

COVID-19 Study Spaces: Supportive Adaptation of Home Learning Environments During the Pandemic

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The COVID-19 pandemic has driven considerable changes in how we live, work, and study. How have students adapted space to support remote study? This research project aimed to understand where students were learning and how they were using and adapting the space. An online survey gathered data from 542 college students across 93 majors at two institutions in the United States. Results suggest that the bedroom space is the most common study space, and that space adaptation is tied to positive outcomes for students.

Introduction

As we reflect on this past year, conversations have spanned how we live, work, and communicate with one another. In higher education, the positive and negative impacts of learning and studying remotely have been at the center of those conversations. One piece of the puzzle is still missing, and that is how students have adapted their at-home environments for remote learning. Where are they studying? How have they adapted, or adapted to, these spaces? The present study aims to improve understanding of remote study spaces – most importantly at-home study spaces. By better understanding home-based learning, support can be offered to students who are cultivating their study and workspaces within their homes. The future of online/virtual learning is yet unpredictable but what we learn about students' supportive adaptations during the pandemic can inform how we live, work, and learn going forward.

Literature Review

The conversation about supportive learning environments in higher education has expanded. Where once researchers and advocates may have focused solely on the formal classroom space, now the conversation includes a broader view of the complex ecosystem of formal and informal

learning spaces that may influence student learning outcomes. Much research has been done into formal classroom learning spaces in higher education, especially with regard to advocating for active learning support (Adedokun, Parker, Henke & Burgess, 2017; Beichner et al., 2007; Bernauer & Fuller, 2017; Mumtaz & Latif, 2017; Oblinger, 2005, 2006; Park & Choi, 2014). Attention has also been given to the role and value of informal learning spaces – expanding the body of knowledge to include not only the built environment, but also digital environments, natural environments, and mobile learning environments (see examples in Deed & Alterator, 2017; Scholl & Gulwadi, 2015; Sølvsberg & Rismark, 2012).

A key takeaway from the last ten years of research is that learning can happen anywhere, so any space can be a learning space. It is known that people vary in their learning needs and ways of interacting with space, so may prefer environments than can be readily adapted to their needs. In fact, most learning may occur in spaces not originally designed for learning (Thomas, 2010). Mobile technologies allow students to exert more individual control over choice of learning location (Bell, Dempsey, & Fister, 2015; Dahlberg & Bagga-Gupta, 2014) while students' learning preferences increasingly call for student-centered learning environments (Jamieson, 2003; JISC, 2006; Keppell & Riddle, 2013; Scholl & Gulwadi, 2015) that are collaborative, social, and personalizable (Herman Miller, 2018; Montgomery, 2008; Sølvsberg & Rismark, 2012).

This broader understanding of what qualifies as a learning environment has become especially vital to education globally in the midst of COVID-19, which the World Health Organization (WHO) declared a pandemic on March 11, 2020 (Cucinotta & Vanelli, 2020). As governments around

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the world locked down communities, the world had to quickly pivot and learn to cope with physical distancing, remote learning, remote work, and restrictions on public and private occupancies. Approximately 19.9 million post-secondary students in the United States experienced a meaningful interruption in academic activities when they transitioned from in-person classes to online classes within days (Muniz, 2020). While many students remained in their college housing, many students returned to their parents' homes to attend virtual classes and study (Kumar, 2020). According to the Pew Research Center, from February 2020 to July 2020 there was a five-point increase in the number of young adults living at home (Fry, Passel, & Cohn, 2020) and 23% of those who moved home during 2020 reported that they moved because their college campus closed (Cohn, 2020). As of this writing, the pandemic has been ongoing for well over a year; lockdowns and other restrictions have been an everyday reality in the United States (U.S.) for more than a year. Most higher education institutions seem to have remained partially or fully online for Fall 2020; 65% of nearly 3,000 schools surveyed by the Chronicle of Higher Education followed a hybrid or fully online model for Fall 2020. Only 27% of those surveyed reported operating primarily or fully in person (Chronicle of Higher Education, 2020).

Perhaps a key takeaway from the pandemic will be that research about learning spaces can happen anywhere. That insight prompted this research team to look beyond institutional boundaries for a snapshot of what learning spaces look like in the era of COVID-19.

Though the most popular mental image of a university learning space is a formal classroom, with hard-surface tables and chairs, the majority of learning on a campus occurs in informal learning spaces, such as libraries and dormitories (Thomas, 2010). Beckers et al (2015) outlined four main types of learning spaces in higher education: classroom space, collaborative spaces, individual study space, and informal learning spaces. While classroom spaces are integral to information delivery, informal learning spaces and communal spaces make students feel more connected to the institution and the community (Biemiller, 2017).

