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How to make Collaborative Learning meaningful for university students

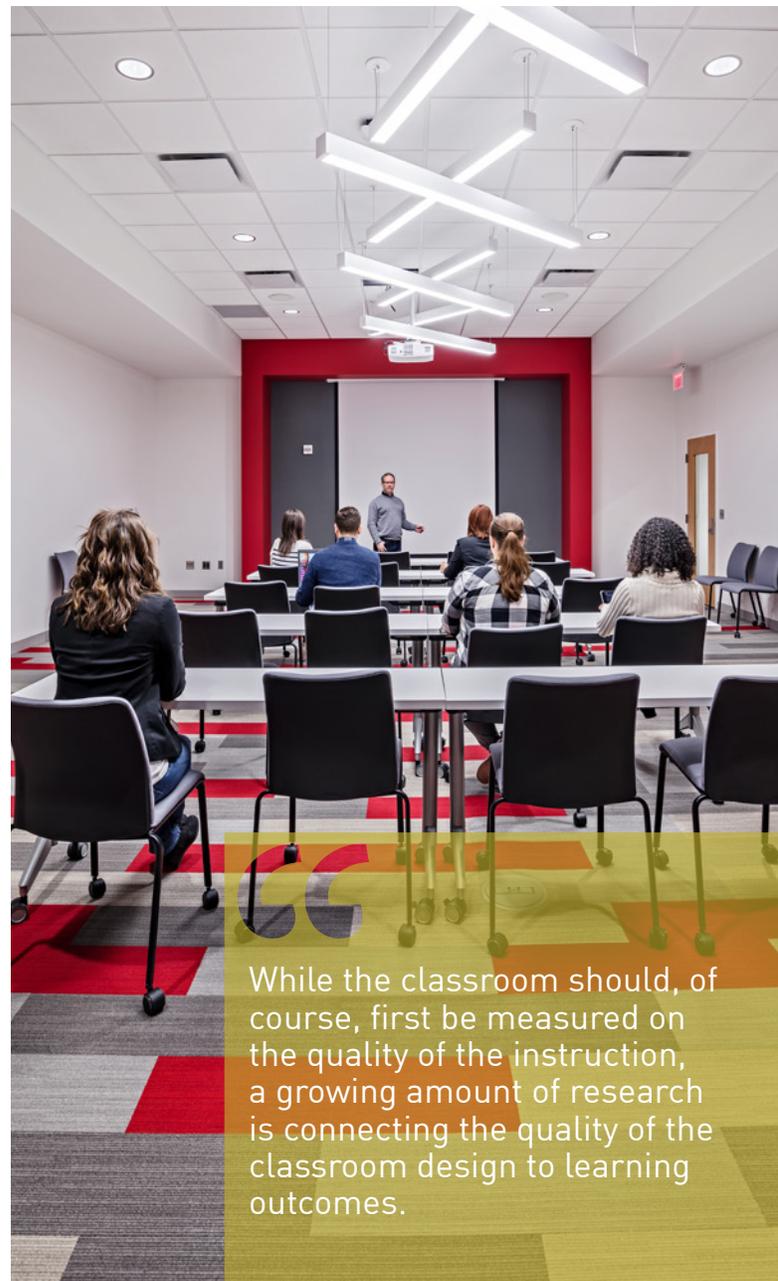
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Walk into any university classroom on any campus and you will most likely notice many similar features. Each room is filled with rows of chairs and desks, all facing a podium anchored in front of a chalkboard. A large projector is mounted overhead. Notice the qualities of each space: the lighting, colors, smells, type of furniture, surface materials, and overall appearance.

Many people would like the attributes to a typical doctor's office waiting room: awkward lighting, worn furniture, and an obligatory flat screen mounted on the wall. The space is not welcoming or interesting. Confronted with such a room, many people wonder, "How long do I have to be here?" This is the state of typical higher education classroom design.

