

LISTENING TO HIGH SCHOOL STUDENTS: PURPOSEFULLY-DESIGNED SPACES AND THE IMPACT ON STUDENTS' ENGAGEMENT IN LEARNING





September 6, 2019

Dear Reader,

In September 2017, VLK Architects released its first scholarly research manuscript. It was the first of its kind in studying the built environment's impact on student engagement. That original study served as the catalyst for **VLK | EDGE**®, which advances the educational discourse about best practices and informs our firm about various aspects of design. We are proud to share with you our latest research, "Listening to High School Students: Purposefully Designed Spaces and the Impact on Students' Engagement in Learning" conducted by The University of Texas at Tyler.

The manuscript you are about to read focuses on a high school of choice in Houston Independent School District in Houston, Texas. In an era of political oratory about the importance, or lack of need for school choice, this Texas public school is providing unique learning experiences for students who have career interests in an energy-related field. Our appreciation goes to the students and teachers of Energy Institute High School for their participation, and willingness to share their thoughts, attitudes, and opinions.

Sincerely,

VLK Architects, Inc.

A handwritten signature in black ink that reads "Dalane E. Bouillion".

Dalane E. Bouillion, Ed.D.
Principal | Educational Planner

**Listening to High School Students:
Purposefully Designed Spaces and the Impact on Students' Engagement in Learning**

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School choice has become a hotbed of conversation in the current political rhetoric taking place in the United States. In Texas, the legislature spends an abundant amount of time trying to advance a political agenda while consistently hearing from public educators who oppose their discourse and want the best education for all students. Regardless of the outcomes of the debates and filed bills over the past few biennia, one example of student choice in a public-school district in Texas is thriving.

The newly designed high school in this study provides students and parents a choice in a STEM-focused type of learning where the academic content is centered around preparing students for careers associated with energy, such as oil and gas, renewable, and alternative. The campus is part of a system of one district's individual schools that provide students and parents choice related to the students' career interests. Remarkably, at the campus in this study, student choices continue to be multiplied as Project-Based Learning (PBL) is prevalent. Students make personal decisions about the evidence they choose to create and share in response to learning expectations.

In such a specialized magnet program, this type of cooperative learning, coupled with extremely high expectations, an environment that expects students to participate in groups that must produce evidence of learning, and individual experiences outside the campus with

internships and real-world contributions, provide a unique venue for student voice. Leveraging the existing relationship between the school leaders and the architecture firm that designed the new building, the research team aimed to shed light onto the students' perspectives about the impact purposefully designed learning spaces have on their engagement in learning. Herein are the voices of the high school students who volunteered to participate in focus group interviews. Given the school's preferred instructional model, PBL, the students are accustomed to being heard, comfortable making suggestions, and discussing their preferences. They had strong opinions as questions were raised about their coursework, their teachers' approaches, and their newly built learning environment. The students know when and why they engage in learning but are also aware of when and why they do not.

Constructivist Theories of Learning

Constructivism

According to the constructivist theories of learning, active learning takes place when students engage in processing at the appropriate cognitive level which results in the construction of cognitive representations (Mayer, 2001, 2008). To be cognitively engaged, students must actively construct knowledge through collaborative problem solving facilitated by the teacher in technology-rich learning environments (Prawat & Folden, 1994). Through PBL, learners have the opportunity to construct knowledge by engaging in cognitive processes, including processing incoming relevant information, organizing the new knowledge into coherent cognitive structures while connecting prior knowledge to the new learning (Mayer, 2001, 2008). Furthermore, according to constructivism, learning takes place when it is situated within the correct context for learners to construct a product and summarize their learning in a report or essay (Harel & Papert, 1991). Learning opportunities must allow students choice to construct knowledge in a way that

provides learners with compelling reasons to be interested in the task (Hidi & Renninger, 2006). Nowadays, these constructivist theories of learning play a leading role in education (Bransford, Brown, & Cocking, 1999; Mayer, 2008) and have critical implications for instructional design (Mayer, 2005).

