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Examining Effects of Environmental Factors on College Students' Learning and Success

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The importance of environmental factors for students' learning performance is inevitable. As students grow up and go to college, they should have changes in their preferences for how their environment for studying should be. Understanding what visual, structural, and organizational elements of one's surrounding can help college students concentrate better comes handy to make arrangements for their study environment accordingly. The goal of this research paper is to study what environmental elements can be stimulating or distracting for college students' learning outcomes when they are studying. Data was collected by surveying students majoring mostly in the sciences using a Likert-type and open-ended questionnaire. Our analysis suggests that a quiet, well-lit, structured, and noise-free study environment is the most ideal for students. Our data further finds out that students prefer accessibility to a table or desk, having note-taking materials (pens, pencils, notebooks, tablets, laptops) well-organized, and having snacks around while studying. Finally, our data suggests that students emphasizing the importance of environmental organization for studying had higher academic performance.

Keywords: environmental factors, physical surroundings, academic performance, college students, learning, success

INTRODUCTION

The availability of different environmental characteristics is important to pay attention to while planning playscapes for children. It is important in children's play that they get the chance to choose their own activities and create their own play environment (Moore, 1985). Diversity, unstructured, and manipulative environment are important features of

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the play environment (Moore, 1986). Results from experimental studies show that all-round playing in a diverse and rough play area has improved the motor skills of children in the experimental group compared to the reference group. It was also found that a natural landscape helped children bring up diversity because the structures in the natural environment were suitable for different play functions (Fjørtoft, 2001). Children often prioritize green structures and natural environment (Moore & Young, 1978; Hart, 1979). Environmental learning happens through direct and indirect experiences of nature. Direct experiences include observations, sensory stimulation, movement in the space and indirect ones include education, interpersonal communication, and popular media (Malone & Tranter, 2003). Science educators have found that children learn the most through their experiences with concrete things (Fleer & Hardy, 2001). Children who play in natural day-care canters showed enhanced motor abilities and attention spans as well as better health outcomes (Bagot, 2005). Children involved in activities in school grounds showed interest in taking care of nests in trees which further showed that transforming spaces for children can improve environmental learning through both planned formal and informal curricula.

The physical environment is observed to be important in students' cognitive, social and physical development beside the impact of teacher and learning program quality (Hebert, 1998; Moore & Sugiyama, 2007). The physical environment should be designed in a way that students feel that they have the capacity to explore their physical environment on their own and create opportunities of play on their own (Maxwell, 2007). Physical environments are important for learning and they include special classrooms and specific materials based on the subject matter and instructors believe that audio-visual archives, computers, carpets, storage spaces can lead to improved learning (Durmuş, 2016). Young students playing in a forest tend to have better motor skills than those who play in traditional playgrounds (Fjørtoft, 2001). Outdoor environment gives young students the space to move freely (Rivkin, 1995) which acts as a critical mode of learning for students (Bilton, 2002) It also allows children to engage in more realistic fantasy play (Ouvry, 2003). Students' play in an unorganized natural environment gives them a better understanding of reality (Francis, 1988). An enriched environment in a natural landscape stimulates play and learning (Rivkin, 1995). Outside environment ensures that young students have enough space around them to move away from confrontations with their peers when they are frustrated and in the middle of lack of cooperation (Ouvry, 2003). A diverse school with many migrants and refugee families made a garden space which created a strong sense of belonging among students (Cutter-Mackenzie, 2009). Students considered working in the garden as an initiative to protect the environment and felt an environmental connection (Wake, 2008). From an interview with an English as a Second Language teacher (Allison), it was found that school garden programs helped children learn as much language as possible due to better scopes of real-life conversation (Cutter-Mackenzie, 2009). The Project GREEN school gardening research study found that gardening along with learning positively impacted students' environmental attitudes (Waliczek & Zajicek, 1996). Students had notably more positive environmental attitudes after taking part in the school garden program. Particularly, female and Caucasian students along with those from rural areas had more positive impact than other students (Waliczek, &

Zajicek, 1999). As a child uses the landscape for play, it is supposed to have a functional impact on children's behavior and play performance. Overall, the physical diversity of the landscape improves learning (Moore & Wong, 1997).

