, engagement, enthusiasm, enjoyment, concentration, attention, and focus.
- Creative thinking.
- Emotional development and social skills.

Source: Thinking Skills and Creativity

Research also suggests that re-designing learning spaces from traditional classrooms to flexible, active learning spaces can positively impact students. For example, a 2014 quasi-experimental study in Curriculum and Teaching studied the effects of re-designing classrooms on student learning experiences, engagement, and achievement. Participants included 164 students at an independent all-boys school in Brisbane, Australia. The school re-designed its learning spaces from traditional classrooms to rooms with a flexible, interactive, 360-degree, polycentric layout with writable walls and modular and moveable furniture.

Survey results showed that the re-designed flexible classrooms had a positive effect on students’ perceptions of their own learning experiences, with five out of six classes showing statistically significant differences in pre- and post-test survey results. The flexible classrooms also had a statically significant positive effect on students’ perceptions of their own engagement in learning. Focus groups with teachers supported the survey’s findings regarding an increase in student engagement and revealed that teachers often changed their teaching practices “to take advantage of the collaborative nature” of the re-designed classrooms. Additionally, an analysis of math and English assessment data that controlled for other variables, such as past academic achievement, found that the majority of the classrooms showed a statistically significant improvement in their students’ math and English achievement.

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30 Figure contents quoted verbatim with modification from: Davies, D. et al. “Creative Learning Environments in Education- A Systematic Literature Review.” Thinking Skills and Creativity, 8, 2013. p. 87. https://ac.els-cdn.com/S187118711200051X/1-s2.0-S187118711200051X-main.pdf?_tid=46626130-bb1c-11e7-b952-00000aaab0f6c&acdnat=1509111757_416e56036962d993fa06f4a67ade4ae5


32 Ibid., p. 9.

33 Ibid., pp. 10–11.
However, it should be noted that the effect of active, flexible learning spaces on student outcomes may also be results of changes in instructional strategy.\textsuperscript{34} Compared to lecture-based instruction in traditional classrooms, instructional strategies in new, innovative classroom designs tend to incorporate active learning approaches.\textsuperscript{35} Thus, the combination of a new learning setting \textit{and} changes in teachers’ instructional practices when teaching in re-designed classrooms may interact to improve student outcomes. In fact, research supports the benefits of active learning as an instructional approach,\textsuperscript{36} as well as the benefits of PBL, an instructional approach commonly used in innovative learning spaces.\textsuperscript{37}

\begin{footnotesize}
\begin{enumerate}
\item Byers, Imms, and Hartnell-Young, Op. cit., p. 2.
\end{enumerate}
\end{footnotesize}
SECTION II: BEST PRACTICES IN NEW CLASSROOM DESIGNS

The following section examines the best practices in new classroom designs, including recommended classroom design features, an overview of PBL as an instructional approach for active learning spaces, and case profiles of three active learning spaces.

INNOVATIVE CLASSROOM DESIGN FEATURES

When planning for the design of new learning spaces, experts recommend school leaders start by defining the student outcomes they wish to see from the new spaces. School leaders and designers must ask, “What knowledge and skills do students need for the 21st century?” and then design spaces that meet these needs. Similarly, school leaders and designers should consider the instructional techniques and activities that teachers will use in the room to guide its design. This way, the design supports the pedagogy and intended learning outcomes. Figure 2.1 below highlights the design process and questions that the classroom designer must address.

Figure 2.1: Design Criteria and Process for 21st Century Learning Environments

- What pedagogy, curricula, activities, and experiences foster 21st century learning?
- What assessments for learning, both school-based and national, foster student learning of the outcomes, student engagement, and self-direction?
- How can technology support the pedagogy, curricula, and assessments of a 21st century collaborative learning environment?
- What physical learning environments (classroom, school, and real world) foster 21st century student learning?

Source: Pearlman

Similarly, Steelcase Education recommends that when designing active learning spaces, school leaders consider elements such as social engagement, participation, feedback, flexibility, noise, and group work. Figure 2.2 on the following page highlights design recommendations that support these elements. While these recommendations were created

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https://www.k12blueprint.com/sites/default/files/Large-Active-Learning-Classrooms.pdf
for designing active learning spaces in higher education institutions, many also apply to high school classrooms.