In the first decade of this Century, institutions responded to a high demand for flexible, social, and collaborative spaces with new design solutions (Howe & Strauss, 2000; Freeman, 2000; Gardner & Eng, 2005; Dotson & Garris, 2008; Gayton, 2008; Delcore et al., 2009). However, studies of actual space use show that, where furniture was moveable and arrangements could be adapted to a variety of purposes, seclusion and noise control were major factors in both student and faculty choices about space arrangement (Antell & Engel, 2006; Walton, 2006; Gotsch & Holliday, 2007; Jordan & Ziebell, 2008; Webb, Schaller, & Hunley, 2008; Applegate,

2009; Jamieson, 2009; Twait, 2009; Vaska, Chan, & Powelson, 2009). Harrop and Turpin found that that the "majority of learners demonstrated clear self-awareness, expressing a preference for spaces where they were not being disturbed; nor were they disturbing others" although "not all students choosing to work individually wish to be in a quiet environment" (2013, p. 69).

Beckers, van der Voordt, and Dewulf also explored why students study where they do and found that, while the literature indicated that students would increasingly spend more time studying in public spaces, students actually reported more instances of studying at home, due to such concerns as the control they had over their environment, the convenience, proximity of food, the comfort, and the ability to listen to music (as an example) while they study. They also perceived that studying at home saved travel time (2016).

Prior to the COVID-19 pandemic, libraries and learning commons were primary destinations for studying (Mallinckrodt & Sedlacek, 1987) and gathering on campus (Cox, 2018). Libraries, and the wide range of supportive study spaces they provide, contribute to student success and engagement; in fact, use of the library is the strongest indicator of student success (Oliveira, 2017).

When U.S. states and institutions went into lockdown in March of 2020, access to supportive studying spaces like libraries and learning commons was cut off. Many students were unable to effectively complete coursework or studying due to lack of stable internet access, lack of space within the family home that they moved back into, or because of mental health reasons (Weissman, 2020). These issues underscore the importance of support systems that include mental health support, technology support, and supportive space. In our observation, much attention has been given to providing mental health support and providing access to technology, but resources to improve supportive space at home have been slim.

Institutions and students have learned that, in this period of time that has been plagued by a global pandemic and continual lockdowns, learning spaces can truly be anywhere—it's no longer just a catchphrase. "[E]very square metre of the built environment has the potential to support the learning activities of a student, from home to the classroom and all kinds of other settings in between, such as a coffee house, café, restaurant, bar, museum, library and public spaces, such as streets, parks or public transport" (Beckers, van der Voort, & Dewulf, 2016, p. 145).

Kumar (2020) suggested that, in the COVID-19 era, students are having to learn and succeed because they want to, not just because they show up to a physical classroom. He also suggested that the COVID-19 era may be pushing us (the world) to understand how necessity truly is the mother of reinvention because now we are pivoting and digitalizing

more and faster than ever, and technology is pushing to keep up with the new needs.

Even before the COVID-19 pandemic, home was a place student utilized for studying. Some students have always preferred studying at home, where they have access to dedicated space, food and other supplies, and easy parking (Asher et al., 2016). Other students actively avoided studying at home, however, instead seeking out alternative locations that did not have the distractions of home, the family duties, or that had space dedicated to studying other than the kitchen table (Asher et al., 2016).

Because of the pandemic and the global shutdowns, students were abruptly forced to transition their studying and learning spaces off campus and away from flexible, supportive spaces intentionally designed for these activities. Necessity became the mother of reinvention with regards to residential space, and students who had previously avoided working from home suddenly had few other options. This affected students worldwide. As designers and researchers, it's important to understand what changes needed to be made to the home environment to best support this shift in modality. The purpose of this research is to explore how students shaped their at-home study spaces to support their study needs during this time of forced online/virtual learning, and to examine the students' perceived efficacy of these adjustments.

Research Design

Method

The research project used purposive sampling to distribute an online survey instrument consisting of open-ended and close-ended questions, twenty-three of which were used for the present study. Of the close-ended questions, eight were scaled items, seven were categorical items, four were multi-response (e.g. select all that apply), two were constant sum responses, and one was a ranked response. Of the open-ended questions, two were conversational questions with single-line input. The third open-ended question involved a self-selected image file upload. Only data from the close-ended questions are part of the present analysis.

The survey collected information on academic program and year of study, course load and modality, and demographics to assess the heterogeneity of the sample. Although it was not the focus of the study, this data also made it possible to observe any potential differences between groups within the sample.

This survey method was chosen as the best fit for the research question, considering the nature of the topic and the need to support remote participation. The aim of the study was to understand how students use informal learning

spaces in the era of COVID-19. The exploratory nature of the question required sampling and processing a larger number of participants, then uncovering emergent themes, and finally focusing in on a smaller number of participants within a theme group. We did not explore *why* students may use spaces in a certain way. This is not to suggest that the *why* is not worth studying; the limitations of pandemic conditions made structured interviews impractical, both with consideration to recruitment and use of researchers' time in an already-overloaded semester. The online survey-based research design, especially the use of primarily closed-ended questions, allowed for a larger amount of data to be collected and analyzed in a timely manner.

