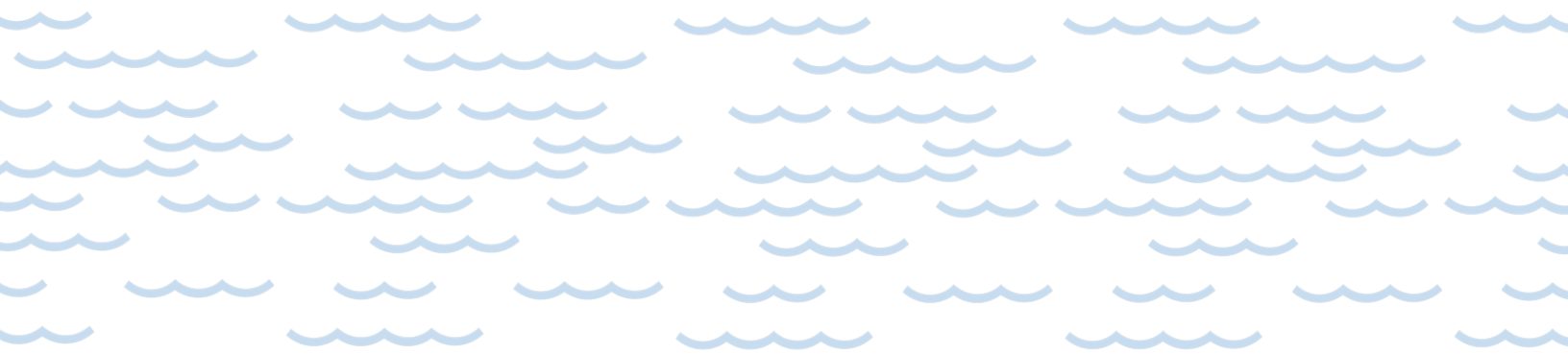




School Renovations that Elevate Student Success and Well-being

A Case for Biophilic and Student-Centered Designs

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I. INTRODUCTION

There is a growing awareness among school districts and facility design professionals that the built environment can enhance or hinder students' academic progress and social development. It is important to evaluate how specific design strategies influence learning outcomes and student well-being. The purpose of this assessment is to examine the effects of a renovation featuring biophilic and student-centered design elements on the teaching and learning environment.

To update and improve its learning spaces, Richland School District 2 (RSD2) renovated Bookman Road Elementary School (BRES) in 2023, renovating the media center, creating a makerspace and a collaboration area that connects to an outdoor learning environment. The district partnered with Craig Gaulden Davis | PBK (CGD | PBK), leveraging their expertise in student-centered and biophilic designs. The goal was to improve the teaching and learning environment by engaging students with instructional practices such as hands-on learning, discovery learning, and creative problem solving, while also ensuring that students feel safe, valued, a sense of place and belonging, and enjoy coming to school.

This paper presents findings from data collected at the end of the first year using the renovated spaces. Data are from student, parent, teacher, and administrator surveys and interviews, and state-level performance measures.

II. CONTEXT

Studies of this kind are important to inform school districts as they strive to use limited resources to provide the best educational environments for their students and teachers. Research should help prioritize design approaches that will result in the greatest benefits. This study follows one of Bethel Hanberry Elementary, a newly built school by RSD2 using biophilic and student-centered design features school wide. This research found a highly positive effect on student learning and well-being, and even on student behavior and teacher retention rates (O'Connor & O'Connor 2024).

BRES, a South Carolina public school in Elgin, SC, has 499 students enrolled in grades pre-K to 5. The school's population is 26.7% white, 53.0% Black or African American, 12.4% Hispanic/Latino, and 7.8% other. About 58% of students are in poverty according to the SC Department of Education. Student achievement and lifelong learning are the school's top priorities. BRES' mascot is a lighthouse beacon that "lights the way in personal character, academics and community service."

III. DESIGN STRATEGIES

Biophilic design is based on research that demonstrates that humans have an innate affinity for nature, and that nature contributes to mental, emotional, physical, and cognitive well-being and performance (Wilson 1986). These responses can be achieved with direct interactions with nature, views to nature, and by the built environment mimicking and incorporating natural elements (Appleton 1996, Kellert et al. 2011). Schools that integrated biophilic design elements such as views of and access to the outdoors, natural lighting, imitating natural environments with lighting and patterns, images of nature, and natural materials, have shown that their students had higher test scores, reduced stress, increased attentiveness and memory, improved cognitive functioning and psychological well-being, increased sense of safety, and more positive attitudes and perceptions of school (Joye 2007, Woodward & Zari 2018, Kellert et al. 2011, Determan et al. 2019, Davvand et al. 2015, O'Connor & O'Connor 2024).

Student-centered design creates flexible instructional spaces that provide students and teachers with the ability to tailor the learning environment to better accommodate students' diverse learning needs. Such spaces may include mobile and reconfigurable furnishings that allow for creating personalized learning environments where

students can arrange themselves, and teachers can arrange students, depending on the activity or student preferences. Such spaces can also be tailored to various teaching methods including direct, indirect, experiential, independent, and interactive. Allowing students to make choices promotes student agency, and fosters communication, collaboration, and problem-solving. Students being able to choose the learning environment that suits them best stimulates interest, enjoyment and comfort, and leads to greater engagement, motivation, positive attitude and social behaviors, and higher achievement levels (Reeve & Cheon 2021, Nair 2019, Evans 2003, Kariippanon et al 2021, O'Connor & O'Connor 2024).

IV. DESIGN FEATURES

a. Media Center

The BRES renovation includes features evocative of the school's coastal culture and mascot to create a calming, inspiring, and engaging facility that supports the school's brain-based teaching curriculum. Upon entering the media center, students are greeted with whimsical shorebird light fixtures, floating at different heights, that lead the eyes along wood columns and beams and through the windows to an outdoor meditation garden. The view to this natural spot, previously barely visible through small



Image 1: Media Center with views to the meditation garden



Image 2: Media Center educational graphics

windows, is now the focal point of the space through new storefront that provides view and additional daylight. Atop the storefront colored glass casts colorful and dynamic shadows that move through the space during the day. A custom circulation desk anchors the front of the media center, designed with nautical references, including a portal window book display. Wood accents in the ceiling and columns are reminiscent of an ocean-side boardwalk.