**Figure 2.2: Classroom Design Recommendations**

<table>
<thead>
<tr>
<th>Design for Social Engagement</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Limit the size of the tables to groups of four to six students and provide swivel seating.</td>
</tr>
<tr>
<td>• Consider adding lounge furniture within the classroom to create informal environments.</td>
</tr>
<tr>
<td>• Support shoulder-to-shoulder postures at the table among the learners and the instructor/teaching assistant.</td>
</tr>
<tr>
<td>• Support breakouts/asides.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Design for Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Create clear sight lines for the instructor to monitor the room.</td>
</tr>
<tr>
<td>• Provide ways for students to signal professors visually, using lights or signs.</td>
</tr>
<tr>
<td>• If microphones are necessary, make them approachable.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design for Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Provide analog tools, such as whiteboards, for students to show their work.</td>
</tr>
<tr>
<td>• Provide digital tools, like apps or clickers, to allow students to show their knowledge.</td>
</tr>
<tr>
<td>• Provide backup tools in case the technology fails.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design for Flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Provide movable furniture.</td>
</tr>
<tr>
<td>• Provide easily accessible power that doesn’t inhibit the flexibility of the furniture.</td>
</tr>
<tr>
<td>• Where applicable, use storable furniture.</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Design for Noise</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Include acoustic panels and carpet to diminish noise levels.</td>
</tr>
<tr>
<td>• Consider microphones for the instructor and for each group.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design for Group Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Assist with wayfinding, and streamline transitions between activities by creating a system to identify specific tables and zones within the classroom.</td>
</tr>
</tbody>
</table>

Source: Steelcase\(^2\)

\(^{2}\) Figure contents quoted verbatim with modification from: Ibid.
**FLEXIBLE FURNITURE**

School leaders should choose furniture for a given learning space based on the types of activities that will occur in the room. For example, classrooms that use a PBL approach will require different types of furniture and different arrangements compared to classrooms that use a lecture approach.

Therefore, new, active classrooms require flexible furniture that students and teachers can easily move around and reconfigure for a variety of purposes and scenarios. As the CDE explains, “Collaborative learning spaces call for flexible furniture to allow versatility and modifiability.” Flexible furniture includes chairs, desks, and tables on wheels to facilitate ease of movement. Similarly, the CDE adds that “movable storage cabinets and mobile carts allow versatility and convertibility in science labs, shared commons, and other learning areas.” Furniture such as standing desks allows students alternative options for learning.

Similarly, a report on new classroom designs from Princeton University recommends using flexible furniture to create well-designed classrooms that facilitate collaboration and active learning. Specifically, the report provides the following furniture recommendations:

- Tables that accommodate two students working side by side when free-floating and can be combined with other tables to create small-group workspaces, large conference tables, and donut-shaped class discussions;
- Chairs with wheels and storage for bags;
- Teaching stations with simple laptop connections to projector(s) and control over lighting and window shades; and
- In some cases, these rooms should include group workstations that allow multiple students to share a flat-screen monitor for collaboration and presentation.

Smith System, which designs furniture for school environments, recommends that school use “modular and sturdy” furniture. In an article on designing STEM classrooms that integrate the lab and classroom, authors from Smith System note the importance of seating, desks and tables, and storage. Figure 2.3 on the following page highlights their recommendations.

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45 Ibid.
46 Ibid.
47 Ibid.
In addition to the furniture and technology, designers must consider other aspects of the physical space. For example, Danish Kurania, a licensed architect who focuses on designing learning spaces and currently teaches a “Learning Environments for Tomorrow” course at the Harvard Graduate School of Education, emphasizes the need for focusing on design features besides furniture. Classroom design also includes light, color, acoustics and noise, and visuals. Experts at the University of Southern California recommend that effective classrooms have de-cluttered walls that reduce visual clutter and crowding, with 20 to 50 percent of clear wall space. Similarly, they recommend keeping wall background colors neutral, such as beige or white, to ensure that students focus on the lesson rather than the walls.

**CLASSROOM LAYOUT**

New, innovative classrooms require a purposeful approach to design and layout. For example, a recent *Times Higher Education* article on designing classrooms to support 21\textsuperscript{st} century learning notes that only filling a traditional classroom with technology is inadequate; rather, these new classrooms require a complete change in design. It further notes that, “the smart classroom requires a more methodic approach that factors in the design of the basic shell, 

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\textsuperscript{50} Figure contents quoted verbatim with modification from: Ibid.  
\textsuperscript{52} “The Science of Classroom Design.” University of Southern California, October 5, 2015.  
https://rossieronline.usc.edu/science-of-classroom-design-infographic/
the teacher’s space, and the students’ independent and collaborative work area.” ⁵³

Additionally, the design must provide an easy access to learning materials and support wireless technology.⁵⁴