Noise and other external auditory simulations are another notable environmental characteristic that hamper performance (e.g., noise in the hallway) or visual (e.g., a large mirror placed next to a child's desk) (Higgins & Turnure, 1984). When children are exposed to uncontrollable noise, their cognitive development is impaired, memory is reduced and language and reading skills are hindered (Evans, 2006). Noise affects tasks involving speech perception and listening comprehension for children more than adults. Children have less capacity than adults to differentiate between signal and noise (Wightman et al., 2003). As people grow up, they are less distracted (DeMarie-Dreblow & Miller, 1988; Higgins & Turnure, 1984). Younger children are even less capable of using contextual cues to make meaning out of noise-hindered words (Elliott, 1979). Studies show that noisy environment in classroom settings impairs children's listening performance (Yacullo & Hawkins, 1987; Jamieson et al., 2004; Neuman et al., 2010; Valente et al., 2012). Studies also show that short-term memory is affected by noise for adults and instant recall of visually presented verbal items is impaired by unrelated sounds (Beaman, 2005; Schlittmeier et al., 2012). Tasks that are non-auditory like short-term memory, reading, and writing are also hindered by noise. Such internal and external attentional resources impact attention allocation of infants (Oakes et al., 2002). It will be difficult to learn about any single object or event if attention is reoriented frequently (Oakes et al., 2002). Attention span may be important to understand the link between temperament and language development and it may also regulate other aspects of temperament (Rothbart & Bates, 1998).

Involving students in critical and metacognitive thinking enhances their mental presence in a learning environment with active participation (Gleaves & Walker, 2013). Studies showed that almost 30%-50% of the students in a distance education program failed to finish the courses and dropped them (Dutton et al., 2002). Important evidence has been found to support that incorporating emails in the learning process improves students' cognitive development related to computer skills (Yu & Yu, 2002). Collected data shows that using email as a part of the learning process can be promising without having to invest in additional equipment and software (Yu & Yu, 2002). Studies also showed that students who participated in international email communication are more likely to share information. Peer review has positive effects on students' learning and specifically the influence of review writing on learning is highly appreciated (Mulder et al., 2014). The use of mobile social technology for learning have been found to have a positive impact on students' social life and provides new and innovative methods to create social learning environments (Abdelraheem & Ahmed, 2018). A huge body of literature collected from the diverse learning benefits students have by taking part in peer review shows that peer-review stimulates students' active role-taking and critical thinking (Liu & Carless, 2006). However, some studies suggest that students prefer feedback from instructors (Biggs & Tang, 2007; Brindley & Scoffield, 1998) because they may have doubts on the ability of peers to provide critical feedback (Cartney, 2010). Since peer review plays a vital role in learning, it is not surprising that the presence of social interaction in e-learning helps to decrease the negative impact of

dehumanized computer environments on children. A study shows how children's response to social interaction can be impacted by what social cues computers provide in e-learning space (Tung & Deng, 2006). Some studies have also confirmed that social presence in e-learning can induce quality learning and increases learners' motivation (Aragon, 2003).