The design encompasses educational graphics about the local, coastal ecology. Displaying images alongside facts helps spark curiosity and provides learning opportunities. Graphics also offer inspirational quotes including one behind the circulation desk showcasing the school's beacon mascot, a familiar reminder to students to "light the way" as they become future leaders. New shelving, lighting, and flexible furnishings contribute to a student-centered learning environment.

b. Makerspace

Directly accessible from the media center, an underused conference space was converted to a makerspace. Biomorphic hexagonal ceiling tiles and lighting fixtures are calming and teach

students about geometrical shapes found in nature. The soothing color palette was carried from the media center to the makerspace. Storefront creates transparency between the media center and the makerspace allowing students to be a part of and inspired by activities in each space and environment. Flexible furnishings include tables on casters that allow multiple configurations and individual lockers for project supply storage that enhance the project-based atmosphere.

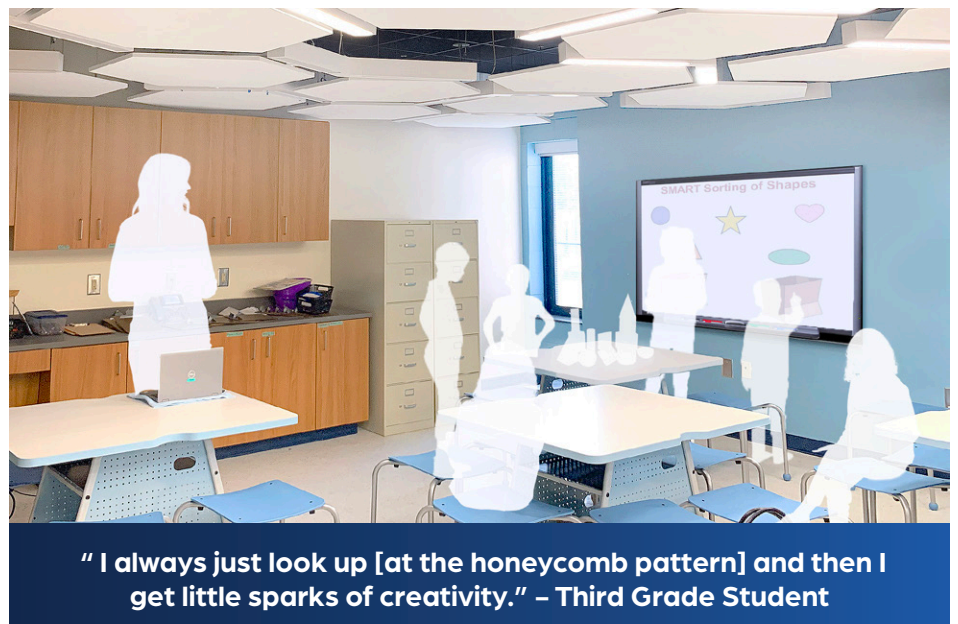


Image 3: Makerspace

c. Collaboration Space Opens to Outdoor Learning

Architects converted two classrooms along the main corridor and near the media center into a bright, open collaborative learning environment. The flexible furnishings allow a variety of activities from guest speakers to group workshops to staff meetings to multi-grade functions. The addition of storefront and colored glass provides a dynamic shadow pattern of colored light throughout the space. Removing the ceiling creates a large spatial volume with exposed mechanical systems so students can see the mechanics of the building. The fresh, vibrant palette from the media center continues into the new collaboration space including a wood slat wall to incorporate materials from nature. A dynamic curved soffit and storefront with wave-like graphics provide visibility, and an inviting entrance. To take advantage of the mild South Carolina climate, the architects designed a dynamic shade structure reminiscent of a beach hut to shade the outdoor learning space.

V. ASSESSMENT METHOD

This case study includes both qualitative and quantitative data to examine how the biophilic and student-centered designs affected the teaching and learning environment at BRES. At the end of the first year using the renovated spaces, stakeholders were asked for their perceptions

about whether the newly designed learning spaces were having the intended effects of improving attitudes, focus, calm, mood, academic performance, and mental well-being. Surveys were administered to students in grades 3-5 and their parents, teachers in grades K-5, and school administrators. The surveys included Likert scale and short answer questions. The surveys asked for opinions on the new spaces and the extent to which they are facilitating improvements in the teaching and learning environment and are improving student well-being and success. To enrich the data from the surveys, a sample of students, parents, teachers and administrators was interviewed with a semi-structured interview protocol. Additionally, since the new spaces were added to an existing school, data relating to academic achievement and growth, and to student satisfaction, were compared between the first year after the renovations (2023-24) and the prior year (2022-23).

VI. FINDINGS

Survey and Interview Results

The results section has five subsections, Learning Environment, Teaching Environment, Biophilic Design, Student-Centered Design, Well-being and Sense of Belonging.

a. Learning Environment



"I can learn so much in the new spaces. I like to observe how things are made or designed or painted." – Fourth Grade Student

Image 4: Collaboration space opens to outdoor learning

SURVEY QUESTION: The new spaces facilitate improvements in student learning.

Survey results revealed that 100% of teachers and administrators, and 96% of parents, agree that the new spaces improved the student learning environment. Student survey results showed that 97% of students said that they like learning in the new spaces for reasons including they learn new things in new ways with new people. In the order most frequently cited in the surveys, students believe that the new spaces help them learn, discover, think, work with others, concentrate, and create. Students reported enjoying having more room to move and work, more opportunities to work with friends, and the beauty of the spaces. One student said, "we laugh more." One fourth grade student commented, "I like that I can move around and have different workspaces because as I grow up, I will need to be used to change." Another said, "The new spaces have brought me and my friends closer because we can work better together in these bright, colorful spaces."

Parents are enthusiastic about the renovations and think that their children are as well. One parent said, "The students talk about the new spaces every day, and are very excited about the renovation." Another stated, "The new spaces are calming and contribute to student focus during instruction and activities." During an interview, a parent commented, "The kids want to be the first to say 'Mom, I've got to show you this cool area that we've got' as they walk their parents to see each of the new learning spaces. Parents say 'wow, these spaces are inviting for all of our kids,' and they definitely notice that everyone is happy."

