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Evaluating the Influence of Sustainable Design within the School Community: A Comprehensive Analysis

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Abstract:- This research examines the sustainability needs of Hamad Town Secondary Girls' School, offering a comprehensive analysis of economic, environmental, acoustic, and social aspects within Bahrain's educational built environments. Using qualitative methods like literature, observations, interviews, and an online survey, the study identifies critical deficiencies, including maintenance issues, environmental challenges, and inadequate facilities for students with disabilities. Proposed improvements target resilient maintenance, enhanced cooling, and inclusive infrastructure. Key findings emphasize the urgency of sustainable interventions in the school environment, aligning with broader educational quality goals and sustainability vision of Kingdom of Bahrain.

Keywords*: Educational Environment, School, Sustainable Design, Sustainability.*

1. Introduction

In the pursuit of progress, communities worldwide are recognizing the imperative of sustainable development, echoing the sentiments articulated in the 1978 Brundtland Report by the United Nations. This seminal document underscores sustainable development as the pursuit of social, economic, and political paths that meet the needs of the present without compromising the ability of future generations to meet their own needs (Buns, K & Henze, G & Tiller, D, 2006). Sustainability, as a concept, extends beyond environmental considerations to encompass the broader notion of enhancing the quality of spaces within evolving knowledge-based societies. Within this context, schools emerge as crucial foundations for community growth and development.

The United Nations' sustainable development goals set the stage for a holistic understanding of sustainability, with considerations spanning environmental, social, and economic dimensions (UN, 2023). Schools, being central to the fabric of communities, play a pivotal role in shaping and reflecting these dimensions. As knowledge-based societies evolve, the significance of schools in fostering sustainability becomes even more pronounced.

The educational landscape in Bahrain aligns with the Ministry of Education's renewed vision spanning from 2023 to 2026. This vision, encapsulated in four values—Excellence, Equality, Belonging, and Teamwork—aligns with the country's broader sustainability development goals in collaboration with UNESCO (MOE, 2023). However, the approximately 210 public school buildings across Bahrain, ranging from old to new (BNA, 2022), pose challenges in consistent implementation. This research delves into the sustainability needs of the educational environment, focusing on Hamad Town Secondary Girls' School as a case study.

Hamad Town Secondary Girls' School, founded in 1990, offers a unique lens into the evolution of educational facilities. It has navigated the shifts in educational paradigms, serving as a significant secondary level institution. Despite its age, the school remains a substantial educational center with around 1100 students, positioning it as an exemplar for older educational buildings striving to align with the country's contemporary sustainability vision.

The school's journey mirrors the broader narrative of old school buildings adapting to sustainability principles introduced after their construction. The transformative efforts undertaken by the school administration provide valuable insights into the challenges and opportunities associated with harmonizing older educational infrastructure with modern sustainability standards.

Qualitative Methods were utilized through a combination of literature analysis, direct observations, interviews and surveys that were employed to comprehensively measure and study the sustainability needs of Hamad Town Secondary Girls' School. The goal was to gain a profound understanding of how design solutions can be leveraged to enhance sustainability and, consequently, the overall quality of the educational environment. This approach aligns with the Ministry of Education's vision and contributes to the broader sustainability objectives of Bahrain.

This research aims to contribute valuable insights that can foster positive change and advancements in existing and future schools in line with Zifferblat's assertion that the environment significantly influences behaviors and perceptions (Zifferblat, S, 1972), through the objectives of observing and measuring the current applications of sustainable practices within existing schools in Bahrain and the way they're being utilized to enhance the quality of place within those buildings.

2. Literature Review

The built environment of educational institutions, particularly schools, carries significant responsibility for the well-being and functionality of its diverse user groups, including teachers, administrative staff, and students. As sustainability gains global recognition, researchers and specialists are increasingly exploring its impact on educational system development and efficacy (Mihăescu, O 2020).

The application of sustainability principles in the design of educational institutions often leads to the classification of such schools as "sustainable schools." However, the absence of a widely accepted definition for the characteristics of these schools poses a challenge (Chansomsak & Vale, 2010). Nonetheless, key elements of school sustainability can be discerned and categorized into three main areas: environmental sustainability, acoustic performance, and economic sustainability (Levengood, M 2017).

A. Environmental sustainability

Environmental sustainability in schools emerges as a critical factor influencing both the planet's well-being and the well-being of school users. This impact extends to reducing absentee rates, influencing student and teacher behaviors, and enhancing concentration levels, thereby positively affecting the efficiency of the teaching process and students' test results (Levengood, 2017).

Within the realm of environmental sustainability, natural lighting stands out as a crucial element due to its proven ability to enhance productivity levels, mental well-being, and overall performance (Levengood, 2017). Despite advancements in lighting technology, natural lighting remains unparalleled. A study on 'Daylighting and Human Performance' revealed that students in classrooms with abundant natural lighting exhibited faster progress in math and reading tests (Heschong, 2002). However, challenges arise, as observed in the same study, when skylights negatively impact student performance due to a lack of control over daylight levels.

Secondly, air quality which can be linked to school environments through the importance of proper ventilation, natural ventilation and mechanical ventilation systems if used improperly can lead to asthma attacks and stimulates allergies in the form of irritated eyes, nose and throat, upper respiratory infections, dizziness, headaches, and fatigue (Levengood, M 2017).