There are many other environmental factors that influence children's learning. Research has found that a learning environment with colorful visuals, good lighting, regulated sound, and proper ventilation relieves students of physical distress and helps them to pay attention to classroom activities and logical thinking (Getzels, 1975). Graphics and signage on the wall surfaces of the learning environment encourages enhanced learning outcomes and changing the graphics can often keep the learning environment dynamic (Taylor, 1993) The findings show that students view their homes, communities, and schools as generally supportive, highlighting a favorable opinion of supportiveness in all of these contexts (Derilo, 2024). Academic accomplishment may not be influenced by the community learning environment alone, but possible synergies are suggested by the way it interacts with other surroundings (Derilo, 2024). The multi-sensory approach used by science and children's museums enhance interactive learning. Therefore, schools should also have visual elements and manipulatives like putting specimens of subjects in the hallway as displayed (Gardner, 1993). Children feel trusted by adults and exposed to a decision-making process when children are given the chance to create their own learning environment, which helps to build up their self-esteem early on (Taylor, 1993). A study showed that therapy balls and cushioned chairs for autism spectrum disorder (ASD) students improved on-task behaviors and classroom experience giving the evidence that alternative seating chairs can satisfy the subjects' need for sensory stimuli which might have otherwise interrupted academic performance (Sadr et al, 2016). Children and young people with special educational needs (SEN) [also known as additional support needs (ASN), learning difficulties (LD) or special needs (SN)] should participate in mainstream education system and opportunities to be able to keep up with the wider society (Frederickson & Cline 2009). When children fully participate in academic and other class activities, they perceive themselves to be real members of the community (Janney & Snell 2006). Implementing a robotics curriculum in an after-school program showed that the program can have the potential to enhance learning objectives (Barker & Ansorge, 2007). From a meta-analysis of school-based violence-prevention programs it was found that aggressiveness reduced significantly for research-initiated programs but had negligible effects for school-initiated programs. It was also found that after these programs were conducted, the aggressive behavior of high-risk youth reduced more than that of non-high-risk youth. Children who were part of this program also had improved academic performance compared to a matched cohort of children who weren't exposed to the program. Children who left schools without finishing the program till the end had reduced academic performance (Fonagy et al., 2005).

METHOD

The goal of our research was to study the impact of environmental factors on students' learning. A study was performed for our research in which 174 students mostly taking science majors participated. The City College of New York, a public university that provides services to minority communities in an urban environment, was the site of the study. Students from the science background included ones who were majoring in Biology, Chemistry, Psychology, Biomedical Engineering, Chemical Engineering, Biochemistry, Economics, Earth System Science and Engineering, Environmental Engineering, Mechanical Engineering, Applied Math, Neuroscience, Anthropology, and Biotechnology.

For the study, students were asked to answer survey questions which included Likert-type and open-ended questions. The administration of the survey and data gathering were approved by the CCNY Internal Review Board (IRB). The survey findings were examined using a variety of environmental factors and how they impact student learning and success. The survey was anonymous meaning the students name was not on the survey. The top of the survey asked students to write their major, GPA, gender, age, number of credits completed and number of science courses completed.

For the Likert-type questions, we converted the answers to numerical values for each of the category of description: (1) Strongly Disagree, (2) Disagree, (3) Neutral, (4) Agree, and (5) Strongly Agree. Then we calculated the average for the total students' participants. As a part of data collection method, the students answered questionnaires about how they want their study environment to be organized, how location, lighting, air affected their learning process, and how they expected others to behave while they were studying.

Two specialists who reviewed the survey concurred that the questions accurately reflect the inquiry into environmental factors and their relationship to learning and performance. The reliability coefficient was calculated using the test-retest approach and was found to be 0.86. The Likert-type questions were subjected to a single factor ANOVA, which revealed $p<.001$ and p-value <0.05, which is strong evidence against the null hypothesis and demonstrates a strong association between the variables.

Guiding Research Questions

1. What are some of the environmental factors that influences learning outcomes?

2. Which environmental factors seem to have a significant effect on learning and success among science college students?

FINDINGS AND DISCUSSION

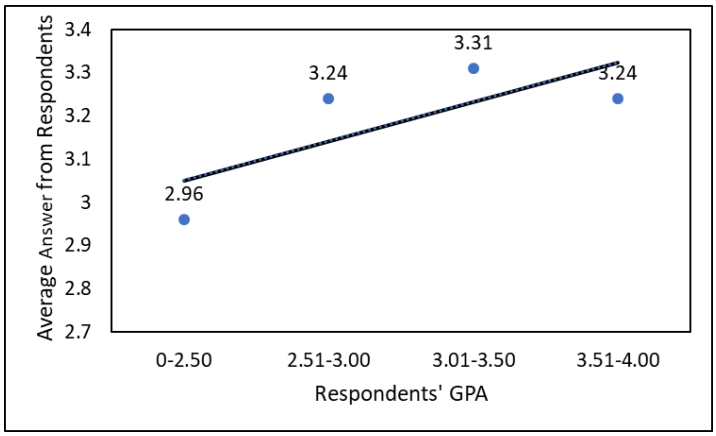

Figure 1
Linear Regression graph of the average responses to the questions asked in the survey vs. the different GPA categories