While the classroom should, of course, first be measured on the quality of the instruction, a growing amount of research is connecting the quality of the classroom design to learning outcomes. Both the design and the qualities of the classroom contribute to an individual's willingness to engage. When students (and instructors) feel engaged, meaningful interactions occur. These interactions correspond to improved performance. This paper will explore recent research findings on classroom design and ways we can improve classrooms in order to foster positive educational outcomes.

In this era of digital natives, technology has shifted the student-teacher dynamic and way students and educators are using the classroom. Everyone now carries access to seemingly unlimited information via



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smart mobile devices. This change has prompted educators to reevaluate the way they teach and the design and layout of the space in which they meet with students. A layout that identifies the instructor as the only source of the knowledge might not make sense anymore.

With this change in the mindset of educators, new teaching philosophies and types of learning environments have emerged. Before proceeding with information on new types of classroom design, this paper will briefly review a few relevant terms. It is worth noting that there is an abundance of available resources online that can provide a much deeper dive into each term.

Teaching Style

TRADITIONAL CLASSROOM STRUCTURE: A common teaching pedagogy in which the core learning is presented in class, then reinforced through homework assignments that require interpretation and synthesis. This teaching style ensures that key information is introduced to students when an instructor is present and requires students to interpret the learning through self-study.

FLIPPED (or INVERTED) CLASSROOM STRUCTURE: An alternative teaching pedagogy in which the core learning is assigned as homework. Class time is then dedicated to collaborative interpretation and synthesis. This teaching style provides students the opportunity to self-teach, utilizing their preferred learning style, to master core concepts prior to discussion of the information.

Classroom Types

TRADITIONAL CLASSROOM: A classroom layout in which student desks all face the same direction. At the front of the room is a podium, a chalkboard (or dry-erase board), and a projector screen. This design reinforces the teacher-student dynamic.

STUDIO (or ACTIVE LEARNING) CLASSROOM: A classroom layout in which student desks are clustered and students face in different directions. The “front” of the classroom is less clear, because the podium is not present (or is more centrally located) and the chalkboards, flat-screen monitors, or projector screens are on different walls. This design de-emphasizes the teacher-student dynamic.

THIRD SPACES: An informal learning space that is not home (first space) or work/classroom (second space). Often referred to as coffee-shop spaces, they can be used for conversation, group study, one-on-one instruction, and other uses. Generally, they are not a defined room. Instead, they are part of a larger space and therefore do not have podiums or chalkboards. These spaces offer a peer-to-peer dynamic, regardless of teacher or student roles.

MAKER SPACES: A semi-informal learning space that focuses on experimentation and visualization. Often referred to as 3D-printer spaces, they offer a place for individuals to imagine, form ideas, problem-solve, and perform try/fail experiments. These places are rooms filled with work-make supplies (3D-printers, cardboard, dry-erase boards, tools, and so on). These spaces offer a peer-to-peer dynamic, regardless of teacher or student roles, usually with skill-based instructors on hand.



The Ohio State University Campbell Hall facilitates an “active learning” style. Design by M+A Architects.

Described below are general considerations for the future of classroom design—Collaborative Learning Environments (CLEs). While each classroom may require unique components, the overarching idea is to make design decisions that can engage students, regardless of their learning style.

Interior Design Features

The design of a collaborative learning environment is paramount when developing a space in which students and teachers can be successful. Described below are researched considerations to help determine the best choices for a particular classroom environment. While there is always a give-and-take, architects and designers should take into account both the classroom type and the qualities of the space when making design decisions.

Layout and Furnishings

A number of studies (Espey, 2008; Park and Choi, 2014) have shown that when a room has no defined “front,” the entire classroom feels engaging, and both students and teachers are motivated to move and to act. A traditional classroom with a static front creates both a “Golden Zone”—where students can easily see the board, observe the teacher, and maintain concentration—and a “Shadow Zone,” where students cannot easily see the board and can become more distracted and disconnected from the teacher (Park and Choi, 2014). In an active learning classroom without a fixed “front,” it is key to create the means for active student-instructor interactions, such as through movable lecterns. In addition, students are more actively engaged in participation when smaller table groupings are available. Combined with access to many different projectors or LCD screens, students in one study (Park and Choi, 2014) were always able to easily see communications from the instructor, eliminating the “Shadow Zone.” Another study (Espey, 2008) found that movable tables had the highest impact on improving student learning.