The emphasis on using close-ended questions shortened the time commitment for participants to respond to the survey and made it less likely for responses to be incomplete or otherwise unusable. This approach also made it possible to analyze large amounts of data in a relatively short amount of time. The use of open-ended questions enabled the research team to capture new insights that had not been anticipated in the design of the close-ended items.

Sampling Technique

Convenience sampling was used initially to distribute the survey directly to students enrolled in courses within the researchers' own departments; snowball sampling was then used to reach students enrolled in courses outside of the department. Both institutions are located in the United States. Snowball sampling led to one of the institutions to send the survey to the entire student body. Through these two approaches, 673 surveys were completed across 93 majors at two institutions. This qualitative sampling technique is non-randomized, and therefore not representative of the entire population of students in U.S.-based institutions of higher education. Despite this limitation, the results gleaned from the data do provide insight into trends that may be apparent in that larger population and suggests which areas may be most in need of further study.

Analysis

Two sets of data were collected using two separate instances of Qualtrics – one for each of the partner institutions, as required by their respective IRBs – and then exported in CSV (comma-separated value) format to combine the data into a single set for further analysis.

For close-ended questions, a frequency analysis was conducted using the total number of responses for any given answer. The data were a mixture of nominal, ordinal, and ratio scales, making it problematic to perform in-depth statistical analyses; results were initially reported in terms of

both count (value) and proportion (percentage). Trend analysis was conducted using two indicators: 1) for any specific response, higher aggregate numbers were deemed indicative of greater consensus within the sample when compared to lower numbers, and 2) among all possible responses within any given survey item, the spread of responses across each option was deemed indicative of the proportional relationship of consensus.

Reliability and Validity

Reliability of the data can be assumed from receiving the same survey results from both universities. For example,

both universities results concluded that the #1 ranked space for students to attend online classes, study, and work on schoolwork was their bedroom with apartment as the most popular residence that was lived in during the school year.

Limitations and Trustworthiness

The trustworthiness of the method was dependent upon the capacity and motivation of the respondent to provide truthful answers, which is a limitation of all self-reporting techniques in research. The researchers perceived low risk of respondents being untruthful as there was no anticipated stigma nor incentive to provide any particular response.

There was also low risk of respondents not understanding the questions as plain language was used in crafting the survey items. However, the method did rely on respondents' ability to read and respond in comprehensible English. There was little concern regarding any potential language barrier as the survey was administered to students studying in English-speaking institutions.

Limitations of the method included respondents' motivation to invest time in completing the survey, answering questions carefully, and answering questions truthfully; sample size, which was limited by the sampling technique employed; and scope of inquiry. The scope of the study examined only the user's perception of the built environment as reported in a single set of data. The study did not collect data about the built environment through direct observation, nor through systematic indirect questions (i.e., there was no specific question about lighting, view, materials, etc.).

While the pool of respondents were primarily female undergraduates 22% of the respondents were male. In total, 93 majors were represented in the sample pool. The variety of respondents indicates congruencies across skillsets, types of personalities, and stereotypes. For instance, interior design students may be more inclined to make environmental changes to their physical space than other students might be, but interior design students only represent approximately 11.44% of the total respondents.