Project-Based Learning

Founded in constructivism, Project-Based Learning (PBL) is an information-processing or cognitive constructivist approach to education (Hmelo-Silver, 2004; Norman & Schmidt, 1992; Schmidt, 1993; Schmidt, De Grave, De Volder, Moust, & Patel, 1989; Schwartz & Bransford, 1998). It gives students the opportunity to guide their learning through standards-based inquiry and collaborative work (Bell, 2010; Markham, Larmer & Ravitz, 2003). The model has become popular and is being used in classrooms across the world (Weatherby, 2007). Through PBL, students are expected to research questions related to real-world problems, and assume responsibility for their own learning (Barrows, 2002; Slough & Milam, 2013) while working on products related to their lives and/or careers (Barrows, 2002). Teachers in a PBL classroom move away from the traditional teaching role where teachers disseminate knowledge (Ozel, 2013) and become a facilitator of learning by guiding and supporting students (Barrows, 2002).

Through PBL, teachers are able to provide opportunities for students to engage in authentic work-related learning experiences (Buck Institute for Education, 2013). For instance, students in career-focused schools have reported increased levels of motivation to actively engage in learning to meet the requirements of the projects (Nielsen, Du, & Kolmos, 2010). Through PBL, students are able to develop project management skills, collaborate, and create (Nielsen et al., 2010), empowering them to make decisions that affect their own learning while

setting personal learning goals (Wood, 2003). Throughout the student-influenced inquiry process embedded in PBL, students learn essential knowledge and life skills via authentic inquiry of complex standards-based tasks (Grahame, 2011). The cognitive processes required during PBL tasks empower students to design and conduct research, bridge theory to practice, and apply acquired experiences to design possible solutions to the proposed real-world problem (Savery, 2006; Torp & Sage, 2002) related to a career of their interest.

A Study to Leverage Students Voice

Grounded in pragmatism, the investigators designed a phenomenological qualitative research study aimed at exploring the impact purposefully designed learning spaces have on high school students' engagement in learning through a constructivist learning model. As pragmatists, the investigators believe that their study and findings are impacted by the context in which the study was conducted (Creswell, 2014). Hence, the investigators designed semi-structured interviews to ensure the needed level of flexibility during the focus groups (Creswell, 2014) to explore student perceptions of the impact new learning spaces have on their engagement in learning. By designing a phenomenological study, the investigators provided students with the opportunity to reflect and describe their experiences in the new learning spaces, and how the spaces impact their educational experiences and engagement in learning. Furthermore, the investigators collected the data through focus groups to encourage participating high school students to reflect and expand on other students' comments (Carter et al., 2014). By conducting focus group interviews, the students were given the opportunity to interact with others who have experienced the same phenomenon and share their perspective about similar or distinctive experiences at the school. The interaction and various participants involved in the discourse about their experiences in the old and new learning spaces were fundamental to the success of

the study (Carter et al., 2014). “Phenomenological research culminates in the essence of the experiences for several individuals who have all experienced the phenomenon” (Creswell, 2014, p. 14). In this study, part of a larger project, the student interviews culminated in the understanding of high school students’ perceptions of the learning experiences and engagement while attending school in purposefully designed learning spaces.

The qualitative study was conducted at an energy-career focused high school in Texas in one of the largest urban school districts in the United States. The students at the high school have all chosen to attend this STEM-focused magnet program. The school, learning spaces, and curriculum were designed to immerse high school students in energy-related, career-focused content through a collaborative, Project-Based Learning model. All participating students were in their first year in a newly designed campus, after having attended high school in multiple repurposed buildings. Two rounds of semi-structured interviews were conducted. The first group of participants was interviewed in the spring of 2017, while the students were attending high school at one of the old buildings where the magnet school had been housed since 2013. Eleven students were interviewed ranging from freshmen to juniors who planned on continuing to attend the high school once the new campus was built. In the fall of 2018 and spring of 2019, during the first school year at the new building, two groups of sophomores, juniors, and seniors were interviewed. Twenty-two students were interviewed, all were enrolled and attended the high school while the school was housed in the old building, as well as the newly designed building.