It is important that architects and designers consider and work to reduce distractions that might occur in a collaborative environment. Students may be less successful if they are distracted by competing

conversations or by being unable to see boards and notes presented in lecture components of class. Therefore, architects and designers must balance the flexibility of furnishings with strategies to reduce excess noise and help students stay focused. Clustered student groups must be able to see and access screens and the instructor. Often, it is necessary to have multiple screens in the classroom (Espey, 2008).

Details in the classroom environment are just as important as the general layout. Student perceptions of their classroom can influence their focus and their perception of learning quality (Castilla, Llinares, Bravo and Blanca, 2017). Researchers who surveyed 918 Spanish university students determined that students feel a classroom is “modern” if it looks new and has good design and good furniture.



The Ohio State University Hitchcock Hall recently underwent a renovation to improve the function and aesthetics of the facility for both students and educators. Design by M+A Architects.

While the survey results don’t indicate that furniture must be brand new, if spaces are furnished with pieces that are durable and contemporary in color and/or style, students may feel more positively towards their quality of education (Castilla et al., 2017). In a different survey of 647 university students, the undergraduates indicated that classroom visibility, hardware, acoustics, and software had the most impact on their ability to learn (Yang, Becerik-Gerber and Mino, 2013). In the same study, acoustics and software had two of the lowest satisfaction scores (Yang et al., 2013). These survey results reinforce the need to devote more attention to acoustics in collaborative

classrooms where group discussions will be more frequent than in a standard lecture space. As we design these collaborative learning environments, we must also account for the loss of perceived personal space. Without individual desks, students may try to create barriers with books or other belongings (Scott-Webber, Abraham and Marini, 2000) in order to create personal space. Designers must consider how to ensure student comfort while condensing individual space (Scott-Webber et al., 2000).

Subject Matter

Inverted classroom teaching styles inform changing classroom design. In one study (Strayer, 2012), students in an inverted classroom were less satisfied with how the classroom structure oriented them to the learning tasks in the course, but they became more open to cooperative learning and innovative teaching methods. The traditional classroom structure scored higher in task orientation and equity, while the inverted classroom structure scored higher in personalization, innovation, student cohesion, cooperation, and individualization (Strayer, 2012). However qualitatively, the students responded more positively to the expectations and set pattern of events of the traditional classroom. In the inverted classroom, students seemed to be more on-edge and less comfortable. They were never completely sure how to engage with the materials during class time (Strayer, 2012).

This study (Strayer, 2012) focused mainly on the instructor-driven structure of the course (traditional versus inverted). However, it is important to note that a physical environment that promotes inverted or blended teaching—such as one designed for in-class, individual computer learning—should elicit some of the same results. In other words, it should score better quantitatively in metrics, yet feel to the students less qualitatively positive. The study results suggest that an inverted classroom is not the preferred design for an introductory course, in which the student is being introduced to new concepts and where more structure is beneficial (Strayer, 2012). Similarly, a different study (Gurzynski-Weiss et al., 2015) found that introductory course instructors remained in the same area whether in a traditional or a collaborative

classroom, but that advanced course instructors became more mobile and tended to teach from the middle of the room when they were in a collaborative classroom (Gurzynski-Weiss et al., 2015). Both students and teachers alike may benefit from more traditional classrooms with introductory content and inverted and collaborative classrooms with more advanced content.

It is also important to consider subject matter when designing a classroom. Barrett, Barrett and Davies (2013) discuss their environmental model to evaluate the quality of learning environments. The environmental model evaluates naturalness (light, sound, temperature, air quality); individualization (choice, flexibility); and appropriate level of stimulation (complexity, color, texture) (Barrett, Barrett and Davies, 2013). The researchers selected these three areas for several reasons. First, people can find comfort in the natural quality of an environment. Second, people tend to remember spaces with personalization or personal connections. Third, people need the appropriate stimulation for different tasks.