Figure 1 shows the average answer from respondents for the Likert-type questions in relevance to their GPA. For our analysis, students' GPA is divided into four categories: 0-2.5, 2.51-3.00, 3.01-3.50, and 3.51-4.00. According to our graph, the average response to the questionnaire from students with GPA in the range 0-2.50 is 2.96 on the Likert scale. For those having a GPA in the range 2.51-3.00 has an increased average response of 3.24. This shows that students with higher GPA are more agreeable to the questions asked and hence agreed on the importance of environmental factors' role on learning. Students with a GPA in the range 3.01-3.50 had an average answer of 3.31 hinting at further increase in average response of students with higher GPA. For the last GPA category of students with the highest GPA in the range of 3.51-4.00, the average answer is 3.24, which also maintains an upward trend for average responses with increasing GPA based on the trendline. This trend shows that students with higher GPA find it more beneficial when their study environment is ideally arranged for them. It can be indicative of students' progress as they organize their study space accordingly. Students with higher academic performance found it useful to have different environmental elements magnified or reduced from their study area. Therefore, it can be suggested that having stimulating factors or eliminating distracting factors from one's study space can enhance academic outcome for college students. This finding aligns with prior research on how learning is enhanced when attention arousing factors in environment are present or when distractions are reduced from children's learning environment (Jamieson et al., 2004; Valente et al., 2012).

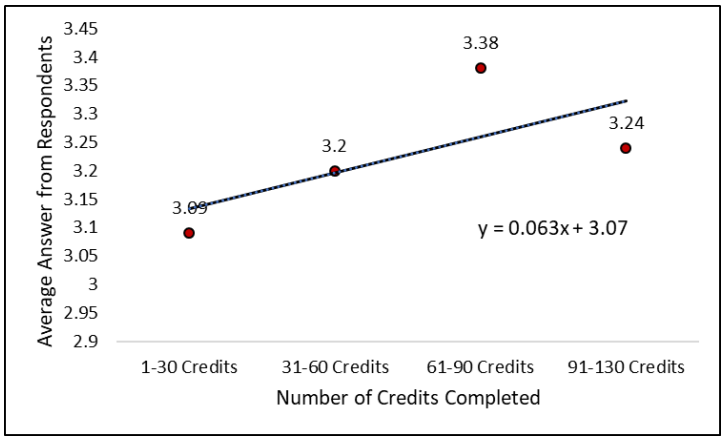

Figure 2
A linear regression curve that correlates the average response to the Likert-Scale questions vs. the number of credits completed

Figure 2 shows the average answer from respondents for the Likert-type questions based on the number of credits completed by the students. For our analysis, students' ranges of number of credits completed are divided into four categories: those who have completed, 1-30 credits, 31-60 credits, 61-90 credits, and 91-130 credits. According to our graph, the average response to the questionnaire from students who completed 1-30 credits is 3.09 on the Likert scale. For those having 31-60 credits completed has a higher average response of 3.2. Students with 61-90 credits completed had an average answer of 3.38 indicating further increase in average answers of respondents with greater number of credits completed. This shows that students with a larger number of credits completed agree more to the questionnaire and are more agreeable to the significance of the role of environmental factors on learning. For the last category of students who had taken 91-130 credits already had an average answer is 3.24, which also follows the trend of a higher average response for students with greater number of credits completed. The trendline drawn through the points is depictive of how organized study environment has proven to be helpful for students who have completed higher number of credits compared to the ones who have completed fewer credits. This is relevant to the findings in other research articles where it was stated that an orderly environment provides disciplinary climate which promotes purposefulness and pleasure in learning, thus promoting better performance and higher achievements (Svartdal et al., 2020).