Through purposeful sampling, school administration selected students for pre- and post-focus group interviews to ensure all participants could compare their experiences in the old and new buildings. Furthermore, school administrators ensured every participant had parent authorization, and a signed consent form to participate in the focus group interviews. Given that

students ranged in age from 15 to 18, once parent authorization was secured, the investigators requested that each student verbally agree to be part of the study prior to the focus group interviews. Focus group interviews were selected as the data collection method to facilitate data source triangulation (Carter et al., 2014). Three separate focus groups were conducted to ensure dependability and data source triangulation. Additionally, to ensure investigator triangulation, each investigator coded the data separately and met to debrief and compare the identified themes.

Data Analysis

The group interviews were audio-recorded and transcribed. The transcripts were first analyzed and organized using NVivo 11 then data were hand-coded. Three coding methods were utilized to analyze the interview data: open, axial, and selective coding (Creswell, 2014). Open coding allowed the authors to identify broad categories of information (Creswell, 2014). Following open coding, axial coding facilitated the identification of themes within the conceptual framework of the study. Finally, selective coding was used to explain the relationship and interconnectedness of the themes (Creswell, 2014). The interviews conducted prior to and after the relocation of the school to the new campus were analyzed and coded by each investigator separately. Each of the authors' data analysis were then compared to identify discrepancies and similarities in the themes identified in the interviews conducted prior to the move (pre-move focus groups) and those conducted after relocation to the new campus (post-move focus groups). The primary investigator kept notes after each coding round and held debriefing sessions with other investigators.

Through open coding of the pre-move focus group data, two categories were identified. Within the two categories, 14 themes emerged. Through axial coding, the themes were narrowed to four interconnected themes. By conducting a separate round of open coding, post-move focus

groups data were coded, and four general categories were identified. The students' quotes within each category were grouped and analyzed to ensure accuracy of the first cycle of open coding. The investigators hand-coded the chosen data after open coding. Out of the four categories, the investigators organized the data into two broader themes: learning spaces and commitment to learning. Through a cycle of axial coding, the investigators coded the data to identify all the themes related to learning spaces, pedagogy and learning found within the selected quotes. Thirty themes were identified. Subsequently, a cycle of selective coding was used to identify relationship among the identified themes. As a result, five sets of interconnected themes were identified. However, only three are reported in this manuscript as those were the three themes directly related to learning spaces.

Findings

The findings reported in this manuscript are part of a larger project to give students and educators the opportunity to voice their perspectives about the impact school design has on students engagement in learning. The research team, comprised of three former K-12 administrators who currently serve as a university assistant professor, a private architecture firm educational planner, and an educational consultant, aim to expand the pragmatic understanding of the impact purposefully designed spaces have on students' engagement and how students perceive their learning experiences in these spaces.

Pre-Move Focus Groups

Eleven high school students were interviewed while attending school at an old, repurposed elementary building where the district housed the energy-focused magnet program. Four main themes were identified, reported in alphabetical order and not intended to represent

quantifiable sorting of the data. Table 1 lists the themes and provides student quotes related to each theme.

Table 1. Pre-Move Focus Groups

Themes	Student Quotes
Lack of Purposeful Design (for Collaboration and PBL)	<p>The game [robotics] had to do with shooting balls, and the cafeteria roof, which is the highest that we have, would actually get in the way when we were trying to shoot, we couldn't accurately test the shooting with the robot...that could be problematic.</p> <p>They keep talking about this is a different type of learning, PBL, but then we are in this old, traditional building. So, is it new, innovative?</p> <p>There are some spaces scattered around the school, that are empty, where you can put furniture so you can go and relax. I think it's a good thing to have; space to gather with friends and group members to work on stuff.</p>
Nature (Outdoor and Natural Light)	<p>I personally like natural light. It's an energy school so it should be one of our priorities.</p> <p>If we had tables in the courtyard in one area... [We could] "bring the inside out, outdoor learning.</p> <p>When you walk in, there is a gloomy feeling.</p>
Space Size	<p>We are low on space for classrooms. One class on one side of the building; another on the other side of the building. It is difficult.</p> <p>I try to get through the hallways in 5 minutes. I'm irritated when I get to class so it's harder for me to pay attention.</p> <p>This year, it's a constant the "field" size [for robotics], and we don't have that much space in this building.</p>