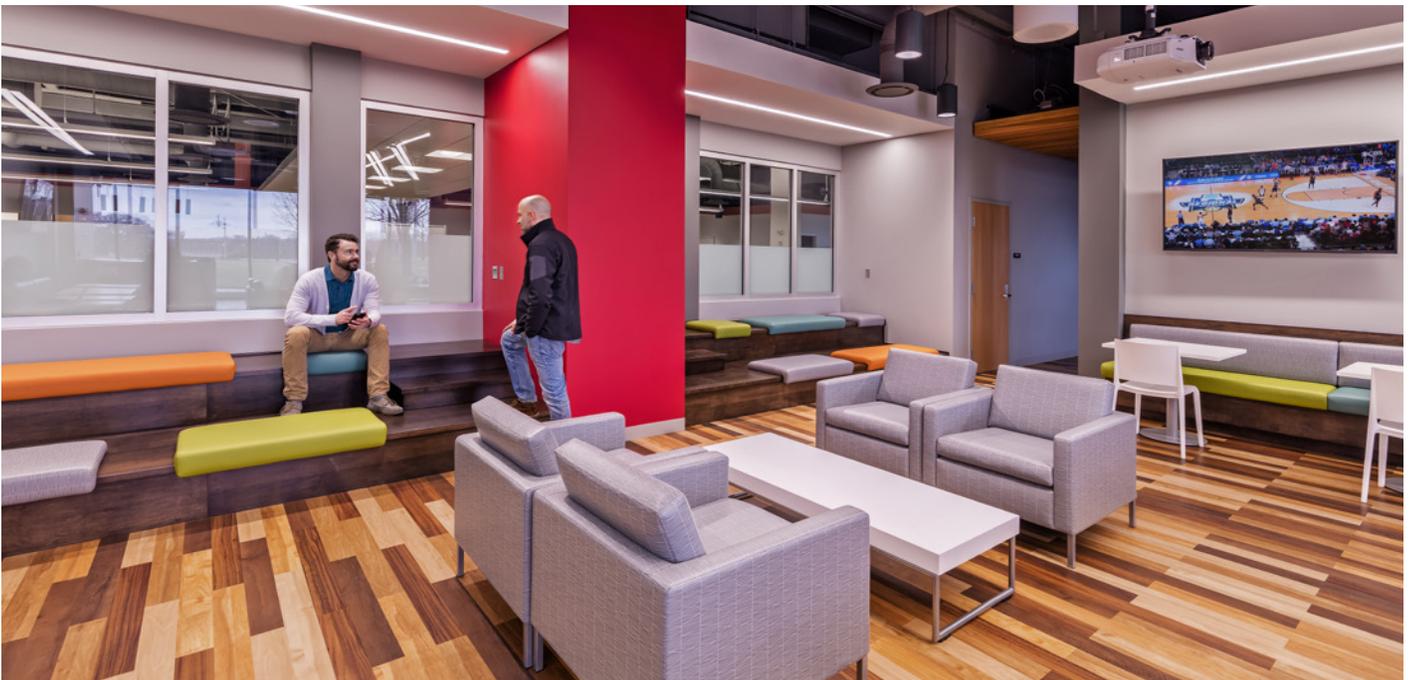
Through the application of the environmental model, the researchers found that while data showed students found interior features somewhat important when evaluating the classroom as a space to learn multiple subjects, they attached special significance to particular interior features when evaluating the classroom as a place to learn about one particular subject. For example, students attached 12% importance to lighting in the overall evaluation of the classroom. However, they attached 100% importance to lighting when the classroom will be used for reading (Barrett et al., 2013). Therefore, taking subject matter into account when planning may help designers produce the optimal classroom design. Designers can improve the quality of students' learning environment by personalizing classrooms for their intended subjects, such as by adding extra customization and adjustable lighting (Barrett et al., 2013).