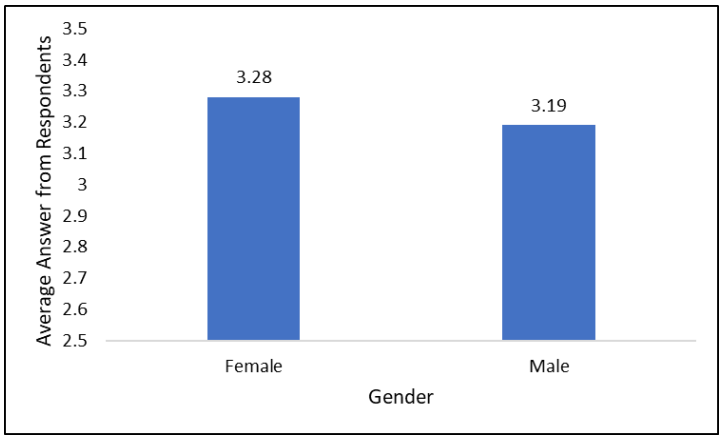

Figure 3
Average responses of male and female students

Figure 3 shows the average answers of male and female respondents for the Liker-type questions. As per our data, the average response of females is 3.28, indicating an average neutral response of female respondents for the questionnaire. The male respondents have an average answer of 3.19, which show that they also have an average neutral response to the study questions. The difference is rather similar which matches findings in other research articles that when it comes to the difference in learning environment, there is hardly any difference among the preference between genders (MacLeod et al., 2018).

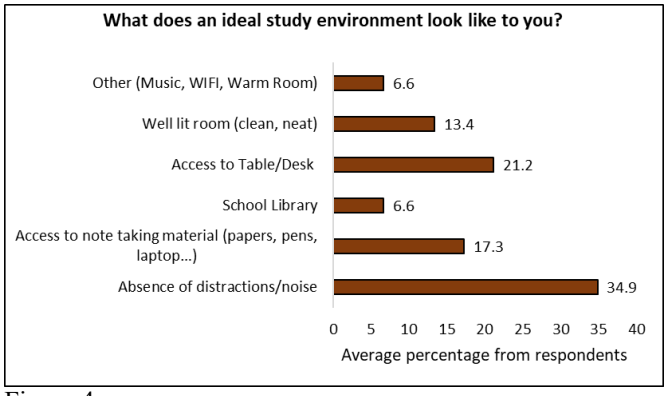

Figure 4
Responses to open-ended question about ideal study environment

Figure 4 shows the respondents answers to open-ended questions. It is a depiction of what elements of study environments the respondents find suitable for learning with greater concentration. 6.6% of the respondents find music, WIFI, and warm environment to be positively associated with good learning performance. This goes to show that a little percentage find it important that their study environment remain warm

and there is music and WIFI. 13.4% of the respondents expect a well-lit and tidy study space to be positively associated with good study outcomes. 21.2% of the participants mentioned the need of accessibility to a table/desk for an ideal study environment. It shows that a considerable percentage of the students find the availability of a desk to be more of a priority than other items for an ideal study space. 6.6% of them preferred library for studying while a notable portion of 17.3% vouched for the importance of note-taking materials like papers, pens, and laptop. The students' highest priority for an ideal learning environment was that their study space is free of distractions and noises given 34.9% of the respondents mentioned the need of absence of such distractions. Distractions during learning are associated with poor academic performance (Zureick et al., 2018). Therefore, it is logical for a large percentage of students to prioritize absence of distraction.