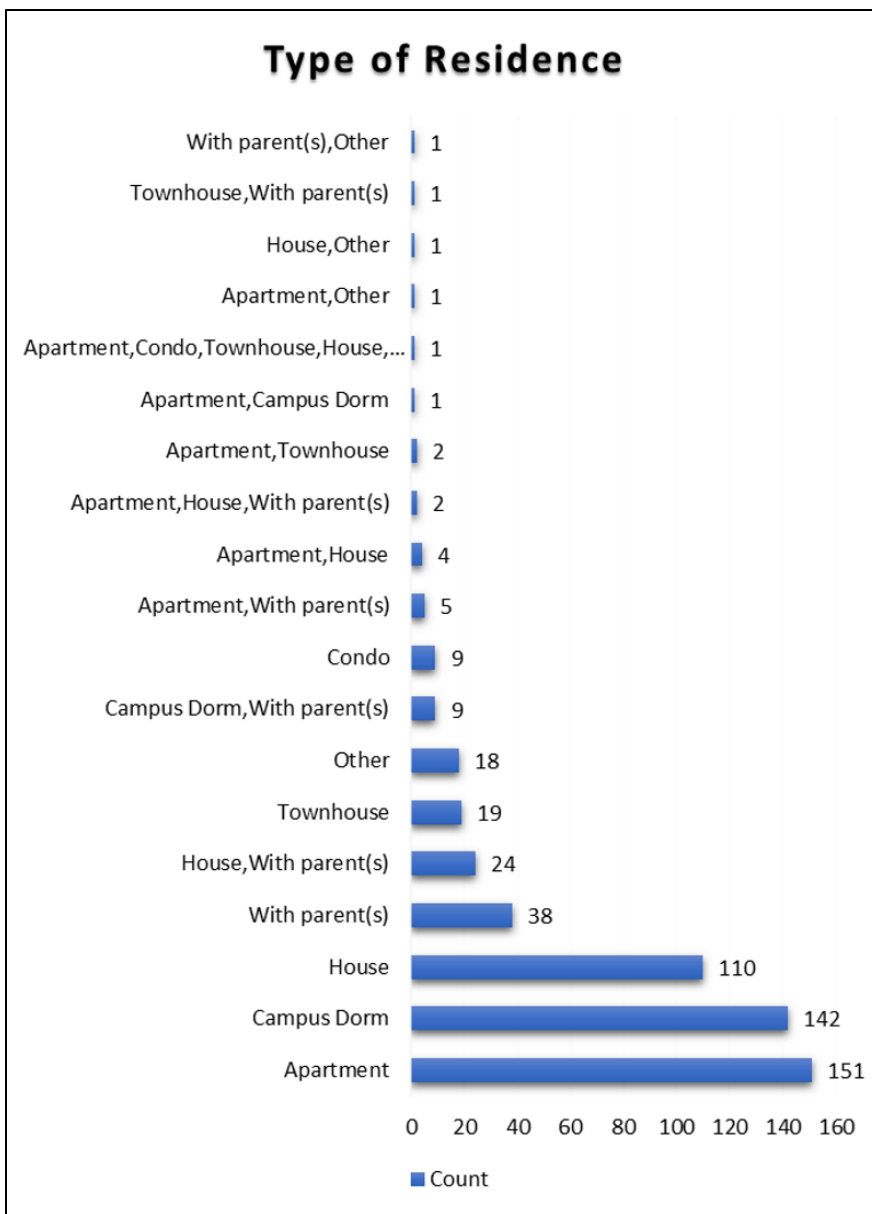


Figure 1. Most respondents reported living in an apartment, campus dorm, or house.

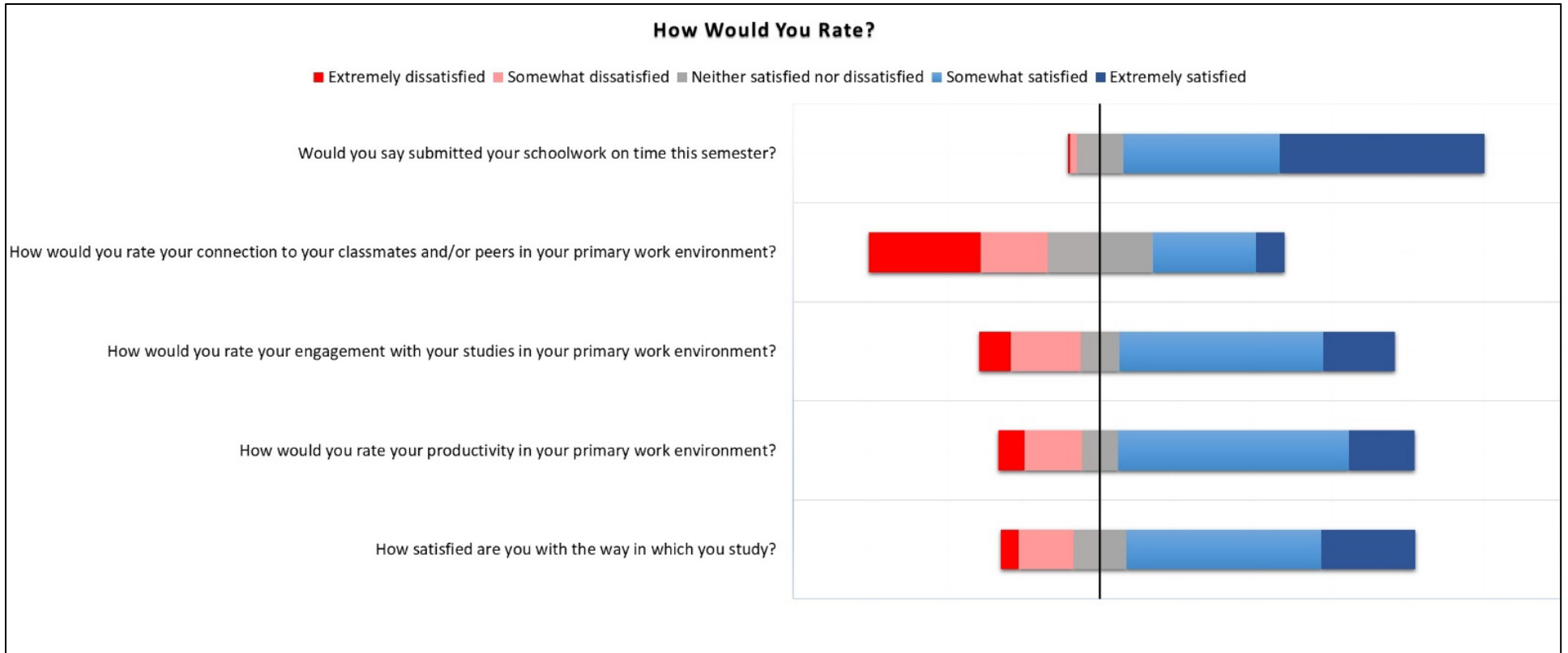


Figure 2. Climate survey items suggest that students may be least satisfied with their connection to peers in their primary work environment.