New classroom designs must support “a variety of learning environments and grouping formats that consider all learning style profiles.”⁵⁵ Thus, the layout of new classrooms should provide space for some students to work collaboratively in small groups, and other students work independently. The ability for students to work in multiple configurations supports instructional approaches such as PBL by providing the infrastructure for “multiple learning activities to occur simultaneously.”⁵⁶ Notably, small groups should have space to work independently while still being connected to the rest of the class.⁵⁷ The CDE adds that classrooms must be able to “accommodate different teaching and learning formats,” such as:

- Individual study and reflection;
- One-on-one instruction;
- Peer-to-peer discussion;
- Small-group work;
- Teacher-directed instruction; and
- Student presentation.

In addition to flexible, movable furniture that easily allows users to re-arrange the room for the above configurations, experts recommend that new classrooms include flexible learning zones to provide students with a variety of learning environments within the classrooms.⁵⁹ For example, teachers can designate one area of the room for whole-class gatherings, for lectures, discussions, or whole-class meetings. Other zones should be separate spaces within the room for some students to work in groups, while others work individually. Similarly, teachers can re-arrange desks and furniture to create smaller nooks for individual reading or working.⁶⁰

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⁵⁵ Ibid., p. 1.
⁵⁶ Ibid.
Furthermore, in the Capacity Building Series, Ken Robinson reiterates the benefits of a flexible and adaptable classroom layout. He emphasizes that classrooms should provide a variety of gathering spaces for students. Figure 2.4 below includes Robinson’s recommendations.

**Figure 2.4: Recommendations for Organizing Classroom Space**

- A large gathering space for whole-group work and discussions, located near whiteboards, easels and/or projector screens.
- A gathering space for small-group and whole-group discussions – where students can see clearly the representations of learning that are posted on boards or screens and hear classmates as they share ideas.
- Flexible and reconfigurable space for small-group collaborative work and inquiry – space must allow for groupings of various sizes, such as pairs, triads and groups of four or more.
- Desks and tables configured to facilitate discussion by allowing eye contact with peers and teacher, the unencumbered flow of traffic and enough space for students to write collaboratively.
- Active areas for inquiry, investigation and wonder and quiet areas for thinking and exploring technology – all areas need to be accessible to students for communicating and documenting their own learning (e.g., computers, computer software, tablets, digital cameras and video recorders, document cameras, interactive whiteboards).
- Instructional materials organized in such a way as to provide easy selection and access for all students.

Source: Capacity Building Series

Figure 2.5 below presents sample classroom designs with space for group collaboration and individual work, as well as flexible furniture that students and teachers can easily rearrange.

**Figure 2.5: Sample Classroom Design**

Source: Steelcase

**PBL IN NEW CLASSROOM DESIGNS**

To engage students in active learning, teachers must accompany the re-designed classroom space with an instructional approach that facilitates active learning. For example, in a

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62 Figure contents quoted verbatim with modification from: Ibid.

presentation to the Higher Education Institutional Research (HEIR) Network, researchers from Ball State University in Indiana emphasize that pedagogy in active learning spaces must “move from lecture-based to active learning” through instruction that is collaborative, problem-based, cooperative, and inquiry-based. Active learning classrooms often use a PBL approach. For example, Pearlman analyzed new, innovative learning environments at five schools in the U.S. and the U.K., and found that each school used PBL as an instructional approach, in addition to similar physical designs that provided spaces for large group discussion or presentations, small group work, and individual work.

According to the Buck Institute for Education (BIE), a nonprofit organization that trains educators on PBL techniques and strategies, **PBL is an instructional strategy “in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging and complex question, problem, or challenge.”** In PBL, students develop content knowledge through inquiry and real-world application, solve problems, and create products that demonstrate their learning. The NYC Department of Education notes that:

> The purpose of project-based learning is to provide a structure through which students can demonstrate mastery of a subject by creating, and presenting, a research-based project that is driven by their own interest in a topic and allows them to work within the same parameters as real researchers.

Notably, students can engage in PBL independently, in small groups, or as a whole class. Projects should focus on student learning of key academic content and skill development. For example, projects can build skills such as problem-solving and collaboration, which align with the design recommendations of active learning classrooms. Effective PBL includes the following characteristics:

- Leads students to investigate important ideas and questions;
- Is framed around an inquiry process;
- Is differentiated according to student needs and interests;
- Is driven by student independent production and presentation rather than teacher delivery of information;

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66 “What Is Project Based Learning (PBL)?” Buck Institute for Education. https://www.bie.org/about/what_pbl
69 Ibid.
71 Ibid.
Requires the use of creative thinking, critical thinking, and information skills to investigate, draw conclusions about, and create content; and

Connects to real world and authentic problems and issues.