Teachers Impact Learning; New Space will not Impact Learning	<p>I don't really think it impacts it [my learning] in any way due to the fact that I always depend on the teacher.</p> <p>It's more about the teachers; the building doesn't matter that much.</p> <p>The space doesn't put any limitations.</p>
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Throughout the focus groups, when explicitly asked about the impact spaces have on their learning, students repeatedly reported that the spaces in which they went to school had no impact on their learning. However, throughout the focus groups, when asked to speak about their learning experiences and how the spaces facilitate or interfered with their work, their comments contradicted their perceptions about the lack of impact the spaces had on their learning experiences. Students spoke about the lack of spaces conducive to collaborative work and projects, including the group work in which robotics team members engage. They expressed frustration with the size of the spaces where they had to work, and the lack of spaces for informal collaboration. Additionally, students spoke about their value of natural light and expressed their desire to have outdoor spaces to collaborate and spend time. A male student who indicated that he did not believe the space had an impact on his learning or engagement, shared at the end of the interview, “Our principal is trying to send us the message about how special we are supposed to be here but then we see our building, and it’s embarrassing. I kind [of], don’t have that feeling.”

Post-Move Focus Groups

After a semester at the new campus, students, some of whom had participated in pre-move focus group interviews and others who did not participate in the first round of focus groups, were interviewed and asked about their experiences in the new building. Contrary to the

pre-move interviews, the students consistently indicated that the purposefully designed learning spaces in the new school had an impact on their learning and engagement in learning. Table 2 presents the post-move focus group themes and supporting quotes.

Table 2. Post-Move Focus Groups

Themes	Student Quotes
Ease of Use and Access	<p>One of my favorite things about this entire campus is there are white boards and dry ease boards all over the place... It really helps with collaboration, when you need to jot something down or have some ideas. Also pretty much everyone has their phones on them at all times so you can take a picture once you are done and you don't have to worry about erasing other people's board...it's just really nice to have all that white board space all over the place.</p> <p>With any environment that have [sic] all the tools at hand, we can easily bring up anything at any moment and finish anything, given the time.</p> <p>When we are doing prototypes, since we have the UC controller right there, these are more easily built. We feel a little bit more invested into the prototypes, but in a good way.</p> <p>Last year, we ran all their work on laptops and when one person is low, that means we have to go across the room to charge up and they won't hear your ideas until after the presentation. In this building, we have outlets coming from the ceiling and already on the table which lets our groups stay together.</p>

<p>Learning Preferences</p>	<p>They can have isolated quietness. They can be there, and they can probably work more efficiently.</p> <p>It makes you feel more or so free, and it makes you more willing to be like, at least for me to be relaxed because you know there is like a slight subconscious since of anxiety, attention and claustrophobia when you are in a small room.</p> <p>Sometimes, if we feel like we are going to get distracted we ask our teachers if we can get into a small group room. It's a small room right next to the actual classroom...when we are doing group work or watching videos that everyone is going to have out loud, [we] just to go into there and focus up with our group.</p>
<p>Space for Collaboration</p>	<p>Nooks and crannies that have this furniture that basically allows students to collaborate during class time and if they want to be quiet and away from the classroom.</p> <p>The classrooms walls even though they are a dividing wall, the wall is still pretty soundproof. You can hardly hear the next classroom unless the door is opened so that is something I really like because then you can focus more on collaboration.</p> <p>The extra space that we get from having flipping walls helps out a lot because generally the way we organize is we have a bunch of sub teams to like five-ish people working on different prototypes or whatever and having all of the space of two giant classrooms. It makes it so much easier for the sub teams to collaborate with each other and to go find someone that can help you.</p>

Common Themes: Pre- and Post-Move Focus Groups

The differences in the students' responses were substantial. During the pre-move focus groups, students consistently indicated their skepticism about the impact spaces had on their learning while expressing opposing views throughout the conversation. During the post-move focus groups, the students constantly reported how the spaces in the new building have impacted their learning and work. Given the contrasting themes, it was not surprising that only one theme was found in both the pre- and post-move focus groups data: the purposeful design of spaces for collaboration. In the old building, students expressed frustration due to the lack of space conducive to collaboration and teamwork. Once in the new building, students continuously spoke about the spaces that foster collaboration and teamwork.