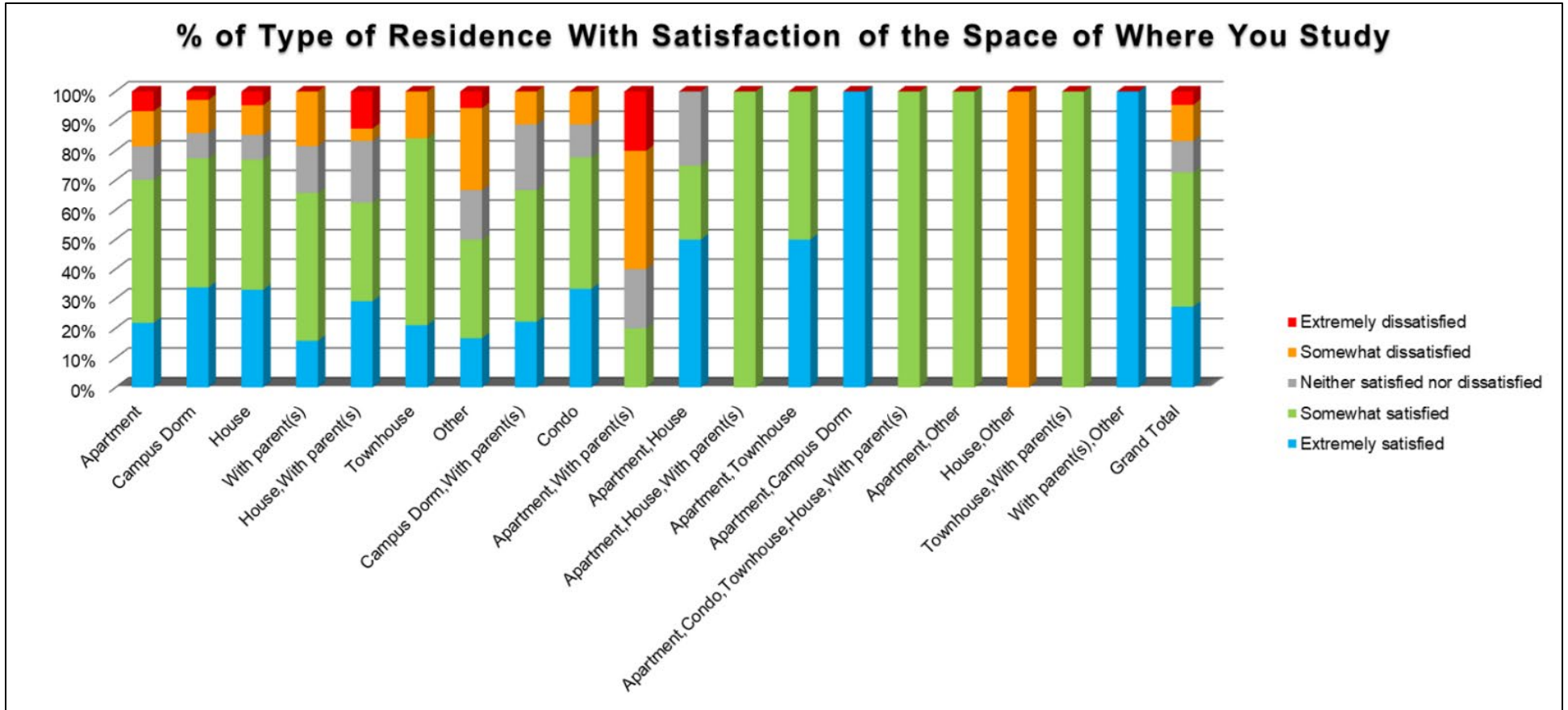


Figure 3. This survey item was problematic but yielded useful results in regard to the stability of satisfaction ratings across the three primary housing types – apartment, campus dorm, and house.

Results and Discussion

Of the 673 survey responses we removed 131 survey responses that were not complete data responses. This left 542 survey respondents for analysis.

To operationalize the problem, it is important to first understand where students are living and what the climate of their study life may be like. Figure 1 illustrates that the majority of respondents reported to be living in an apartment, campus dormitory, or house. More student reported that they lived in an apartment than any other type of residence. Living in a campus dorm was the second most reported location, and living in a house was the third, with all other locations being much less common. This survey item, though, proved to be problematic as respondents were not restricted to one choice. Some of the choices were also seemingly duplicates of one another, or overlapped, resulting in respondents selecting more than one choice. The survey item should be refined, but the results from this item were included because the three most common types remain relevant to contextualizing the rest of the data. Further, the results of this item were used to interpret data trends where the ability to select multiple choices did not hinder the utility of the results.