These factors collectively can result in the designation of the building or space as having "sick building syndrome", which is a term used by EPA to describe "situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but no specific illness or cause can be identified." (EPA, 1992).

Air quality emerges as a concern to educational buildings due to the negative effects of bad air quality on the occupants' health, which increases the spread of infection, allergies and consequently increases absenteeism (Levengood, M 2017).

ASHRAE (The American Society of Heating, Refrigerating and Air-Conditioning Engineers) have set rates of ventilation for indoor air, based on standards such as moisture prevention, outdoor air intake, capture of contaminants and cleaning / maintenance guidelines (Hedrick, n.d.).

Lastly, thermal comfort is an important element to consider within the educational environment. Teachers usually expect to have a form of control over the temperature of the classroom (Schneider, M, 2002), the lack of control over the temperature and other factors could have a negative effect over the efficiency of their teaching process (Levengood, M 2017).

Moreover, studies show that when an individual is presented with the ability to control the temperature of a space in a 5-degree range, it can increase their productivity levels, their wellbeing and comfort. (Levengood, M 2017, as cited in LEED V4, 2013).

B. Acoustic Performance

Considering the classroom as the primary space for educational interactions, acoustic performance becomes paramount. Noise levels within classrooms can profoundly impact students and teachers, influencing their energy levels and attention spans. High noise levels can be distracting, negatively affecting the efficiency of the teaching process (Zannin & Zwirtes, 2008). Teachers' ability to control acoustic conditions is crucial for effective classroom activities.

C. Economic Sustainability

Economic sustainability in school buildings involves fostering environmentally friendly attitudes and providing facilities that encourage sustainable behaviours (Chansomsak & Vale, 2010). However, achieving this concept requires continuous maintenance and development of school buildings to align with evolving strategies and values. Unfortunately, budget cuts pose a significant challenge, leading to facility deterioration, straining user-building connections, and hindering facilities from keeping pace with evolving educational values and strategies.

3. Methodology

Utilizing qualitative research methods helped assess the incorporation and implementation of sustainability principles in the selected school. This methodology was chosen for its capacity to yield an in-depth basis of knowledge appropriate to the research, aiming to establish a strong informational base encompassing the school's structure, overall layout, diverse facilities, and the day-to-day challenges faced by its occupants.

Furthermore, given that the research delves into human needs, behaviors, and attitudes, qualitative research serves as the cornerstone for constructing the research findings. The subsequent methods selected and executed are based on this foundation, ensuring a comprehensive examination of the subject matter.

A. Literature Review

The literature review serves as a foundational step, offering a comprehensive understanding of issues related to school sustainability and the multifaceted factors inherent in the educational environment. This initial exploration guides subsequent data collection methods, directing attention towards the pivotal elements emphasized in the literature.

Within this literature, critical sustainability key elements are identified, laying the groundwork for their coverage, observation, and analysis to determine the extent of sustainable design within the school environment. Noteworthy factors encompass acoustic control, as well as environmental and economic sustainability, as detailed in the literature review.

B. Direct Observation

Conducting observational activities took the form of a visit to the school during a typical school day, allowing for the direct observation of individuals' behavior and attitudes in the space. This immersive approach provided an opportunity to experience the building in person, detecting both its advantages and potential issues within the constructed environment.

On November 16th, 2023, the school's principal, Ms. Naema AlAbdan, graciously welcomed and facilitated the visit. Ms. Layla Husain, an arts teacher at the school, served as the guide, offering detailed explanations of various aspects within each space of the built environment.

The school, consisting of a singular large building shaped like a four-winged fan, features a central courtyard planted with diverse trees and bushes. Classrooms are strategically distributed around the courtyard, with corridors overlooking this green space, fostering a visually pleasing ambiance, and facilitating air circulation.

Furthermore, the school facilitates a backyard utilized for morning lineup activities, sports events, and additional wooden classrooms, including the E-learning classroom. Noteworthy facilities include a spacious sports gymnasium with an integrated stage, faculty car parking, and a library.

C. Interview

Choosing the interview method was deliberate, as its dynamic question-and-answer format facilitates extensive access to participants. This interactive approach, characterized by a back-and-forth dialogue, unlocks valuable insights from participants' perspectives. Open-ended questions were strategically employed to obtain detailed information and enrich the depth of responses.

Ms. Layla Husain willingly participated in the interview, offering a comprehensive description of topics ranging from environmental sustainability (including lighting, air quality, and thermal control) to maintenance concerns. Additionally, the conversation expanded to encompass broader issues within the school community, such as bullying, and the challenges faced by students with learning difficulties and disabilities. This broader exploration underscored the significance of social sustainability in educational environments.

D. Online Survey

Opting for the online survey method was strategic, leveraging its capacity to reach a broader participant base quickly, obtaining a larger sum of responses in a shorter timeframe. This approach enabled a comprehensive exploration of daily challenges within the educational environment, offering diverse perspectives and enabling the formation of a nuanced understanding of the situation.