Limitations

Given that the findings reported in this manuscript are the results of focus group interviews, the investigators are cognizant of the limitations of focus groups and the influence members of the groups might have on the responses of others (Carter et al., 2014). The findings are limited to the themes and ideas students felt comfortable sharing in the presence of other students in the room.

Implications

Seven themes emerged from the study: four from students' experiences prior to the new built environment, and three after coding the narratives once the students were learning in the new school. It is important to discuss the implications of all themes situated within the context of the students' timing of their experiences. Meaning, the first four themes, identified as a result of the pre-move focus groups, are the themes that resulted from the students' thoughts while going to an elementary school built in 1921 that had been assigned to house the district's innovative

educational approach to energy-related high school curricula. The other three themes, identified following the post-move focus groups, stemmed from the experiences realized while the students were attending school in their new building, which was purposely designed to envision the look and feel of an energy sector corporate campus.

Implications of Pre-Move Focus Group Themes

The four themes originating from the first round of interviews are described negatively as they prevented teaching and learning effectiveness. Situated in this outdated environment, the student participants spoke of instructional practices and expectations, as they were status quo. Students were always expected to engage, achieve, and create. They consistently complied, but in areas that were dark, cramped, and loud due to the squeaky, blowing air-conditioning units that spanned most of the ceiling on the exterior walls.

Limitations of Existing Space. The students spoke of their academic programs but described the limitations of space in the old building. This speaks to the importance of understanding the evolution of curricula as well as instructional methodologies. Providing the same space—the traditional rectangular classroom—throughout the building limited the opportunities for students to adequately prepare for current presentation needs and demonstrations. Ironically, a new concept, a school focused on energy-related careers, was housed in an old Industrial Age building. The irony was realized by a student who indicated, “They keep talking about this is a different type of learning, PBL, but then we are in this old, traditional building. So, is it new, innovative?” It made the student wonder if the learning approach was really going to prepare him for his future.

Students never defined their learning by a classroom. Rather, they spoke of what they needed in order to do their work. It was normal to use the long hallways outside of the traditional

classroom because there was more room. The traditional concrete masonry unit (CMU) walls that created the environment for the first round of interviews provided place, but not purposeful space for learning. Activities that define PBL were found in skinny hallways, and on the floor in classrooms after students pushed their desks against the walls to have an adequate area to think, collaborate, and produce.

Lack of Natural Light. Knowing that every student attending this school is interested and focused on an energy-related career, it is understandable that a student reported, “It’s an energy school so it should be one of our priorities.” However, the lack of natural light provides another example of irony, as one strand is focused on alternative energy. Solar energy, as an example of instructional content, was being researched and discussed, but not modeled.

Need for Square Footage. Although the Texas Education Agency creates standards for square footage requirements in instructional environments, these should be considered minimum standards. Specialized curricula and materials associated with them should also be considered when assigning coursework within an existing space. Additionally, specialized instructional approaches like PBL may require specialized space for collaboration, interdependent learning, and areas for production. Projects also necessitate materials that must be housed and readily accessible based on expected teacher outcomes or student-directed responses to instruction. In a PBL environment, square footage per person should not be the driving factor. Space should be defined by how students work together, and by the furniture in which they need to accomplish their goals.

Misaligned Conditions. The exterior of the old school where the first round of interviews took place had a mural of very young children petting a rabbit painted on the wall. Along the sidewalk leading to the front door was an additional mural depicting young children in

line wearing backpacks and holding supplies ready for the school day to begin. Recruitment for this magnet high school was interesting when the implied communication of the murals is considered. Clearly, a mismatched message was evident.

Inside the building, students talked about areas that were “empty”, where discussion and work could take place but lacked furniture and adequate support for technology. They clearly believed that the conditions of the building had no impact on their learning. It did not prevent, nor did it assist in, the facilitation of instruction.

Implications of Post-Move Focus Group Themes

The three themes that emerged from the study provide poignant information for both educators and architects. Ease of use, learning preferences, and space for shared responsibility are the results from the collaboration that occurred during pre-design and throughout the design process. However, the value that the students placed on these elements have direct connections to the actions of the educators who both set the tone for the use of the building and facilitate instruction on a daily basis. It was the intent of the design to create instructional spaces that would best support Project-Based Learning for an energy-influenced future career. The most important end-users—the students—validated through examples that the intention of the design was realized.