While many spaces in higher education institutions have been designed to promote and facilitate in-person group work, the pandemic changed the ways in which groups could get together. Digital technologies allow for easy

collaboration in any location, meaning that students no longer have to study together to share knowledge. 84.7% of students reported that they primarily studied alone, and 89.33% reported that they were more satisfied by studying alone. 87.27% felt they were more productive when they studied alone. These results support Regalado and Smale’s (2015) findings that when given the opportunity, students will seek individual study spaces to study solo. As will be seen, though, there were limitations to student satisfaction with studying alone.

Figure 2 charts the results of the climate survey items. What we established from this climate survey was that the majority of students reported being extremely or somewhat satisfied that they had submitted their schoolwork on time this semester, and rated themselves as being extremely or somewhat satisfied in their engagement, productivity, and approach to studying within their primary work environment. Which environment they considered to be their primary work environment will be illustrated later. Note, though, the marked attitudinal shift regarding connection to classmates and/or peers in the primary work environment. This suggests that students – the majority of whom reported studying alone - did not feel connected to their classmates or peers. Possible contributors to the lack of connection include increased social distancing, decreased space occupancy and, in the absence of physical presence, insufficient support for peer-to-peer interactions via online learning technologies.

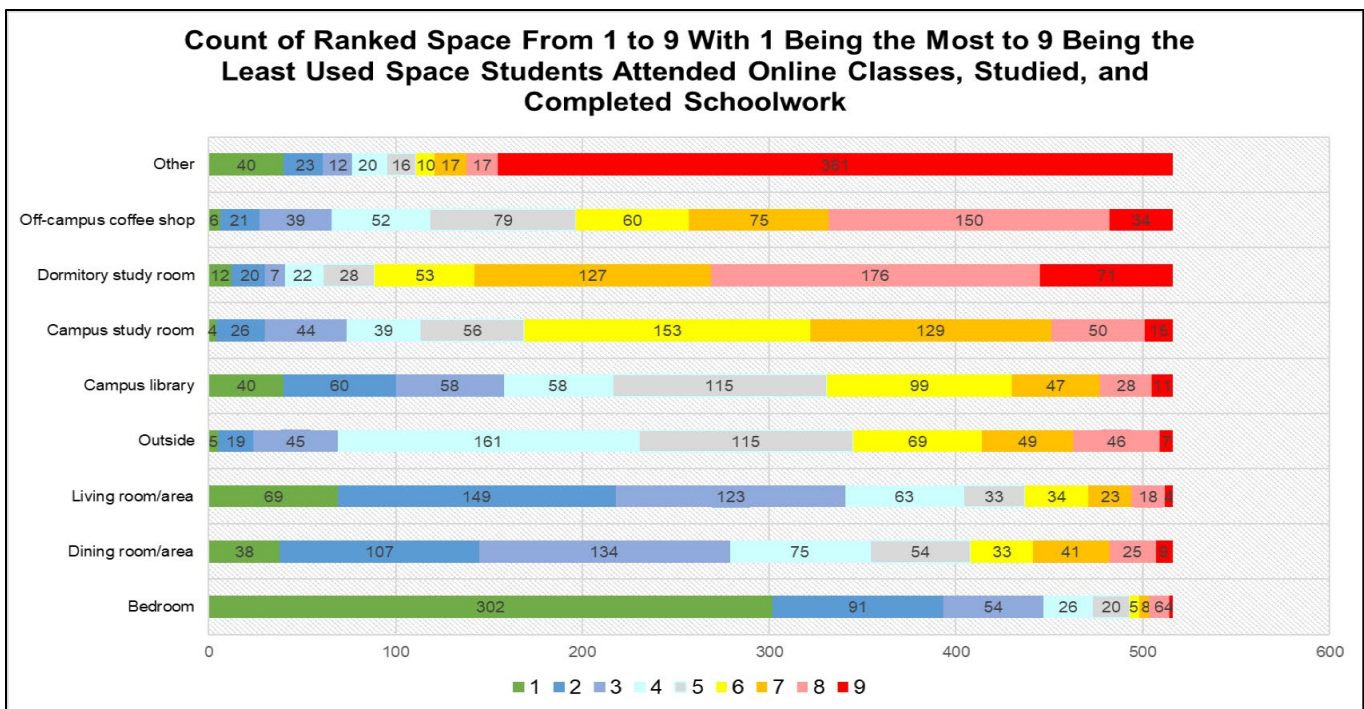


Figure 4. The bedroom, living and dining room, and campus library were the top reported places to study during the pandemic.

Figure 3 builds on the climate survey with an overview of satisfaction with study space mapped to their reported housing type. This survey item retains the problems described alongside Figure 1, such as the ability to select multiple choices, and therefore is limited in its implications. On the far left of the chart, which shows the satisfaction levels of those who selected only one choice – apartment, campus dorm, or house. Note that the variation in satisfaction of study space remains relatively consistent among these three areas. This finding is worth noting as it has implications for the utility of the broader findings to design applications across all three property types. In other words, the findings may be equally applicable to all three space types – apartments, dorms, or houses.