The survey, constructed on Google Forms, featured 13 questions categorized into three sections. This deliberate structure, encompassing various question types such as closed-ended, multiple-choice, and an open-ended question, aimed to elicit detailed responses while engaging participants in expressing their viewpoints thoroughly.

Each section of the survey was designed to address specific aspects of the research, ensuring organized and clean data collection. This strategic layout guided participants seamlessly, eliminating any ambiguity or confusion in their responses.

The survey provided participants with the opportunity to articulate their experiences fully, fostering diverse perspectives. This approach solidified a foundational dataset, laying the groundwork for thorough analysis and interpretation.

4. Findings

The employed data collection methods offered a comprehensive insight into the present state of older schools in Bahrain, aligning seamlessly with the nation's sustainability vision for 2030. The on-site visit to the school building generated a substantial amount of information, shedding light on the school's current condition, identifying its needs, and highlighting its challenges in integrating sustainable design. The findings underscored the school's struggle to align with the four renewed values of the ministry and, concurrently, the overarching sustainable vision of the country.

A. Economic Sustainability

The observations highlighted a pressing need for comprehensive maintenance at the school, notably evident in the peeling paint finish across multiple areas of the building. Beyond the adverse impact on aesthetic appeal, this condition poses a tangible danger. The airborne particles from peeling paint can infiltrate the respiratory systems of building users, potentially heightening risks of asthma attacks, allergies, and sinus infections (Figure 1).

Furthermore, the maintenance issues extend into the sports gymnasium, where central air conditioners serve as the primary cooling system. The user experience in this space is compromised by the inability to manually control

the temperature, leading to a detectible chill. Additionally, broken air conditioner grills and malfunctioning lights contribute to an environment that falls short of optimal conditions. Moreover, the gymnasium's flooring appeared unclean, with dust particles accumulating conspicuously around its corners.

Figure 1. Peeling paint on the ceiling, dust and dirt accumulated on the ground (Source: Author)

As highlighted during the interview, the maintenance arrangement for the gymnasium typically spans a lengthy period of up to 5 years. This extended timeframe is attributed to the intricate nature of the air conditioning system, compounded by the double height of the space's ceiling (Figure 2). These complexities contribute to inconsistencies in the gymnasium's performance, especially considering its multifunctional use for various school activities like art competitions and theatrical plays. Notably, these events often involve video recordings, necessitating adequate lighting to produce high-quality recordings.

Figure 2. Broken AC grills and non-working lighting, and dirt accumulation on the ground (Source: Author)

The classrooms exhibited various maintenance issues, particularly evident in the hasty and unsafe installation of data show devices. Wires extended from ceiling lights, connected to devices, pose a substantial risk of electrical malfunctions, increasing the potential for fires (figure 3).

Moreover, in the art studio, exposed water pipes (Figure 3) revealed a consequence of the studio's transformation from an ordinary classroom to accommodate the growing student population, as mentioned in the interview (Appendix A). These pipes protrude from the sinks designated for students to clean their brushes and art palettes, leading to frequent blockages. The necessary maintenance and cleaning process typically requires up to 4 days to request, schedule, and complete.

Figure 3. Faulty electrical solutions in the classrooms and exposed water pipes in the art studio (Source: Author)

B. Environmental Sustainability

The school building in Hamad Town, with its round orientation facing all compass directions, encounters a significant environmental challenge. The main entrance faces east, leaving the back side exposed to the main road and westward sun during midday break. This orientation results in extreme heat conditions for students and teachers spending breaks outside, intensified by the lack of shading devices and the completely exposed backyard susceptible to various weather conditions (Figure 4).

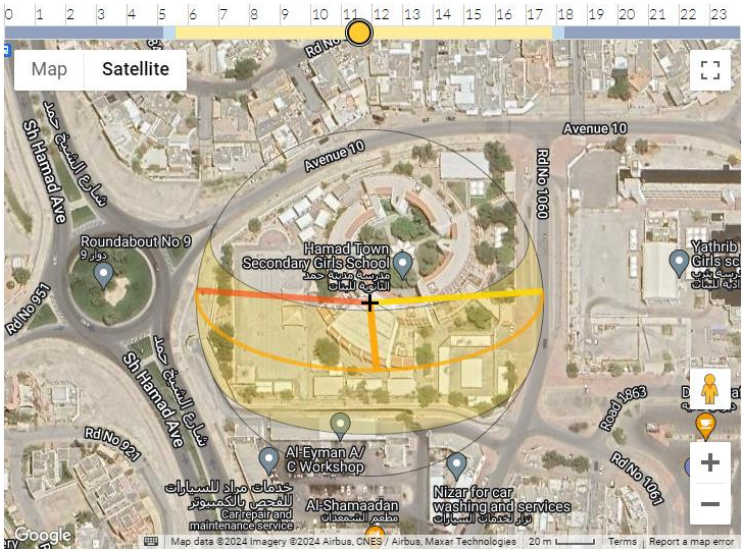

Figure 4. The school's location on the map in accordance with the sun movement during the day (Source: Google Maps).

Furthermore, environmental sustainability is examined through various factors, as outlined in the collected data. Firstly, respondents of the survey (Appendix B) largely indicated their inability to rely solely on natural lighting for classroom activities. However, when combining artificial lighting, the majority affirmed that the lighting is generally sufficient for conducting lessons (Figure 5).