Teachers responded that engagement and enthusiasm have increased because students enjoy the new learning options. One teacher said, "I appreciate the natural light and the amount of flexible space we now have in each of the new spaces. Research shows that natural light is good for the brain. The amount of space we have allows for entire grade levels to meet and learn together in new ways. It's nice that we have flexible furniture, which can be moved to fit the needs of the lesson, while also allowing for choice." Another teacher said, "The renovations are exciting and support brain-based research about how children learn best including having bright open spaces, flexibility and choice. The colors, the blues and the greens help connect us to nature."

The BRES principal of 18 years commented, "The new learning spaces have contributed greatly, as we are able to continue the work that we're doing as a brain-compatible learning school in spaces that are upgraded, updated, innovative, and refreshing for our students. I think it really builds the excitement of the students, and really fosters a want to be here." The assistant principal

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– BRES Principal

"The students are even more excited about learning when they're in our new spaces. There is greater overall participation and engagement."

– BRES Assistant Principal

Fifth Grade Student





"I feel curious when I'm in the new spaces and there are a lot of interesting details." – Student

Image 5: Media Center circulation design and nautical design elements

said, "The students are even more excited about learning when they're in our new spaces. There is greater overall participation and engagement."

During an interview, the technology and learning coach said, "We are in love with all of our new spaces. This is like a gift to us. The ability of the spaces to change where and how students learn is such a gift, because all too often we're stuck inside those four classroom walls and that gets old. With our Highly Effective Teaching (HET) model, which is based on brain-based learning, we know that natural lighting is best for the brain and we know that choice is best for the brain, and the new spaces provide both. Getting student buy-in by offering choices is effective. Overall, the newly renovated spaces encourage students to learn and collaborate in new and innovative ways we've never been able to offer before. It's all about engagement."

SURVEY QUESTION: The design of the new space fosters a sense of wonder and curiosity in students.

Surveys revealed that 96% of parents, 100% of teachers, and 100% of administrators believe that the design of the new spaces inspires students and sparks their curiosity. The assistant principal said, "Our students really notice the details."

SURVEY QUESTION: The colors in the new spaces have a positive effect on how people feel.

When asked whether they like the colors in the new school, 97% of students responded affirmatively. When asked whether the colors have a positive effect on how people feel, 96% of parents, 93% of teachers, and 100% of administrators responded positively.

b. Teaching Environment

SURVEY QUESTION: The new spaces support a range of teaching approaches such as direct, indirect, experiential, and interactive.

Survey results revealed that 100% of teachers and 100% of administrators agree that the renovated spaces support a range of teaching approaches. Teachers value how easily reconfigurable the spaces are to support their teaching. One teacher said, "I like that I can choose spaces other than the classroom to give students different ways to work and learn." Other teachers reported that the new spaces, especially the collaboration space, allows for grade levels to have meetings as a whole group, as well as conduct in-school field trips, host guest speakers, or invite visitors to work with students.

In an interview, a teacher of 28 years said, “Flexibility for the teachers is wonderful. It is great to have spaces outside the classroom and in different areas of the school to create the variety of learning spaces students need. For example, one teacher can work with the small group at the little tables and low chairs or find the wobble chairs for students who need to move because that’s going to help them learn. Another teacher can use the high step furniture for guest or student performances, or to sit like an audience in an auditorium. The flexibility is working for students and teachers. It’s hard to imagine such high enthusiasm about everything.”

The assistant principal said, “The teachers were super excited when they saw the media center, makerspace, and this beautiful collaboration space opening to an outdoor learning space. They now have the space to bring their entire grade level in or bring students from different grade levels together. They can collaborate with each other, to see what common assessments need to change, and what common activities and assignments we should do.”

SURVEY QUESTION: The new spaces help teachers innovate in their teaching.

When teachers and administrators were asked if the new spaces help teachers innovate in their teaching,

“We are in love with all of our new spaces. This is like a gift to us. The ability of the spaces to change where and how students learn is such a gift, because all too often we’re stuck inside those four classroom walls and that gets old. With our Highly Effective Teaching (HET) model, which is based on brain-based learning, we know that natural lighting is best for the brain and we know that choice is best for the brain, and the new spaces provide both. Getting student buy-in by offering choices is effective. Overall, the newly renovated spaces encourage students to learn and collaborate in new and innovative ways we’ve never been able to offer before. It’s all about engagement.”

– BRES Technology & Learning Coach



Image 6: Collaboration Space with biophilic design features

93% of teachers and 100% of administrators responded affirmatively. In the surveys, teachers and administrators said that they value spaces for indoor and outdoor learning, the spaces for tools and materials, flexible furnishings, and the variety of functional areas of different sizes for different purposes.

In an interview, the assistant principal said, "Now that we have these new spaces, it's time to think outside of the box. This gives teachers the opportunity to rethink traditional learning and imagine what teaching and learning can look like for our students." The Technology and Learning Coach said, "The newly renovated spaces have brought us forward thinking. We can move forward and look into the future to see how teaching and learning will change. We also enjoy holding our faculty meetings in the collaboration space with its high ceilings and comfortable seating."

SURVEY QUESTION: Elements in the new spaces can be used as teaching tools.

When teachers and administrators were asked if they think elements of the new spaces can be used as teaching tools (e.g. creating lessons about colors, shapes, patterns, materials, design, and structure), 93% of teachers agreed. Administrator responses were 83% positive. One fifth grade student said, "I can learn so much in the new spaces.

I like to observe how things are made or designed or painted."

c. Biophilic Design Features

When surveyed about BRES' new biophilic design elements, students, parents, teachers, and administrators reported at very high levels that these elements significantly enhance the learning environment, improve student performance and well-being, and boost engagement and enthusiasm.

i. Natural Light

SURVEY QUESTION: The open spaces with natural light contribute positively to the school environment.

Survey results revealed that 95% of students and 100% of the parents, teachers, and administrators believe the open spaces with natural light contribute positively to the learning environment. In surveys and interviews, respondents highlighted improved natural lighting for creating a bright, uplifting atmosphere that promotes happiness, a sense of calm, and better concentration.