The primary location that students reported studying in was in their bedroom. Figure 4 provides a visualization of all rankings showing that, while bedroom was the top choice for studying, students also reported the living room and dining room spaces frequently among their top three places to study. Outside of the residence, the campus library was the most frequently used space. It is critical to remember, when viewing these results, that this survey was conducted during the pandemic. It may not be the case that so many students study in their bedroom (in comparison, for example, to a coffee shop or library) when these spaces are operating under ‘normal’ conditions. What this item reveals is simply where they report to be studying during pandemic times. It was important to establish this as part of the context

for the adjustment’s respondents reported making to their study space.

Within those that reported the bedroom as their primary study space, the most common body positions for studying were studying in a chair, sitting or lying in bed, or working at a table. Figure 5 shows body positions mapped to the type of residence, but the problems with reporting on the residence data persist in preventing meaningful differentiation between residence types. Some possible trends that merit further study may include that more students in dorms reported sitting or lying on the floor to study than in any other reported residence type. Respondents were also asked to indicate what types of adjustments they had made to their study space. Figure 6 shows the most common adjustments made across all residence type. The most common adjustments that student made were making it more comfortable to sit, making the space quieter, and adjusting the lighting.

As shown in Figure 5, the category of house with parents shows the smallest number reported working at a table. This raises the question of how many students may have dedicated workspace in their bedroom space within the parents’ residence. Even if tables may exist in public areas of the residence, the desire for privacy may explain why respondents seem to choose to study in the bedroom even when a formal study area may not be available within the bedroom space. Further study is needed and suggests that photos of student study spaces would reveal more fine grain

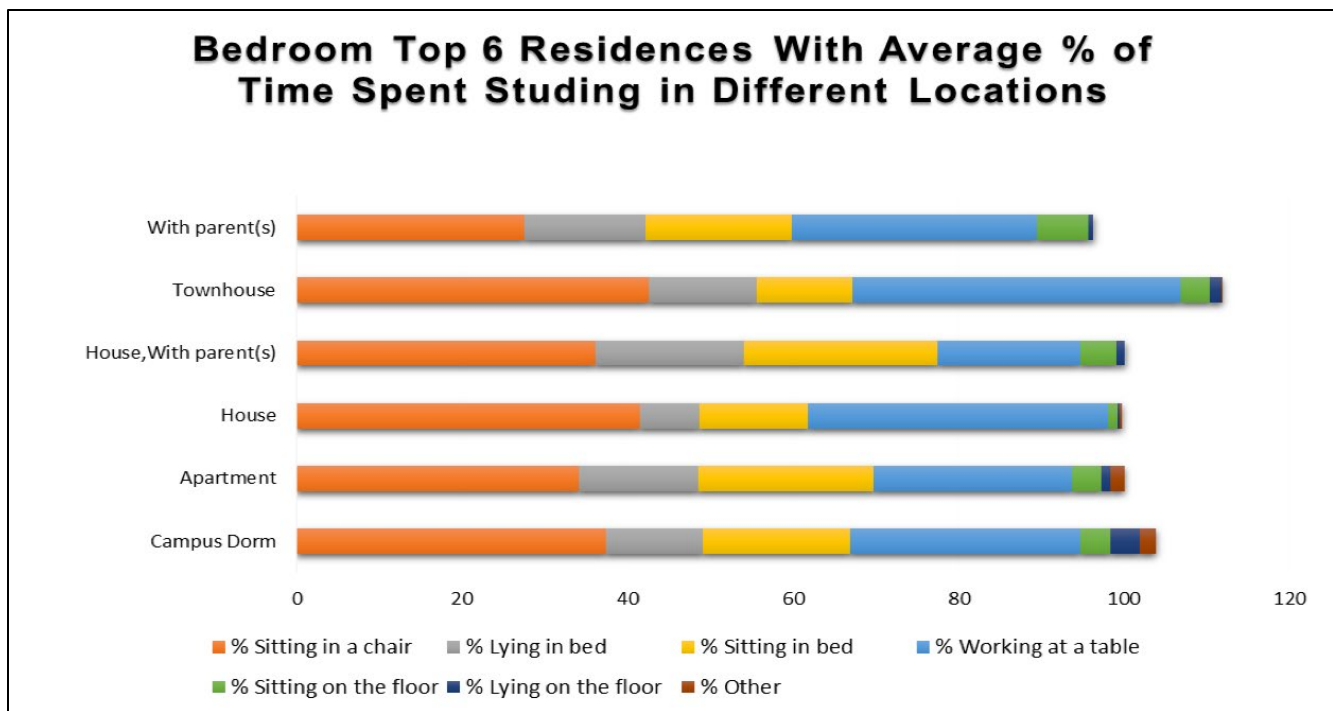


Figure 5. The majority of respondents who identified the bedroom as their primary study space reported that they sit in a chair, sit or lie in the bed, or work at a table to study.

qualitative data by which to interpret the limited statistical data that can be obtained from a close-ended survey.