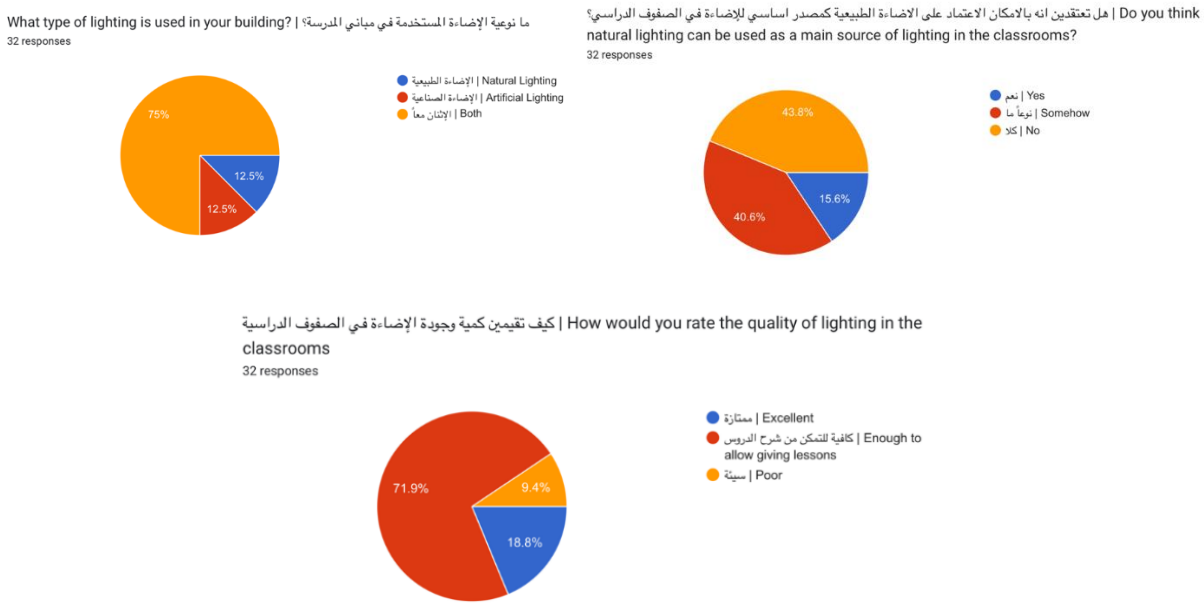

Figure 5. The responses to questions relating to lighting within the school building (Source: Google Forms).

On the other hand, respondents expressed that natural lighting indeed influences their productivity to some extent. Ms. Layla, an arts teacher, elaborated during the interview (Appendix A) on the challenges she faces in controlling natural lighting levels within the studio. The need to keep curtains closed for projector use creates a dark atmosphere affecting both hers and her students' productivity, leading to fatigue and sleepiness.

Secondly, in the thermal control section of the survey (Appendix B), most participants conveyed a lack of control over classroom temperatures, negatively impacting the teaching process (Figure 6). The interview further supported this claim, noting extreme heat, especially in the initial month after summer holidays. Outdated cooling devices, specifically window air conditioners, proved insufficient to effectively cool the classrooms (Figure 7).

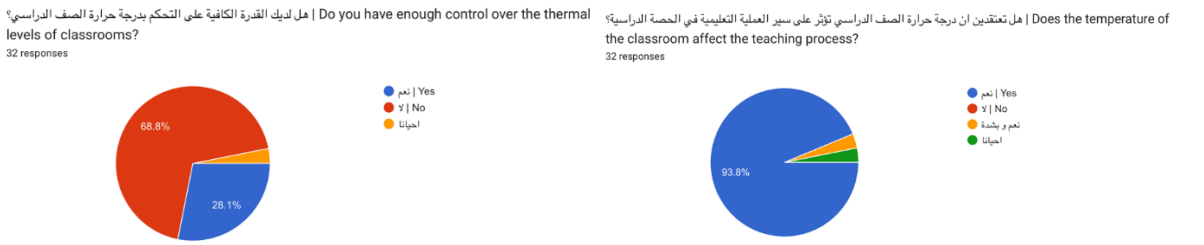

Figure 6. Most participants agreeing to being unable to control the temperature of the classroom, which negatively affects the teaching process (Source: Google Forms).

The interview (Appendix A) delved into the repercussions of high classroom temperatures, highlighting students' complaints and requests to relocate classes, though this provides no relief as the entire school faces the same issue. Additionally, the teacher emphasized how the elevated temperature adversely affects her productivity, especially with the need to move extensively during classes, resulting in thermal discomfort and fatigue.

Figure 7. Window air conditioners are the mainly used cooling system (Source: Author)

Lastly, air quality emerged as another concern within classrooms. In response to an open-ended survey question, nearly 50% of participants cited health issues such as sinus infections, migraines, eczema, and dust allergies, directly linked to poor classroom ventilation. Factors contributing to this include closed windows to prevent hot air seepage and a lack of routine cleaning in the space. Addressing these environmental issues is paramount to fostering a sustainable and healthy learning environment.

Figure 9. Showing the majority labeling the air quality of classrooms as poor or moderate (Source: Google Forms).