Third Spaces

In higher education, students seek social spaces where they can engage in communal activity. Activities such as group studying have given rise to the “third space,” created by the mutual use and ownership of this type of place— a common, open, public space that is not home or the workplace. Third spaces serve both university students and community members. Researchers did ethnographic research—made observations, took notes, compiled photo logs, and conducted interviews—to evaluate the effectiveness of these spaces (Timm-Bottos and Reilly, 2014). People interviewed for the study found great value in third spaces. Because the spaces are open to the public and have many different patrons, people said they felt relaxed and cozy there. People also described feeling engaged, energized, and encouraged in third spaces. Many said that the environment was ideal for learning, not studying—creating a break from the typical university routine. The community integration—even the walk from the university to a studio-type environment—created a unique mindset in which typical class biases were left behind. With the “third

space” model, instructors conduct university classes in a way similar to that of community classes; faculty and students are partners, even making and sharing food to promote informal connections (Timm-Bottos and Reilly, 2014).

Similarly, another study (Bryant, Matthews and Walton, 2015) observed students interacting with a newly introduced third space in the campus library, named “The Open,” at Loughborough University. During the design of the space, designers identified two unique requests of current students: They wanted to be able to eat and drink in these study spaces, and they wanted support for multi-tasking. Once completed, the study identified eight broad themes that can be applied to other campus third spaces: (1) collaborative study; (2) individual study; (3) intrusions and interruptions; (4) the third space as a social space; (5) the third space as a public/private space; (6) use of technology; (7) diversity; and (8) library staff/library materials (Bryant et al., 2015). Social activity in a library involves conversation and discussion among people, about either the work at hand or about other matters. Community activity in a library involves seeing and being seen quietly engaged in study. In a



Spaces that integrate cafe spaces for students and faculty, allow for engagement with one another. These spaces allow for studying and socialization. Design by M+A Architects.

quest to supply what students seemingly want, spaces have trended toward a more social function; however, the study authors (Bryant et al., 2015) warn that this is a dangerous trend. Instead, they argue, the value should be on communal activities where people work separately on similar activities (Bryant et al., 2015) to balance learning, productivity, and socialization.

Students can benefit from having access to these third spaces in their higher education environments. Social engagement without the direct connection to a classroom, in the traditional sense, can invite creativity, deeper engagement with each other and surrounding communities, and increased productivity.

Benefits of CLEs and Social Learning

A study at the University of Southern California surveyed three instructors and about 150 students to gain insights on the flipped classroom framework. Overall, students were satisfied with the flipped classroom activities, with many agreeing that the class time interaction was helpful to their understanding of course concepts. In the survey, the students gave the highest satisfaction scores to teaching presence (3.18 out of 4), social presence (3.08), cognitive presence (2.94), and learner presence (2.9) (Kim, Kim, Khera and Getman, 2014). Additionally, nine design principles emerged from the flipped classroom. These classrooms should provide:

- an opportunity for students to gain first exposure prior to class
- an incentive for students to prepare for class
- a mechanism to assess student understanding
- clear connections between in-class and out-of-class activities
- clearly defined and well-structured guidance
- enough time for students to carry out the assignments
- facilitation for building a learning community
- prompt and adaptive feedback on individual or group works
- technologies familiar and easy to access (Kim et al., 2014)