For example, New Technology High School (New Tech) in Napa, California found that “students best work, produce, and construct knowledge through project-based learning.” Teachers at New Tech provide students with projects that require critical thinking and last one to three weeks. At the beginning of each unit, New Tech teachers introduce “students to a realistic, real-world project that both engages their interest and generates a list of information students need to know.”

**Simply giving students a project to work on does not constitute quality PBL.** Rather, PBL requires teacher scaffolding and student-guided inquiry. Based on a comprehensive literature review and 15 years of educator experience, the BIE developed the Essential Project Design Elements that offer guidelines for effective PBL and promote student learning and engagement. Figure 2.6 below provides these recommendations.

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CASE PROFILES OF ACTIVE LEARNING SPACES

The following subsection profiles innovative, active learning spaces at two high schools and one university, including a description of each space’s design features and corresponding instructional approaches. Each profile concludes with photos of the learning space.

OAKLAND MILLS HIGH SCHOOL (MD)

In March of 2017, Oakland Mills High School (OMHS), located in Howard County Public School System (HCPSS) in Maryland, revealed a newly re-designed math classroom. The innovative classroom design, created with input from students and teachers, was completed over six months. The classroom is designed to integrate math and language instruction to support an increasing number of English Learners (ELs) in HCPSS. The room’s design and features allow

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75 Figure contents quoted verbatim with modification from: “What Is Project Based Learning (PBL)?,” Op. cit.

teachers to provide special supports for Spanish-speaking students during regular mathematics instruction.  

**CLASSROOM DESIGN FEATURES**

The furniture and layout of the new “dynamic workspace” support collaboration, problem-solving, and language acquisition. All desks and chairs are on wheels to allow for easy rearranging, and triangular desks clustered in groups of four throughout the room facilitate collaboration. The room’s design includes multiple whiteboards for students to work on solving math problems — three of the four walls have large whiteboards, while the fourth hosts a large interactive television. Moveable vertical whiteboards and high tables with whiteboard surfaces promote problem-solving. As one student noted, “I like the whiteboards because we can use them to solve things...When you go around the room, it's hard to do everything on your paper. If you get it wrong, then you have to erase it. If you have the whiteboards, you can erase everything and then start over.” Additional design features include an interactive projector and flat screen, a long table on one side of the room with a row of laptops, stand-up desks, and areas for small-group work.

**INSTRUCTIONAL APPROACH**

The redesigned learning space promotes instructional changes including increased collaboration and problem-solving, supports for ELs, and differentiated instruction. When determining the classroom design and instruction, the district states that the goal of the redesign is to “make sure that teachers have the resources and strategies they need to have students engage in those collaborative learning opportunities.” The HCPSS English for Speakers of Other Languages (ESOL) Coordinator also emphasizes that the new classroom design allows for students to work together in small groups, which also benefits students with limited English proficiency.

The new classroom design also ensures that instruction better supports ELs. Previously, content-area language instruction took time away from math instruction; however, the new classroom design facilitates integrating math and language instruction. The ESOL coordinator explains that the classroom supports teachers in “providing that language-enriched environment for our students and providing them with accommodations and

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77 Ibid.
80 Ibid.
83 Ibid.
resources.”\textsuperscript{86} For example, the ESOL coordinator notes that resources such as the interactive TV help integrate language and math instruction to support language acquisition.\textsuperscript{87}

\textbf{Figure 2.7: Photos of OMHS New Classroom}

Source: Howard County Public School System\textsuperscript{88}

\textbf{CHARLOTTESVILLE HIGH SCHOOL (VA)}

To meet its students’ needs for a space for STEM, Charlottesville High School (CHS) in Virginia created an innovative space for students to explore the areas of science, engineering, robotics, and manufacturing.\textsuperscript{89} The space, which the students named Sigma Lab, cost $1.26 million and consists of multiple, connected rooms of 8,580 square feet total.\textsuperscript{90} School leaders designed the Sigma Lab to mimic the setup of local manufacturing plants.\textsuperscript{91}

\textbf{CLASSROOM DESIGN FEATURES}

The classroom furniture and layout provide different spaces for students to collaborate, draft ideas, and build final products.\textsuperscript{92} Sliding glass doors separate the different areas to reduce noise.\textsuperscript{93} The Sigma Lab design allows for a variety of class configurations, with space for small groups to work together easily, and areas for individual student work.\textsuperscript{94} For example, spaces in the classroom promote collaboration by providing meeting tables and whiteboards.\textsuperscript{95} The space also includes writable walls and an interactive LCD display where the teacher and

\textsuperscript{86} Michaels, Op. cit.
\textsuperscript{87} Ibid.
students can project their work. Additional technologies such as computers, 3D printers, a CNC machine, and a laser cutter allow students to design and build their own creations.