Learning Efficiency. Students spoke of their new school in terms of the ease of use, which aligns with learning efficiency. Within most vocations, time is a commodity, but in education, how time is spent is actually detailed in a plan approved by the State of Texas specifying the number of minutes committed to teaching and learning (Texas Education Agency, 2017). Maximizing the pre-determined amount of time dedicated to instruction—which is limited in comparison to the number and depth of Texas standards teachers must cover and students shall

master—is on every teacher’s mind when planning and implementing instruction. Purposefully designed spaces can positively impact learning by facilitating the use of spaces and instructional materials. Participating students provided examples through which they detailed plentiful space for both themselves and their learning tools. Having ample space for students to exist, learn, move, and utilize instructional materials can no longer be defined by a single desk. Moreover, the instructional expectations for groups to create and evaluate together requires room for a collective process. By understanding intended instructional methods, such as PBL, expert design can be accomplished while considering both the academic and social needs of the next generation. When details associated with teaching and learning expectations are applied during the design process, learning efficiency increases and is recognized by the students as being drastically different and improved.

Learning Preferences. Although much debate exists regarding student learning styles (Delahoussaye, 2002), students were forthcoming in the preferences they feel contribute to their acquisition of knowledge and skills. Tools that support their learning needs, such as smaller spaces allowing for team problem solving, outfitted with “boards everywhere” for visual demonstration and collective ideas were mentioned repeatedly. The only drawback to the plentiful boards was the ability to always “find a marker” to record thoughts.

Interdependence Space. Student participation in teams/group work is a requirement at this school. There is no way around this expectation, and students accept this approach, whether they view it as a preference or a challenge, upon enrollment. PBL requires students to think deeply, take risks, create, evaluate themselves and their team, and produce real-world tangible evidence as a result of learning. This process requires space, along with the appropriate materials and technology for success. PBL is more than collaboration – it is an interdependent process

where students build trust in order to accomplish an intended outcome. Students reported that having interdependent group space that physically connected the classroom, hallways, and open collaboration areas provided them with choice for their needs. Some of these include sound reduction, adequate floor space, learning outdoors, lighting preferences, and the ability to visually connect to their teacher from a variety of learning spaces.

Conclusion

Traditionally, student voice has not been included during the school design process. Education, especially at the high school level, is still evolving from the conventional expectations of teachers imparting knowledge while students sit and listen. In schools across the nation, including the school where the study was conducted, students increasingly have agency in their learning through innovative, real-world learning opportunities, which provided an ideal context for the presented study. In this high school study, when offered the opportunity, students were able to use reflective skills to express and validate with examples their learning preferences, and the impact the new learning environments have on their education.

The findings of the study indicate that students can promptly identify the characteristics that positively impact their learning, and the mismatch between facilities and the curricula when old school buildings are retrofitted to house innovative schools. While students did not anticipate that the new facilities would have an impact on their learning, the findings indicate that during their time at the old building, they were cognizant of the limitations of housing a PBL-school in a repurposed building, and the importance of having adequate space for teaching and learning.

After moving into a modern school building designed specifically for students who desire a career in an energy-related field, these high school student voices were powerful. Given

their experiences in student-driven learning environments, in which they are required and able to make choices on a daily basis, students were adept to clearly expressing their likes, dislikes, and views about their learning. The findings indicate that the students recognized the instructional importance and the impact of their new spaces.

Awareness of the environmental attributes that support personal student motivation only garnishes each student's ability to excel. When their identified features are made accessible, and in a beneficial environment, learning can be achieved at mastery levels with ease. For educators, the value of student voice is tremendous; it informs educational processes and has implications for curricular design and delivery, leveraging purposely designed learning spaces and student preferences to achieve the best education possible. For architects, and other design professionals, these student voices detail the types of spaces that should be incorporated in order to ensure learning efficiency, learning preferences, and interdependence space.

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INNOVATE }

"Failure is an option here. If things are not failing, you are not innovating enough." -Elon Musk



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