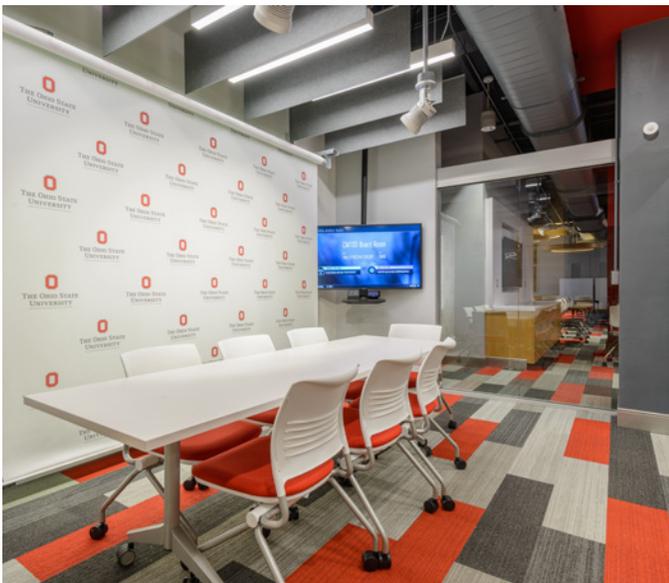
In another evaluative study (Gurzynski-Weiss et al., 2015) intermediate-level class instructors said that the collaborate learning environment positively facilitates group work, makes it easy to interact, and is comfortable. However, they also indicated the active classroom can be distracting, crowded, and disorganized (Gurzynski-Weiss et al., 2015). Students responded positively to the active classroom's mobility and ease of interaction, comfort and convenience, and feeling of relaxation. However, they also said that the place felt cluttered, given the tight space of the classroom (Gurzynski-Weiss et al., 2015).

In the same study, instructors of advanced classes indicated that in the traditional class, students remained in the same seats all semester, felt positively about technology, and felt negatively about the room's shape. However, in the collaborative classroom, instructors expressed positive feelings about the technology, the faster transitions between activities, the increased interaction, and the furniture and space in general. They said that they planned more activities to use the space and the resources. However, instructors expressed negative feelings about the classroom's distance from their office and the fact that the furniture was in the back of the classroom (Gurzynski-Weiss et al., 2015). These comparisons show, for both intermediate and advanced courses, that there are advantages in having an active, collaborative classroom—with the caveat that there are also distractions and noise.

Technology

The design of a classroom goes hand-in-hand with advancing technologies. Simply replacing older technology with something newer may limit the potential embedded in the cost of newer tech. For example, when institutions replaced manual projectors with digital projectors, many did not take advantage of the digital projectors' motion and sound capabilities. As a result, students did not see much difference between the two types of projectors. They had much the same learning experience—just at a much higher cost. Eventually, many institutions provided audio and visual support for digital projectors in each classroom.

The most exciting opportunity provided by technological advances is the opportunity for technology to provide interaction instead of the transfer of information (Pai & Borba 2012). Architects and designers should use technology in the classroom to create a shared learning experience. They should provide technology that can support instructors in encouraging their students to seek out information in class, rather than rely on instructors to present the information. Technology can provide approachable problem-solving activities (Lee, 2017) that jump-start creativity and collaboration, particularly for students who are uncomfortable thinking creatively and independently.



The Ohio State University Campbell Hall's renovation allows for technology to create content. Design by M+A Architects.

In addition, designers should match digital and visual technology with casual furniture in small clusters. Imms & Byers (2017) found that when students utilized technology in a more dynamic and flexible space, something changed in the manner in which they and their teachers utilized technology. This change allowed instructors to direct collaborative group activities and to link the technology together for all-class learning. Further, the intimacy of smaller nearby technology can allow students to communicate within their comfort zone.

Pedagogy

In a study of two classes, the studio-style classroom affected both the willing and reluctant teacher's instructional methods (Taylor, 2009). Both found themselves becoming more flexible in style, more open and approachable to students, and more fluid in lecture and collaboration. Their reliance on lecturing was reduced, and more collaborative problem-solving, critiques, and discussions came out of the studio classroom. The majority of students in both classes responded that they enjoyed the classes more, felt more engaged with the professors, and communicated more with their peers (Taylor, 2009). Both faculty and students attributed these effects to the new classroom arrangement, and not strictly to active learning pedagogy.

This research suggests that the classroom environment not only affects student learning but can also affect professors' teaching methodologies (Taylor, 2009). Studio classrooms should have movable furniture; small tables for small group discussions; comfortable (and fun) chairs; open space; a room shape/layout without a defined "front"; and interactive whiteboards. When students are given the freedom to ask questions, to interact with technology, and to change classroom arrangement and structure, the studio takes on an inviting atmosphere that encourages learning and engagement (Taylor, 2009).