C. Acoustic Performance

The survey incorporated a dedicated section aimed at assessing the noise levels and acoustic performance of Hamad Town Secondary Girls' School. Slightly over 50% of respondents expressed contentment with the noise level in classrooms, characterizing it as low and distant.

Nevertheless, certain sources of noise, such as road traffic and other classroom disturbances, still permeate the classrooms, impacting student concentration and hindering the efficiency of class activities. Interestingly, a modest 9% of respondents questioned the role of classroom design and finishing materials in controlling external and internal noises, reflecting a respectable degree of awareness among faculty members.

D. Social Sustainability

During the interview, Ms. Layla voiced significant concerns about the proliferation of bullying within the school, attributing a part of it to the ministry's initiative to integrate students with learning difficulties with their peers. However, due to the disparate pace at which these students grasp and comprehend classroom content, their peers often engage in bullying, fostering a hostile educational environment.

Furthermore, direct observations underscored the school's lack of accommodation for students with disabilities. With only one ramp leading to a dead-end corridor and the absence of elevators, the school faces a substantial challenge in terms of social sustainability.

This issue extends beyond disabled students; a student with a broken leg, for instance, would need to be relocated to a ground-floor classroom or one of the wooden cabins in the school's backyard, as revealed in the interview. If these alternatives prove unsuitable due to differences in level or major, the entire classroom must be shifted, creating a logistical challenge for the administration, and disrupting the academic routine for other students. This situation highlights the urgent need for enhanced social sustainability measures within the school infrastructure.

5. Discussions

The comprehensive analysis of Hamad Town Secondary Girls' School revealed a substantial insufficiency in fundamental sustainable features, directly influencing the overall environmental quality within the building. Introducing minor enhancements across various dimensions of school sustainability holds the potential to significantly improve the facility's overall quality. This transformative approach aims to create a secure and nurturing environment, fostering academic growth and professional development among occupants.

Critical areas requiring immediate attention include the establishment of a more resilient cleaning and maintenance schedule, aligning with advancements in electricity, plumbing, and finishing. Addressing the absence of ramps on the ground floor is imperative, given the numerous steps present around the building.

Moreover, the data highlights the pressing need for an upgraded cooling system, essential for regulating classroom temperatures and facilitating proper ventilation through windows. These proposed improvements are strategically designed to positively impact the overall health and performance of the school environment.

The focus on prioritizing teacher comfort and enhancing student test results through incremental improvements not only benefits the immediate school context but also sets a precedent for more widespread improvements within the educational system. This holistic approach contributes to the elevation of Bahrain's educational quality, fostering prosperity, and catalyzing overall development for society.

A. Limitations

Despite the valuable insights gained from this study, it is essential to acknowledge certain limitations. The study's focus on a single school may limit the generalizability of findings to other educational institutions. Additionally, the inability to include student perspectives poses a limitation, given their ages range between 15 to 17 and basing the study off them would require parental consent. Obtaining parental consent for student participation could prove challenging and not viable. Future research endeavors should consider expanding the sample size to include a more diverse range of schools and overcoming the challenges associated with involving students.

B. Future Implications

This research lays the groundwork for future implications and avenues of exploration. Subsequent studies could delve into the specific impact of sustainable enhancements on academic performance, teacher satisfaction, and overall student well-being. Comparative analyses involving multiple schools (locally and regionally) could offer a broader understanding of the effectiveness of sustainable interventions in various educational settings. Additionally, longitudinal studies tracking the implementation and outcomes of sustainable improvements could provide insights into the long-term benefits and challenges faced by educational institutions pursuing environmentally conscious practices. Such endeavors would contribute to the continual enhancement of educational environments and the advancement of sustainable practices in educational settings.

6. Conclusion

In conclusion, the thorough examination of Hamad Town Secondary Girls' School has shed light on critical aspects of its built environment, revealing both strengths and significant deficiencies in terms of sustainability. The responsibility of educational institutions, particularly schools, extends beyond academic facilitation to encompass the well-being and functionality of diverse user groups, including teachers, administrative staff, and students. As

sustainability garners global recognition, its impact on educational system development and efficacy becomes an increasingly pertinent area of exploration.

The application of sustainability principles in school design often leads to the categorization of these institutions as "sustainable schools." However, the absence of a universally accepted definition for these schools presents a challenge, prompting a closer examination of key elements within three primary categories: environmental sustainability, acoustic performance, and economic sustainability.

The methodology employed, combining qualitative research, direct observation, interviews, and an online survey, facilitated a comprehensive exploration of the subject matter. The findings unveiled a host of challenges, emphasizing the urgent need for sustainable enhancements to the school's built environment.

Within the realm of environmental sustainability, the study revealed the critical influence of natural lighting on reducing absentee rates, influencing behaviors, and enhancing concentration levels. However, challenges arise, as observed in issues related to the lack of control over daylight levels. Additionally, air quality emerged as a significant concern, with adverse effects on health and increased absenteeism. The importance of maintaining proper ventilation, adhering to ASHRAE standards, and ensuring thermal comfort became evident in creating a conducive learning environment.