Students often mentioned natural light as one of their favorite aspects of the new space. One fifth grader said, "I like how we can get more natural light and vitamin D, so when we are learning it is healthier." Another student said, "I love the sunlight shining through the windows, and it makes me feel calm and relaxed." A third grader said, "I like the library now because the light can come in." A parent said, "I love and appreciate the natural light and the openness, and how it feels like we are bringing the outdoors inside." During an interview, the PTO President said, "Being in the new spaces is the highlight of the day for these children, they absolutely love it as you can tell by the smiles on their faces. For example, the library is still a library. It has books, but it's such a different place—it's so much lighter and so much happier. Whenever I go in there, I'm so much happier and lighter too; it's just more inviting." A teaching coach said, "The amount of natural light and 'letting the outside world in' is positive for students and enhances the learning environment. During an interview, the Learning Coach said, "What I love about this space is, first and foremost, the natural light and bringing nature in. I know that we have a lot of naturalistic learners. In the collaboration space and in the media center are these wonderful color tiles throughout the windows which create this mosaic or stained glass effect on the carpet all throughout the day. You can never come into either of those two spaces during the day and see the same thing. With the beautiful lighting, it just constantly changes all throughout the day, which is a fun surprise for the children as well. It's bringing outdoor beauty into an enclosed space."

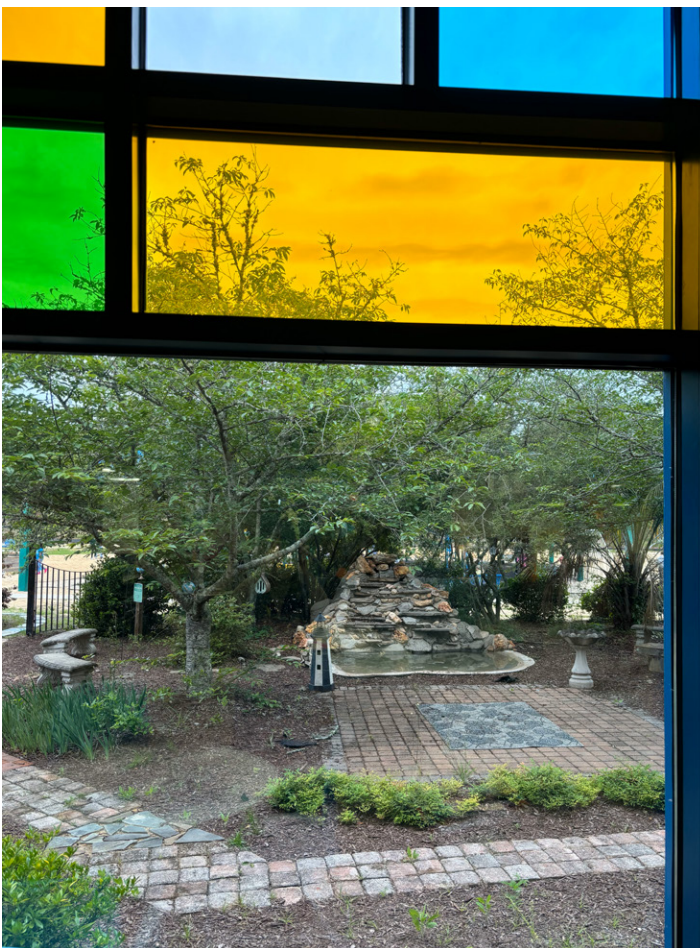


Image 7: View from media center to outdoor garden

ii. Connection to Nature

SURVEY QUESTION: The added views to nature enhance enthusiasm and engagement.

Survey results revealed that 100% of parents, teachers, and administrators responded that adding views to nature enhances enthusiasm and engagement. When students were asked if they liked being able to see the gardens outside the media center through the windows, 95% responded positively. One third grade student said, "I feel more connected to nature because of the big windows, and it makes me feel like I'm outside all the time. I like how they added stained glass. I feel like nature is all around me." A fifth grader commented, "Before the renovation, there were tiny windows where you could only see a little bit. Now the room is designed with light and beautiful colors and it helps me feel like I am outside, but also inside which is very nice. I love looking out the windows at the garden and the waterfall. Being in there helps me learn better because I feel calm, and peaceful." One teacher described that the new design has been wonderful and calming for children including the colors, the light coming in through the stained glass, and the ability to see the waterfall feature from the media center windows. "This connection to nature and the natural light help them center and focus on what they are doing."

iii. Outdoor Learning Space

SURVEY QUESTION: The new outdoor learning area contributes to a positive learning environment.

Survey results revealed that 88% of students like learning in the new outdoor space, and 92% of parents, 100% of teachers, and 83% of administrators said that the outdoor learning area contributes to a positive learning environment. Students said that they enjoy and have fun being in the outdoor space to learn, spend time with friends, and do activities. A fourth-

Survey results revealed that 100% of the parents, teachers, and administrators think the open spaces with natural light contribute positively to the learning environment and that adding views to nature enhances enthusiasm and engagement.

"What I love about this space is, first and foremost, the natural light and bringing nature in. I know that we have a lot of naturalistic learners. In the collaboration space and in the media center are these wonderful color tiles throughout the windows which create this mosaic or stained glass effect on the carpet all throughout the day. You can never come into either of those two spaces during the day and see the same thing. With the beautiful lighting, it just constantly changes all throughout the day, which is a fun surprise for the children as well. It's bringing outdoor beauty into an enclosed space."

- BRES Learning Coach



"We love the outdoor learning space. The children love it and it changes the way they think about learning"

- Teacher

Image 8: Outdoor Learning Space with shade structure reminiscent of beach hut



Image 9: Seagull-shaped light fixtures

"I walk into the media center, look up, and can not believe how beautiful it is to see the lights are shaped like birds. There is nothing random in here." – BRES Assistant Principal

grade student said, "I like the outside area because we learn math there sometimes, and the sunlight is cool looking on you when you sit down." A third-grade student said, "I'm very excited to go to the new outdoor space because sometimes we need a little more time outside in the middle of the day, and then sometimes we can go and do experiments out there." One parent said that they appreciate the outdoor spaces to explore and do science, "because children don't get outside much anymore unless we take them."