**INSTRUCTIONAL APPROACH**

The Sigma Lab allows CHS to offer new courses that they could not previously provide. For instance, CHS now offers a variety of engineering and design classes where students work collaboratively and individually to conceptualize, design, and create projects. CHS explains that with the creation of the Sigma Lab, the school can provide “new courses specifically designed to promote technical literacy, engineering skills, problem-solving proficiency, and group cooperation.” While originally designed for the STEM fields, other academic subjects also take advantage of the innovative features of the Sigma Lab. For instance, an anthropology class built replicas of early human skulls using the lab’s 3D printer.

![Figure 2.8: Photos of CHS Sigma Lab](source: Charlottesvile City Schools)

**UNIVERSITY OF MINNESOTA (MN)**

In contrast to traditional large lecture-style classrooms, the University of Minnesota offers many student-centered, technology-enabled Active Learning Classrooms (ALCs). The University of Minnesota ALC modifies the North Carolina State University’s SCALE-UP classrooms and the Massachusetts Institute of Technology’s TEAL classrooms.

**CLASSROOM DESIGN FEATURES**

Compared to rows of desks in traditional university classrooms, the ALC consists of large round tables that seat up to nine students. Each table can support three laptops, and includes

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99 Ibid.
100 Ibid.
103 “Active Learning Classrooms (Office of Classroom Management).” University of Minnesota. https://classroom.umn.edu/space/classroom-types/active-learning-classrooms-alc
switching technology to project students’ screens to a flat-panel display projection system. Each table also hosts three microphones, and students must collaborate to share screens and microphones. The room’s perimeter showcases 360 degrees of glass surface marker boards or whiteboards. Additionally, a central teaching station “allows the instructor to select and display table-specific information.”

**INSTRUCTIONAL APPROACH**

The ALCs represent a shift from traditional lecture-style instruction to instruction that promotes collaboration and group work. As the University of Minnesota states, the ALCs “were designed specifically to support student group work.” However, the University explains that the classrooms by themselves will not lead to collaboration; rather, educators must create activities and assignments that take advantage of the space and promote group work. ALCs promote inquiry learning and collaboration by offering:

- Cooperative learning environments that encourage collaboration and peer teaching;
- Technology that allows individual and group sharing;
- Furniture that facilitates small-group work;
- Interactive coaching during learning activities; and
- New options for class structure, learning, and instruction.

**EVIDENCE OF IMPACT**

The University of Minnesota has conducted research on the effectiveness of the ALCs. The University’s findings suggest that students in ALCs exceed their predicted course grades because the space leads to better teaching and improved student learning. Further, the University of Minnesota states that controlled studies demonstrate that ALCs:

- Help students exceed final grade expectations;
- Affect teaching-learning activities, even when the instructor attempts to hold these activities constant;
- Are not conducive to a lecture-based approach; student performance improves when instructors move to active, student-centered teaching methods; and
- Are perceived in a largely positive light by students and instructors, but require some adjustment of teaching techniques.

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104 “Active Learning Classrooms.” University of Minnesota. [https://cei.umn.edu/support-services/tutorials/active-learning-classrooms](https://cei.umn.edu/support-services/tutorials/active-learning-classrooms)
106 Ibid.
The research findings also suggest that ALCs improve student engagement. 110 A 2007 University of Minnesota pilot study of the ALCs found that both faculty and students reported overall positive experiences and views of the ALCs. Instructors in the study found that the ALCs deepened relationships between instructors and students, shifted the instructor’s role to that of a facilitator or “learning coach,” and changed how students interact with one another to be more collaborative.111 Students reported that the ALCs made them feel more connected to their instructor and classmates, increased discussion, and made students feel more talkative and active.112 More than 85 percent of the students surveyed responded that they would recommend the ALC for their other classes.113 Notably, the study also revealed that the format of the round tables was “important for changing the pedagogical dynamic in the rooms.”114

Figure 2.9: Photos of the University of Minnesota’s Active Learning Classrooms

Source: University of Minnesota

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112 Ibid., p. 4.
113 Ibid., p. 6.
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