Acoustic performance in classrooms surfaced as a paramount factor, impacting both students and teachers. Despite a majority expressing contentment with noise levels, challenges from external sources persist, affecting concentration and teaching efficiency. Economic sustainability, encompassing the fostering of environmentally friendly attitudes and providing facilities for sustainable behaviors, faces hurdles due to budget cuts, leading to facility deterioration and hindering alignment with evolving educational values.

Addressing economic sustainability concerns requires immediate attention to maintenance issues, particularly those posing risks such as peeling paint and unsafe electrical installations. Environmental sustainability improvements should encompass adjustments to the school's orientation, consideration for natural lighting impacts on productivity, and the implementation of effective thermal control measures. Enhancing acoustic performance involves mitigating external noise sources and empowering teachers with control over classroom conditions. Social sustainability calls for urgent measures to accommodate students with disabilities, addressing concerns related to bullying and facilitating a more inclusive educational environment.

Proposed improvements, ranging from a resilient maintenance schedule to enhanced cooling systems, aim to significantly improve the overall quality of the facility. Prioritizing teacher comfort and improving student test results through incremental enhancements not only benefits the immediate school context but also sets a precedent for broader improvements within the educational system. This approach aligns with Bahrain's educational quality goals, contributing to prosperity and societal development.

Acknowledging the study's limitations, such as the exclusive focus on a single school and the inability to include student perspectives due to age-related constraints, offers avenues for future research. Expanding the sample size to encompass a diverse range of schools and overcoming challenges related to student involvement could further enrich the understanding of sustainable interventions in various educational settings.

As a foundational exploration, this research lays the groundwork for future implications. Subsequent studies could delve into the specific impact of sustainable enhancements on academic performance, teacher satisfaction, and overall student well-being. Comparative analyses involving multiple schools and longitudinal studies tracking the implementation and outcomes of sustainable improvements would contribute to the continual enhancement of educational environments and the advancement of sustainable practices in educational settings.

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APPENDICES

Appendix A: Interview

Interviewer (In): On the topic of school's environment and sustainability within the school community I am here with teacher Layla Husain, an arts teacher in Hamad Town Secondary Girls School, for the record this interview will be solely used for academic purposes. Hello and thank you for agreeing to do this interview.

Layla Husain (LH): Hi, you're welcome; I'm happy to help you with this research.

IN: So how many years have you been teaching in this school?

LH: I've been working in this school for about seven and a half years.

IN: Because we're talking about sustainability- and that includes environmental sustainability, I would like to know if you have any allergies?

LH: Yes actually, I have sinuses allergy.

IN: Have you ever had an allergic reaction or a flare up in class?

LH: Well, sometimes we use some materials in the art classes such as spray paints, wall paints or even glue, these kinds of smells cause me some headaches.

IN: So, do you feel like the classrooms have good air quality and the sense of ventilation and air regeneration? like if once you use these types of substances, is it easy for you to have good ventilation in this in the classroom?

LH: Well, I'm not able to open the windows whenever I want especially because of the hot weather, and because I need to keep the class dark so I can use the data show, so the curtains and the windows are closed most of the time, and this doesn't help me to have a good ventilation in the class.

IN: And has a student ever had an asthma attack in your class? Especially since just like you said, you use a different materials and substances that could lead to some kind of problems with breathing.

LH: Well, I don't recall any situation like that especially that the administration of the school provides us with the names of the students that have any illnesses and that is why we can manage to not have any kind of situation like that.
IN: As an art teacher, how important is natural light utilization in your classroom or the art studio?

LH: Very important! especially that most of the art curriculum teach the students the study of colors, students need to have good study of the colors, about mixing them, and classifying them. So, a good lighting would help them with that.

IN: And do you think that there's enough natural light coming into the art studio?

LH: Well, we have three windows in the art studio, so when the curtains are opened, we can have enough sunlight. However, as I said earlier,I have to keep them closed most of the time because of the height temperatures in the studio, which sunlight would make it even more hot, and because I need to keep it dark in order to use the data show. So, in short- no we don’t get enough sunlight. In addition, the lights would sometimes stop working because of the continuous use; and I mentioned that we don't have regular maintenance, resulting into a waiting period of two or three weeks to get them fixed. In general, most of the time we don't have good lighting conditions in the studio.

IN: Do you think that has an affect your productivity levels? Like in the case of lights going out and not having enough sunlight… does it affect your productivity levels (negatively or positively) or the way you convey your lessons to your students?

LH: Of course! Good lighting gives me energy, it puts me in a good mood, I also can't have any plants because of the lack of sunlight, I always kill my plants in my art studio [laughs].

IN: [laughs] which is quite sad because plants add a very nice touch to any classroom!

LH: For sure!

IN: How about the students, does having enough lighting -in your professional opinion- do you feel that it affects the results of their artwork? Or their behavior in class?

LH: Well, many factors affect their artworks, such as the lighting, the duration of the class, the time of the class, even the level of talent of the student (if she's an artist or not) so I don't think the lighting would be the main effect on the artwork.

IN: [interjects] I understand, but I'm talking generally- regardless of their academic level, on the days when you have good artificial light, in addition to good natural light, do you feel like the students cooperate with you more, or have more energy?