A teacher stated that the outdoor space is one of the new places she likes best, "It makes an everyday skill,

such as reading with a partner, into an adventure and this heightens enthusiasm for learning." Another said the outdoor learning space provides fresh air and different scenery, which promote learning. During interviews, a teacher commented, "We love the outdoor space. The children love it and it changes the way they think about learning. Some of our children are what we used to call nature smart, and being outside and being in the open air has made a change, and they take it seriously."

iv. Nature References

SURVEY QUESTION: Connections to nature in the newly designed spaces contribute positively to the learning environment.

When asked during the interview whether the connections to nature improve the learning environment, the assistant principal said, "We love and appreciate the 'all things nature' design. We are a Lighthouse School, and so all things ocean, all things beach. We often say that the images of waves on the collaboration space glass are our waves, and in the media center we have birds. I walk into the media center, look up, and could not believe how beautiful it is to see the lights are shaped like birds. There is nothing random in here."

During interviews, a third-grade student said, "One important thing that connects me to nature is these lights in the library that look like seagulls right when you walk in. In the makerspace, we have these lights on the ceiling that look like honeycombs that remind me that we are creative like the pattern of honeycombs. I always just look up and then I get little sparks of creativity."

Fourth Grade Student



"I like to make friends, so I get to meet a lot more people in the new spaces. I feel happier now that the school is very bright and colorful. I see almost all of my favorite colors in these rooms like cyan. I really like the waves on the window because we're Bookman Beacons and because a lighthouse is surrounded by the ocean. So it reminds me of the ocean, even the way there are curves in the wall. Yeah. I really like all the colors, shapes, everything."

– Fourth Grade Student

d. Student-Centered Design

i. Choice and Instructional Variety

SURVEY QUESTION: Students benefit from having more choices about where and how they learn.

When surveyed and interviewed about BRES' new student-centered learning features, students, parents, teachers and administrators overwhelmingly agreed that the variety and flexibility of the new instructional spaces improves student success, engagement, agency, and enthusiasm. All groups note that the new spaces are beneficial and effective, offering opportunities to collaborate, create, and choose a variety of learning settings for individual and group work.

When asked if students benefit from having more choices about how and where they learn, 96% of students, 100% of parents, 93% of teachers, and 100% administrators agree that they do. Students reported having more options to explore, learn, and connect than they did before. When asked how they benefit by having more choices about how and where they learn, student responses mostly highlighted having greater opportunities to learn in new areas, learn different things, learn in new ways, and work with different people. One student said, "the collaboration space helps me put my creativity and my friends' creativity together. And, it's really fun to have this beautiful media center to have some peace and quiet time while I finish my test."

One parent commented "it's wonderful that students can change their surroundings and this really encourages them to learn differently and retain what they're learning."

In an interview, the PTO President described that the makerspace supports science instruction and project

making, including crafting carnival style games out of cardboard boxes. "Previously, we didn't have the space for them to be creative. Now we have spaces for thinking outside the box, to create, and to do what children are supposed to. These spaces are giving them new ways to learn. They are excited and energized."

When asked how having a variety of learning spaces and options benefits students, teachers placed high value on having a variety of ample spaces, opportunities to make choices, opportunities to collaborate, socialize, and learn from other students, and chances to move and change to address different learning needs and to rejuvenate throughout the day. One teacher commented, "I particularly enjoy the diverse learning experiences which improve student engagement." One teacher appreciates the "opportunities for novelty by changing up their everyday routines. For example, students might choose to read independently, or with their book buddies in a new space with seating of their choice." Another stated, "Our phenomenal makerspace fosters creativity in a manner that we have never been able to harness before because it's a space made just for that purpose." A teaching coach added, "One neat example of learning in the collaboration space is seeing 80 children with chess mats all in front of them and learning as if in a chess competition. While most enjoy the long sightlines and open entry from the hall into the collaboration space, a couple of teachers noted that a downside is that the noise from passersby is sometimes distracting."

Teacher and administrator interviews highlight the importance of student-centered learning. A kindergarten teacher said, "Different children need different things. We have to figure out how they learn best and what's going to

Third Grade Student

"Students feel happier. The new spaces connect me to that Beacon because they are bright, and colorful, and make me feel at home. And I feel like I am changing the world in some way."

- Third Grade Student

"We love and appreciate the 'all things nature' design. We are a Lighthouse School, and so all things ocean, all things beach. We often say that the images of waves on the collaboration space glass are our waves..."

- BRES Assistant Principal



“Previously, we didn’t have the space for them to be creative. Now we have spaces for thinking outside the box, to create, and to do what children are supposed to. These spaces are giving them new ways to learn. They are excited and energized.”

– BRES PTO President

“I would say we don’t have to offer too many behavior corrections because the students are really enjoying the space. A fifth grader who often has challenging behaviors with us is now like a perfect child when he can come into this space and use the Legos or puzzles or games. I was surprised that he created an entire McDonald’s restaurant with the drive-thru the other day while waiting for his class to finish testing.”

– Media Specialist

work for them. The choices they can make in these spaces help us get to know how they learn. The children love the flexibility, especially when they get to choose how they’re going to arrange themselves.”

A media specialist said, “Students love the media center and makerspace. One of their favorite activities is having the freedom to create their own designs. A first grader made a little boy in a wheelchair out of blocks.” The assistant principal said, “Learning doesn’t have to take place only in a classroom. It can take place in different environments. We can now offer the variety of learning spaces that help students who learn differently, and that boosts confidence. In the makerspace and media center students can build and display their work. Students are super excited about all of the new spaces.”

ii. Flexibility

SURVEY QUESTION: The use of flexible seating contributes to a positive learning environment.

When asked whether the use of flexible seating that allows students to work in different postures and configurations contributes to a positive learning environment by supporting physical needs and promoting student engagement, 100% of parents, 93% of teachers, and 100% of administrators agree that it does. When asked to describe benefits, the most common answers were



“My friends love to sit on every single chair and take in the different furniture and the views. They are all very beautiful.” – Fifth Grade Student

Image 10: Media Center with a variety of flexible furnishings

improved comfort, better addressing student needs, better accommodating instructional variety, and increasing student agency. One teacher noted, "The variety of seating is inviting to students and makes a variety of collaboration options for seating (floor, chairs, stools, etc.)." The media specialist observed, "They love the furniture and the shapes of the tables. It has a modern look to it, but it also gives them the ease of working in collaborative groups."