In another study, students responded very positively to the flipped classroom method (Gilboy, Heinerichs and Pazzaglia, 2015). In the study, 76% of students preferred to watch videos before class instead of listening to an in-class lecture, and 64% preferred to have the class time dedicated to in-class activities. In addition, 62% of students said that they learned more effectively from the video lectures than from the in-person lectures, and 56% also stated that they learned the course material more effectively in the flipped format. However, students were concerned that they didn't have enough opportunities to ask the professor questions. This concern should be evaluated in future flipped classroom designs.

With mostly positive reactions to this teaching methodology, classroom design can also be flipped. When most, or all, lecture occurs online, the classroom design can become more flexible and active—putting the rigid rows of seats and small desks in the past. Implementing the active learning-styled classroom would further encourage the positive reactions and learning experiences that are expressed in this research (Gilboy et al., 2015).

Evaluation

Based on these evaluated factors, researchers (Barrett, Davies, Zhang and Barrett, 2015) evaluated an average student's performance between the worst classroom and the best classroom. They found there was an 11-point progress differentiation, meaning that a student in the best classroom would progress in learning 11 points more than the student in the worst classroom.

Given these results, the best design features for primary school classrooms are:

- **Well-distributed daylight and/or high-quality artificial light**
- **High-quality and purposeful furniture and fixtures**
- **Interesting and comfortable tables and chairs**
- **Multiple zones for learning activities**
- **A flexible and easily rearranged classroom**
- **Wide corridors**
- **Large building/classrooms for alternative learning activities**
- **Wall/floor colors that create an effective color scheme (Barrett, 2015)**

Other researchers determined seven dimensions to student subjective responses (Castilla et al., 2017):

- **Functionality and layout:** “well laid out,” “well organized,” “spacious,” “good furniture,” “good equipment,” “easy access,” “well positioned,” “good design,” “good ventilation”
- **Cozy and pleasant:** “cozy,” “cheerful,” “pleasant”

- **Concentration and comfort:** “silent,” “helps me concentrate,” “good temperature,” “comfortable,” “intimate”
- **Modern design:** “new,” “good design,” “good furniture”
- **Good daylight and outward facing:** “good daylight,” “outward facing,” “well lit,” “good ventilation,” “good design,” “easy access,” “cheerful”
- **Good artificial lighting:** “good artificial lighting,” “well lit”
- **Humidity:** “damp,” “oppressive”



The Ohio State University Baker System renovation allows for communal gathering spaces for students. Design by M+A Architects.

Four design factors were also determined:

- **Finishes:** “claddings,” “walls,” “ceilings,” “decoration,” “doors,” “flooring”
- **Personal work space:** “furniture arrangement,” “dimensions,” “furniture,” “location and access”
- **Interior environmental conditions:** “acoustic conditions,” “noise level,” “artificial lighting,” “humidity conditions,” “equipment,” “layout and installations”
- **Relationship with the outside:** “daylight,” “windows,” “ventilation conditions,” “thermal conditions”

These design factors contribute to the feelings and subjective impressions of a classroom.

Summary

As university environments continue to evolve, it is important to keep the focus on the heart of the university—the classroom. These environments need to demonstrate the serious consideration being devoted to the learning experience. Successfully creating collaborative learning environments is a moving target. Specific needs are unique between universities, departments, and courses, but the existing research does offer clear universal opportunities for evidence-based investments. The improvements listed in this white paper have the potential to create a memorable and unique learning space and to assist all students in engaging, collaborating, and realizing the potential within each course.

M+A Architects and the Department of Design at The Ohio State University commissioned this white paper, participating in discussions that finalized the research question examined in the paper and identifying relevant research that explores the research question. At M+A Architects, we are using this and other evidence-based research to support our decision-making process. To continue the conversation on higher education, active learning environments, and our other services, contact Mark Bryan at research@ma-architects.com.

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