LH: Of course! Yes of course they would usually be sleepy when the class is dark, I even sometime opt to explaining the lesson without any data shows in order to do something different and exciting, so they don't get sleepy, so I guess it definitely is an important factor.

IN: Definitely, and what about thermal environments do you feel like you have enough control over the thermal environment of the classroom? Can you control the temperature of the classroom easily or not?

LH: Not at all… we have two window air conditioners in the art studio, usually after the summer holiday; the art studio would be so hot and it would be very difficult to get it to a good temperature, a process that could take a month or two. So, we definitely don't have good thermal control. Moreover, ceiling fans can be annoying to the students because there will be flying papers and what not.

IN: [adds] ceiling fans are actually insufficient to cool down the space anyway, because they tend to bring down the hot air from the ceiling of the space so they're not really sufficient as as a cooling device, and especially in the case (like you said) at the beginning of the school year where the schools have been like abandoned for about 3 months, and the classrooms tend to be very hot and it will take time to cool them down.

IN: Do you feel like the temperature affects your ability to teach or the quality of your lesson?

LH: Well, the students always complain and ask to go somewhere else, they would sometimes ask me to give them the artwork exercise as a homework so they can move back to their classroom because they can't work in the hot temperature and, of course it would affect me too because I need to move all the time in order check the students' artwork so with continuous movement I would even feel more hot, which negatively affects my energy level in class.

IN: On my visit, I noticed the wash basins in the arts studio have exposed pipes; have you ever had an accident to that regard?

LH: No actually, the students always use the sink with the teacher's observation, and the pipes are exposed because the studio wasn't always an art studio, at the beginning of the design stage of the building; it was supposed to be a normal classroom but then they needed to have an art studio, so they just added the wash basins later.

IN: Have you ever had any leaks; or a problem with water leakage?

LH: We usually have blockages rather than leaks actually, because of the colors when we clean the brushes and color pallets and what not- and this causes blockage most of the time.

IN: And is the maintenance in that situation provided quickly?

LH: Not really, we have to go through do many steps to apply for and get provided maintenance, so it takes time around two to three weeks!

IN: Can you tell me about the storage area of your area studio, it seemed quite cluttered without proper ventilation.

LH: The one in the art studio never had any issues, but the books storage actually caught fire last year because of the hot weather and the exposed electrical wires, which lead to half of the books being burnt.

IN: So yes, storage areas not having proper ventilation has caused you a lot of problems!

LH: Definitely! But luckily, the book storage is not located closely to the student classrooms.

IN: Okay, again during my visit I noticed some faulty wiring systems in the classrooms, data shows wires were linked to fluorescent lighting which- in my opinion is quite dangerous to students and can cause some accidents and problems. My question is, have you had any problems in that area?

LH: Actually, this area is brand new! the administration had asked for more wooden cabins because we need more classrooms due to the very large number of students, and when they were provided; only then would they ask for more details like the data show systems. This causes these issues, like there is not enough space to hang the data show, there is no space for the white boards, and other stuff like that.

IN: Okay... my question was, did you like have any electrical problems happening during class?

LH: Not yet, because it is the first semester, we are using these cabins, so in the future yes there might be problems especially if the students turn it on by mistake, we have no idea what would happen exactly.

IN: And how about the computer classes? Again, during my visit I noticed a really big hard drive that was just haphazardly fixed at the top of the wall, and it was placed on top of a student's chair, are there any future plans to have it covered to prevent any accidents? Or a plan to change the seating arrangement of the students, again to prevent any future accidents?

LH: Well, I never heard the administration saying that there is a plan to cover it, and I have visited more than one school that have the same situation, so I think this is the normal situation in all schools.

IN: I have also visited the physical education gymnasium, and it was very cold! And I actually noticed that so many of the air conditioning panels were broken. Additionally, there was no natural lighting whatsoever as there were no windows, it mostly relied on the artificial lighting the fluorescent lighting; and at the same time, so many of them were not working. Can you talk to me more about that situation? How is the maintenance scheduled? How is the space being used?

LH: Let's talk about the air conditioning system first, the first thing you need to know that the gymnasium has a different type of air conditioning system, and it can't be controlled manually, it is controlled automatically. And the space is usually occupied by more than one class.

IN: [remarks] So more than one teacher, more than one group of students.

LH: [adds] Yes exactly, and the thing is- the soccer team the basketball team in the school would have some after school activities, but the air conditioners would automatically be turned off after the school time, and they can't presume their activities there. We have had a lot of instances like that and the teams would usually go and ask for permission to control it manually.

IN: So, what you're saying is that the space is kept cold on purpose.

LH: yes, it is kept cold on purpose on in the summer to retain the coldness even after school, but then the winter comes and it takes time to change the temperature so it stays cold, and a lot of students again would complain.

IN: What about the lighting? I asked you about that because there were no windows I believe, and a lot of the artificial lights were not working.

LH: Yes, as I said we it takes time to have maintenance done in the school, especially in the gymnasium because it has a very high ceiling so it needs special care and so this maintenance would be each four to five years.

IN: [adds] Oh years not months!

LH: Years! and there are actually windows in the gymnasium, but they overlook the interiors like the corridor where the students would change their clothes, that's why it doesn't get enough lighting. Even when we have some other activities like competitions (not just for the PE) but for several other things like; when we have an art competition, and we use the gymnasium to have it-

IN: so, it's acting more like a multi-purpose room? because I noticed as well that it has a stage as well.