In an interview, a student said, "I love the different furniture. I love to sit at different places at every time just to see what it's like to be in that space or what each chair feels like. It's a lot of fun and me and my friends love to sit on every single one and take in the different furniture and the views. They're all very beautiful. I'm glad the Beacons after me can enjoy all of this that I got to enjoy as a fifth grader." The principal said, "One of the areas that we are particularly fond of is the collaboration space. It allows students to work with large groups or small groups because of the novelty, flexibility, and variety of seating options. Our tables and chairs the media center and collaboration space can transfer from one space to another." The Teaching and Learning Coach said, "I love that we have the flexible seating here because we know that choice really helps students learn and engage better because they have more buy-in as to what they're learning. They can choose what fits their environment, their needs, and their learning style the best."

e. Well-being and Sense of Belonging

SURVEY QUESTION: The new learning spaces have a positive effect on well-being.

Survey and interview questions related to well-being show that all groups show high levels of agreement that the renovations have improved student well-being.

i. Students

SURVEY QUESTION: Describe how you feel in the new spaces.

One survey question asked students how they feel in the new spaces. The most frequently reported answers were comfortable, happy, relaxed and curious, followed by motivated, included, and enthusiastic.

SURVEY QUESTION: I enjoy learning with friends in the new spaces.

When asked whether students enjoy learning with friends in the new spaces, 96% responded that they do.

During an interview, a fourth-grade student described how the new spaces improve her learning and social experiences, "In the new spaces, we can talk to each other.

"The children are much, much, much happier in general. When you see them walking down the hall and you see the smiles on their faces, you know that being in the new spaces is almost like going to recess, which is the holy grail for students."

- PTO President

"The opportunities supported by these new renovations have helped to improve and enhance students' learning and well-being."

- BRES Teacher

"We haven't seen tons of behavior issues, and I think that having these spaces suggests a higher level of engagement when it comes to our students working with each other and being able to navigate what it looks like to collaborate. The students' confidence in themselves has increased and their learning abilities have improved."

- BRES Assistant Principal

Dr. LaChe Sumpter, BRES Assistant Principal



We can relax and do so much more. I'm excited about chess and what we are learning every time we come in here. We can learn about each other and life skills. We live together at school, we have fun, mostly communicate so we can learn how to work together. It's important that you learn with everyone so you can know them better. And so you can help them. If you stay with the same person for too long, you'll just know the same thing every day. Now I can stick with other people and make different choices."

SURVEY QUESTION: What are some of your favorite things about the new spaces?

When students were asked about some of their favorite things about the new spaces they highlighted having more room to move around and be active, seeing and meeting new people, making new friends, and being able to have fun and learn at the same time, and design reminders of being Bookman Beacons.

During student interviews, it was evident that students place a high value on features providing a sense of place and purpose as the Beacons. One third-grader explained, "Students feel happier. The Beacon is our school mascot. We are Beacons to light the way in personal character, academics, and community service. When we read the quotes on the walls and see the images about being a Beacon, it helps us know that we are helping the world and we are shining a light on people. The new spaces connect me to that Beacon because they are bright, and colorful, and make me feel at home. And I feel like I am changing the world in some way."

One fourth-grader commented, "I like new spaces because I am very curious. I would describe these spaces as calming,

relaxing, and peaceful." Another said, "They make me feel more comfortable and I like new things." A fifth-grader explains, "I like having more freedom than just staying in the classroom. The greatest reason is being able to relax and have fun, while still learning."

During interviews, a fourth grader said, "I like to make friends, so I get to meet a lot more people in the new spaces. I feel happier now that the school is very bright and colorful. I see almost all of my favorite colors in these rooms like cyan. I really like the waves on the window because we're Bookman Beacons and because a lighthouse is surrounded by the ocean. So it reminds me of the ocean, even the way there are curves in the wall. Yeah. I really like all the colors, shapes, everything."

ii. Parents

Parents call the new spaces beautiful, welcoming and inviting. One said, "I love the color scheme and the design elements." During interviews, when asked about how the new spaces affect moods, attitudes, and well-being, the PTO President observed, "The parents notice that everyone's happy. The children are much, much, much happier in general. When you see them walking down the hall and you see the smiles on their faces, you know that being in the new spaces is almost like going to recess, which is the holy grail for students. These fantastic spaces allow students to gather, engage, and just breathe."

iii. Teachers

Teachers mentioned that the students seem to "perk up" when they are in new spaces and enjoy their classes in them. One teacher comment is representative of

Kim Kuhn, BRES Teacher (Kindergarten)



"Different children need different things. We have to figure out how they learn best and what's going to work for them. The choices they can make in these spaces help us get to how they learn. The children love the flexibility, especially when they get to choose how they're going to arrange themselves."

– Kindergarten Teacher

When surveyed and interviewed about BRES' new student-centered learning features, all groups overwhelmingly agreed that the variety and flexibility of the new instructional spaces improves student success, engagement, agency, and enthusiasm.

the perceptions of many, “The opportunities supported by these new renovations have helped to improve and enhance students’ learning and well-being.”

The Media Specialist commented, “I would say we don’t have to offer too many behavior corrections because the students are really enjoying the space. A fifth grader who often has challenging behaviors with us is now like a perfect child when he can come into this space and use the Legos or puzzles or games. I was surprised that he created an entire McDonald’s restaurant with the drive-thru the other day while waiting for his class to finish testing.”

iv. Administrators

The assistant principal holds that student behaviors and the social and emotional connections in the school have improved due to being able to work in the new spaces with other students. She explained, “We haven’t seen tons of behavior issues, and I think that having these spaces suggests a higher level of engagement when it comes to our students working with each other and being able to navigate what it looks like to collaborate. The students’ confidence in themselves has increased and their learning abilities have improved. Working with peers outside your classroom and of different ages gives a level of confidence to some students as well, where they can mix and mingle, and collaborate with their peers on other grade levels.” The assistant principal also noted, “Our students actually notice the design details in the new spaces.”

f. State and District-Level Data Results

Each fall and spring, RSD2 administers Measures of Academic Progress (MAP) testing to assess reading and math performance in students in grades two through five. MAP tests are Northwest Evaluation Association’s (NWEA) nationally norm-referenced tests that are measurements of student school year achievement growth. The median student achievement growth is reported.