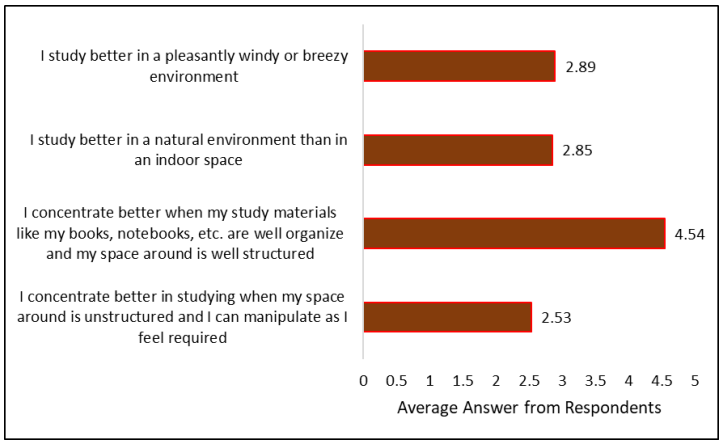

Figure 5
Likert-type questions and average answer from study participants for Likert-Type questions

For the Likert-type questions, students were neutral about the role pleasantly windy or breezy environment for studying. They were also mostly neutral in their preference for natural environment over an indoor space. While earlier research showed that children learnt better in natural sites, our present research hints at a different opinion from college students, who don't necessarily strongly agree to the significance of natural study space (Fjørtoft, 2001). This finding suggests that college students might not find natural landscape always suitable for studying due to lack of accessibility to WIFI or other services. While earlier research showed natural playscapes can add diversity to children's learning environment, college students seem to prefer accessibility to resources that they might not always have in a natural site. Students agreed strongly that they concentrated better when their study materials like books, notebooks, etc. are organized well and the space around is structured accordingly. It points out the importance of organization for an ideal study space and how an organized structure for a study area can enhance learning outcomes. This finding also shows a contrast of the viewpoints of college students to those of findings for children from prior research.

Earlier it has been suggested that unorganized natural environments play a role in learning about reality for children (Francis, 1988). However, college students clearly prefer a well-organized study space. College students were also mostly neutral about how important it was for them to be able to manipulate their study area when it is unstructured. This reaffirms our finding that they would root for a more structured than unstructured study area and don't think that unstructured area paves a way for manipulating their study space as required.

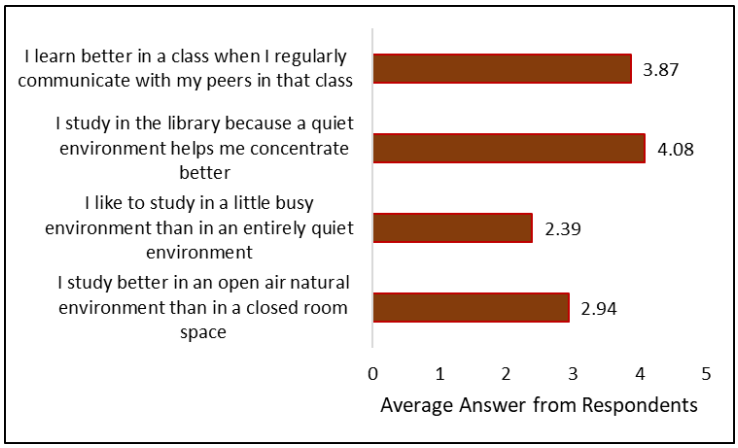

Figure 6
Likert-type questions and average answer from study participants for Likert-Type questions

Figure 6 shows another set of Likert-type questions and average responses of respondents for the questions. Students agreed that they learn better in a class when they regularly communicate with their peers in class. This also brings our focus to how having no in-person peer communications can hamper learning process of college students. Furthermore, it encourages research on whether virtual communication among peers have the same effect on learning as in-person interactions among them in class. Students also agreed that they prefer the quiet ambience of the library for studying. Quiet environment might be preferable because higher environmental noise level decrease accuracy, increase reaction time, disturbs attention, and requires more effort to maintain attention (Zhang et al., 2018). Even though earlier finding showed neutral attitude of students when asked about library studying, they agreed that they prefer studying in the library because a quiet environment helps them concentrate better. So, it can be suggested that students prioritize quiet area for studying whether it is in the library or anywhere else that can offer less noise. Students were mostly neutral about studying about studying in a little busy environment than an entirely quiet environment, which confirms our previous suggestions. They were also neutral in their view of preferring an open-air natural environment than a closed-room space, which is also in line with their neutrality of opinion for natural environments for study area.