LH: Yes, and as you said we do have a stage, and I happen to lead the media committee of the school [smiles], and whenever we have a play, I have to record the play with the students, and it would be so hard for us to come up with a good quality video because of the lighting.

IN: Alright, we will move on to a different type of sustainability that is mostly focused on social sustainability. So, I would like to ask if there is any consideration for disabled students in the school; like people using wheelchairs and such?

LH: We have an old building, it's a three storey building with no elevators, no ramps, so obviously no. It's hard for the disabled students to move freely around the school.

IN: Can you elaborate on that? For example, what if you have a student with a wheelchair, how would the administration react in that situation?

LH: The administration has provided some cabins [referring to classrooms in the form of wooden cabins], in the backyard so whenever we have a disabled student, the student will be in one of these cabins.

IN: Understood, how about in the case of a student having an accident during the semester- as in she was assigned to a certain classroom; and then ended up having an accident that broke her leg… what is the solution for this case?

LH: Well as I said, we have some classrooms in the form of cabins in the backyard, so whenever we have a case like this at the student would be moved to one of these cabins. However, not all classes study the same

curriculum or have the same teachers, which makes it hard for the students to cope with the new environment, the new colleagues, the new lessons, and everything.

IN: [interjects] So the administration would only transfer that student and not the entire classroom?

LH: Yes, only the student would be transferred. However, in some cases we would have to move the entire class, but it is even harder for everyone in that case.

IN: Alright, if I may ask about students with learning difficulties, do you think the school has enough consideration for them?

LH: The Ministry of Education has a clear vision of merging and blending students with special needs with the other students, so besides the special care in the academic field I don't think they have a good consideration. In our school, the teacher would have special handout papers for them, and special tests made just for them, but when it comes to their socializing- it's not good enough due to -for example- bullying.

IN: And do you think it's a good idea to blend them with the with their peers? especially since they're learning capabilities are different than them.

LH: It depends on many factors. First, the student's condition; some of the students with learning difficulties can be blended easily with their peers. On the other hand, some of them are not. Additionally, it depends on the classroom, some of the classes have a high rate of bullying within them, but some of them know how to cooperate with each other and help these kinds of students. Lastly, it depends on the teachers too! some teachers can easily help students develop, while some of them don't know how to deal with these special cases because we don't really have specially trained teachers for that. The school doesn’t have special teachers, special classrooms, we don't have any special equipment or strategies for them.

IN: How can the school environment improve the situation? What solution can you propose?

LH: In my opinion, I think providing classes with less numbers of students would be more appropriate for them, especially since we have really a big student body consisting of one thousand students! With this action, students with learning difficulties would get more attention from the teacher, and they probably won't be bullied all the time like what's happening right now.
IN: Is there a lot of bullying going on in the school?

LH: Yes.

IN: Okay, that is all, thank you so much for giving me so much of your time, this was really helpful, and I really appreciate all the input and information that provided, and I really appreciate your cooperation.

LH: I hope that was helpful for your research, I was more than happy to assist in any way possible.

Appendix B: Online Survey

Towards a Sustainable School Environment

This Survey is designed to evaluate architectural elements used in Hamad Town Secondary Girls School to develop solutions leading to a better and more sustainable school environment.

The survey is divided into 3 sections: study of lighting, study of acoustics, and study of air quality and thermal control.

The responses to the survey are collected and processed to ensure anonymity and will be used for educational purposes only.

The survey will not take a long time to fill, your support and cooperation are highly appreciated.

Section 1: Study of Lighting

Q1: What type of lighting is used in your building?
- o Natural Lighting
- o Artificial Lighting
- o Both

Q2: How would you rate the quality of lighting in the classrooms?

- o Excellent
- o Enough to allow giving lessons
- o Poor

Q3: Do you think natural light has an effect on your productivity levels?
- o Yes
- o Somehow
- o No

Q4: Do you think natural lighting can be used as a main source of lighting in the classrooms?
- o Yes
- o Somehow
- o No
- o Other: ……

Section 2: Study of Acoustics

Q1: What is the level of external noise filtering into the classrooms?
- o High sounds and noise
- o Far away and low sounds
- o no external noise

Q2: What are the sources of external noises coming into classrooms?
- o Road noises
- o Other Classrooms
- o Other: ……

Q3: Does the external noise of the classroom affect the students' attention span?
- o Yes a lot
- o No
- o Other: ……

Q4: Does the external noise of the classroom affect your teaching efficiency?
- o Yes a lot

- No
- Other: ……

Q5: Do you think the design of the classroom and the used finishing materials play a role in controlling the outside and inside noises?

- Yes
- Maybe
- No

Section 3: Air Quality and Thermal Control

Q1: Do you have enough control over the thermal levels of classrooms?

- Yes
- No
- Other: ……

Q2: Does the temperature of the classroom affect the teaching process?

- Yes
- No
- Other: ……

Q3: How would you rate the quality of ventilation in the space?

- Excellent
- Enough
- Poor

Q4: if you have any allergies, does it get irritated whilst being in the classroom?