We compared BRES median student achievement growth the year prior to the renovation with the median achievement growth after a year of learning in the newly renovated school. Prior to the renovation, BRES reading growth was at the 39th percentile. Post renovation, BRES caught up to the national median at the 50th percentile,

an exceptional increase in the median growth percentile of 11. Math performance was even more impressive. Median math growth rose from the 30th percentile pre-renovation to the 47th percentile post-renovation, an increase in the median growth percentile of 17. (See Table 1) BRES was the only elementary school of the 24 in the district to achieve an excellent overall rating on the State Report Card, with student progress also receiving an excellent rating. (See Appendix Figure 3).

According to NWEA’s latest Advancing Learning Outcomes for all Kids report, “findings for the 2023–24 school year largely mirror what we reported at the end of 2022–23: growth continues to fall short of pre-pandemic trends in most grades.” The BRES reading and math MAP scores are impressive, especially in this context.

Will Anderson, RSD2’s chief operations officer said, “I cannot overstate the importance of investing in research-driven design to help improve student achievement and well-being. The example of a recent renovation at BRES, focusing on learning spaces, affirms through assessment data that the facility itself makes a tremendous difference in how students feel, learn, and perform. As compared to pre-renovation data, after one year in the renovated building which features student-centered and biophilic designs, we see striking achievement growth, and compelling improvements in student, teacher and parent enthusiasm and engagement.”

The School Climate Survey is part of the South Carolina State Report Card, and it measures satisfaction with the learning environment, satisfaction with the social and physical environment and satisfaction with school/home relations. Comparing student perceptions of school climate before the renovations with those after one year in the newly renovated school, student perceptions improved in all three categories.

Improvement in student perceptions about the learning environment include: classes are challenging and make them think (8.25% improvement), the teachers help them learn (4.77% improvement), that the media center provides helpful resources (6.47% improvement), they are satisfied with the learning environment (1.98% improvement), and that there is enough room to learn (1.68% improvement).

NWEA MAP TEST RESULTS						
	2023		2024		Improvement	
	Reading	Math	Reading	Math	Reading	Math
Fall to Spring Growth Percentile	39	30	50	47	11	17

Table 1: BRES NWEA MAP Testing Results

"I cannot overstate the importance of investing in research-driven design to help improve student achievement and well-being. The example of a recent renovation at BRES, focusing on learning spaces, affirms through assessment data that the facility itself makes a tremendous difference in how students feel, learn, and perform. As compared to pre-renovation data, after one year in the renovated building which features student-centered and biophilic designs, we see striking achievement growth, and compelling improvements in student, teacher and parent enthusiasm and engagement."

- Will Anderson, Chief Operations Officer
Richland School District Two

Improvements in student perceptions about student behavior and the social environment

include: students behave well in class (4.70% improvement), I have seen or know of a student being bullied at school (4.38% improvement), I have been bullied at school (1.43% improvement), and I have bullied someone at my school (4.97% improvement).

Improvements to student perceptions about parent involvement

include: my parent knows how well I'm doing at school (1.48% improvement), my school is welcoming to parents (2.42% improvement), and parents volunteer, participate, and help support the school community (6.94% improvement) (see Figure 1 and Appendix Table 3).

The South Carolina Climate Survey also measures teacher satisfaction with the learning environment, social and physical environment, and school/home relations. Comparing teacher perceptions of school

**South Carolina Climate Survey Student Results
2023-24 versus 2022-23**

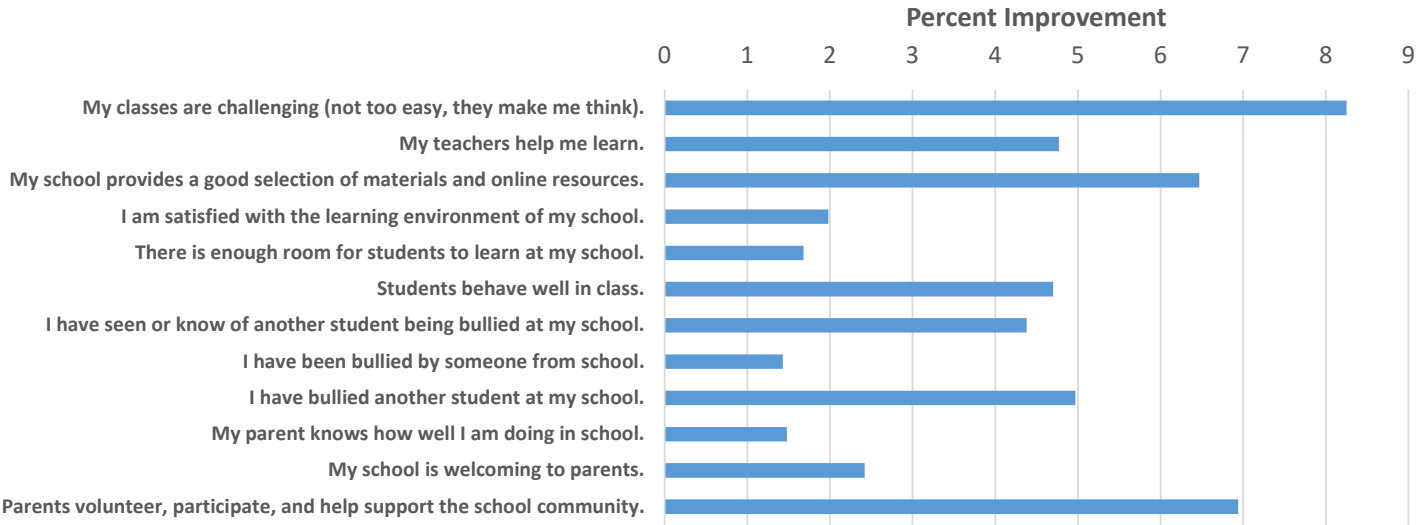


Figure 1: South Carolina Climate Survey – BRES Student Results

**South Carolina Climate Survey Teacher Results
2023-24 versus 2022-23**



Figure 2: South Carolina Climate Survey – BRES Teacher Results

climate after one year learning in the newly renovated school to their perceptions before the renovations, perceptions improved in all three categories.