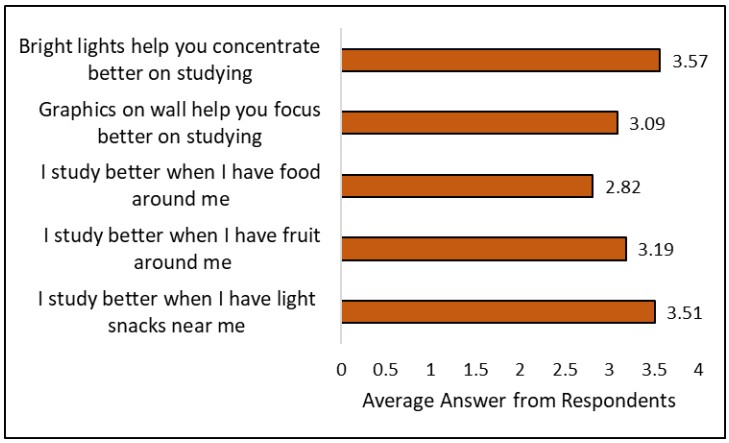

Figure 7
Likert-type questions and average answer from study participants for Likert-Type questions

Figure 7 is a depiction of the remaining set of Likert-type questions for our research and average responses. Most students agree that bright light help them concentrate better on studying. Prior research has also shown similar enhancement in learning outcomes for children, who had better attention span when in a well-lit environment (Getzels, 1975). They are neutral about whether graphics on wall help them focus better on studying or not. This shows that college students don't emphasize the presence of graphics around their study space while children often have better learning outcomes with the use of graphics and other visual elements in their learning area according to prior research (Taylor, 1993). While studying the effect of food and fruits around when studying, students reported neutral contributions of these for better learning outcomes. However, students mostly agreed that having light snacks worked out for an ideal study environment. This goes to show that students do not consider food and fruits to be either stimulating or causing harm to their study performance. However, they certainly consider having light snacks around. From this finding, it can be suggested that light snacks might keep students energized during their study session and boost their learning performance.

CONCLUSION

Environmental factors often contribute to students' learning outcomes. Some elements of environment can stimulate learning performance for students and some other elements can cause distraction for students. The goal of our research was to find out what environmental factors impact positively and negatively to students' learning outcome. Through our research, we were able to identity calm, quiet, and noise-free study space to be the most ideal form on learning environment for college students mostly majoring in the sciences.

We also have other significant findings. For example, we found out that structuring study space with proper ventilation, bright lights, and making it distraction free can

enhance students' academic performance. Students do not feel comfortable being in a moderately busy environment over entirely quiet area. This finding makes it clear that college students find a completely quiet area to be their ideal study environment. Also, students who spent significant period in college indicated by the number of credits completed tend to emphasize the role of surroundings while studying. Our research also suggests that respondents with ideal study conditions might have better academic performance.

Another noteworthy finding is that students did not consider library to be their most ideal environment for studying. As long as they have less noise around, they find it easier to concentrate whether in a library or other closed spaces. Students also found it suitable to have their note-taking materials well-arranged. As far as the role of natural landscape is concerned on studying, college students did not show strong preference for outdoor open-air space over indoor space for studying. Respondents were also neutral about how visual elements impacted their study area, showing that they did not feel the need of having graphics or another artwork around while studying. Our data shows that bright lights can enhance students' concentration and hence increase attention span. From our analysis, we can also be report that light snacks can have a positive impact on studying.

For future research to expand on the findings of this study, researchers can explore the relationship between the environmental factors and learning outcomes across different settings and student populations. Moreover, optimization of study environment for maximum learning effectiveness can be investigated.

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