According to the South Carolina Teacher (SCT) Teacher Retention Overview (Feb. 2024), schools reporting higher levels of satisfaction with the learning environment and with the social and physical environment have higher retention rates. Satisfaction with the learning environment increased from 97.5 to 100%, satisfaction with the social and physical environment increased from 97.4 to 100%, and satisfaction with school/home relations increased from 97.5% to 100%. The survey questions are aggregated within the categories in Figure 2 and Appendix Table 4.

We would like to have examined student English language arts and math performance from 2022–23 to 2023–24 using South Carolina Ready test results. However, testing modalities changed from pen and paper to online during that time. Consistent with typical results from such a change, scores district-wide dropped significantly and were deemed to not provide meaningful comparisons.

VII. CONCLUSION

By combining biophilic and student-centered designs, the newly renovated learning spaces at Bookman Road Elementary School successfully achieved the goals of facilitating improvements in the teaching and learning environment and in the well-being of students.

The biophilic features, including views to nature and opportunities for outdoor learning, natural and dynamic lighting, large open spaces, and the use of shapes, patterns, and colors found in nature are particularly effective. These elements enhanced student engagement and well-being and helped create a sense of wonder.

Student-centered design features replaced traditional learning spaces with a rich variety of instructional spaces to include large and small collaboration spaces that promote indoor and outdoor learning, an updated media center connected to those spaces and to nature, and flexible layouts. These changes promote choice in teaching and learning approaches and environments, support students with different learning needs and styles, and foster a more engaging and inclusive educational experience.

The notable improvements in school climate and academic performance further highlight the design's effectiveness. It is worth noting that while the surveys and interviews attempt to isolate the contributions of the design elements, the effects of these elements occur within a school community working diligently to provide an excellent educational experience. There was no change to school size or the attendance zone, to school leadership, or the HET instructional program. BRES, already performing at a high level, improved significantly by modifying learning spaces.

When educators are asked to identify interventions that will improve learning, they rarely identify improvements to the built environment. The renovation at BRES demonstrates the important role school design can play in elevating the educational experience. This case study offers important insights for other school districts and architects as they prioritize the types of renovations and designs that will have the greatest impact on student success and well-being. The thoughtful combination of biophilic and student-centered designs can significantly enhance teacher satisfaction and instructional innovation, student learning, enthusiasm, engagement and agency, and a sense of belonging for students and their families. ■

Student and teacher perceptions improved in all three categories of the SC Climate Survey: satisfaction with the learning environment, satisfaction with the social and physical environment and satisfaction with school/home relations.

By combining biophilic and student-centered designs, the newly renovated learning spaces at Bookman Road Elementary School successfully achieved the goals of facilitating improvements in the teaching and learning environment and in the well-being of students.

The thoughtful combination of biophilic and student-centered designs can significantly enhance teacher satisfaction and instructional innovation, student learning, enthusiasm, engagement and agency, and a sense of belonging for students and their families.

VIII. APPENDIX

BRES SURVEY RESPONSES PERCENT AGREEMENT

STUDENTS % AGREEMENT	PARENTS % AGREEMENT	TEACHERS % AGREEMENT	ADMINISTRATORS % AGREEMENT
	Design of the new spaces improves learning		
97%	96%	100%	100%
	Views to nature improve learning		
95%	100%	100%	100%
	Natural light and open spaces improve the learning environment		
95%	100%	100%	100%
	Colors in the new spaces have a positive effect on the learning environment		
97%	96%	93%	100%
	Choices about where and how to learn improve the learning experience		
96%	100%	93%	100%
	Outdoor learning improves the learning experience		
88%	92%	100%	83%
	Students enjoy learning with friends in the new spaces		
96%			
	Flexible seating improves health and engagement		
	100%	93%	100%
	The new design fosters wonder and curiosity		
	96%	100%	100%
	The new spaces support a range of teaching approaches		
	100%	100%	100%
	The new spaces foster teaching innovation		
		93%	100%
	Building design elements can be used as teaching tools		
		93%	83%

Table 2 – Survey Response Percent Agreement

STUDENT SC CLIMATE SURVEY RESULTS

Question	2022-23 % AGREE	2023-24 % AGREE	% Improvement
My classes are challenging (not too easy, they make me think).	42.90	51.15	8.25
My teachers help me learn.	68.50	73.27	4.77
My school provides a good selection of reading materials and online resources.	64.50	70.97	6.47
I am satisfied with the learning environment of my school.	63.00	64.98	1.98
There is enough room for students to learn at my school.	76.20	77.88	1.68
Students behave well in class.	29.40	34.10	4.70
I have seen or know of another student being bullied at my school.	26.50	22.12	4.38
I have been bullied by someone from school.	19.40	17.97	1.43
I have bullied another student at my school.	8.20	3.23	4.97
My parent knows how well I am doing in school.	74.10	75.58	1.48
My school is welcoming to parents.	77.30	79.72	2.42
Parents volunteer, participate, and help support the school community.	71.40	78.34	6.94

Table 3 – South Carolina Climate Survey Results – Students

TEACHER SC CLIMATE SURVEY RESULTS

Question Category	2022-23 % AGREE	2023-24 % AGREE
Satisfaction with the learning environment.	97.50	100.00
Satisfaction with the social and physical environment.	97.40	100.00
Satisfaction with school/home relations.	97.50	100.00

Table 4 – South Carolina Climate Survey Results – Teachers

State Data – Report Card



Bookman Road Elementary School

2023-2024 Overall Rating

Excellent
62

School performance substantially exceeds the criteria to ensure all students meet the Profile of the SC Graduate



**Academic
Achievement**

Good



School Climate

Good



Student Progress

Excellent

Figure 3 – SC School Report Card, Bookman Road Elementary School 2023–2024

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