Adjustments to space, specifically the bedroom space, were positively correlated to overall satisfaction with space, feelings of productivity in the space, and engagement in coursework during remote work sessions. Adjustments to space, though, did not appear to have a meaningful relationship with satisfaction with peer-to-peer connections. Figure 7 summarizes these relationships in four graphs. A respondent who made many adjustments to their study space could be extremely dissatisfied with the level of connection to their peers while one who made few adjustments could be extremely satisfied. One possible explanation for this could be that students who spent less time studying at home, alone, were less likely to make adjustments but more likely to be away from home in a shared study space such as the campus library. More likely, however, would be the interpretation that the physical space has little impact on feelings of connectivity during remote learning. In other words, a respondent who makes the workspaces comfortable, quiet, and well-lit may still struggle to connect with peers if the online learning environment does not natively support peer-to-peer interactions or micro interactions. The potential relationship between physical space and online space in supporting student learning is a subject for further study but there are parallels between the respective bodies of knowledge for human-computer interactions (HCI) and human-environment interactions (HEI).

Areas for Further Study

The impact of the COVID-19 global pandemic and subsequent lockdowns and other alterations to daily life will likely be felt for years to come. Even after universities fully re-open and study spaces such as the library are back to full capacity, habits and patterns created during the pandemic may still linger, affecting behavior and interaction patterns. Students who began to primarily study at home may still choose to study at home, at least part of the time, for convenience’s sake or because they created a supportive study space.

The demonstrated ability for students to learn from anywhere may have long term impacts on the future of higher education. For example, students’ experiences could drive an increase in online and blended course offerings. More flexibility in modality could mean more students choosing to attend classes from home, some or all of the time, and higher education might see an increase in enrollment and degree completion numbers among non-traditional students who were not supported by fully on campus programs of the past. This may also translate to a generation of new graduates who are comfortable *working* from home in spaces similar to how they studied and attended online classes during their undergraduate education. For that reason, what we learn about students’ study spaces today may inform what we need to know about their work-from-home spaces tomorrow.

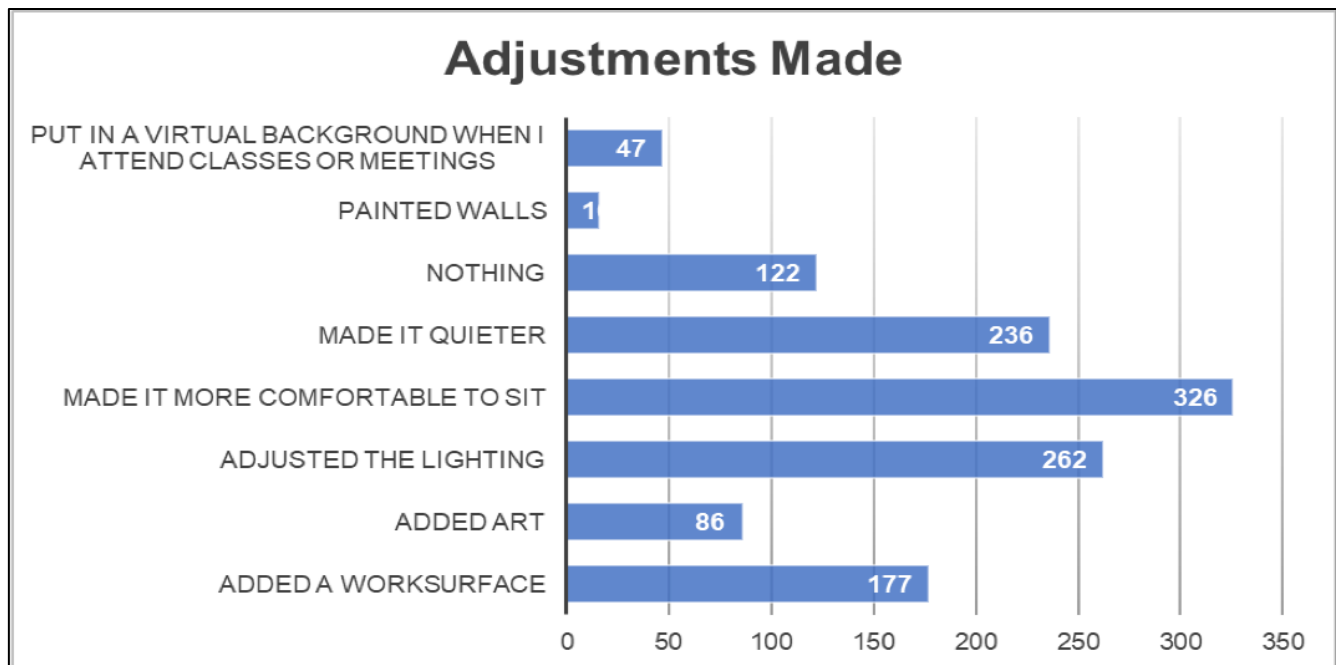


Figure 6. The most common adjustments made to respondents’ study spaces were making it more comfortable to sit, making the space quieter, and adjusting the lighting.

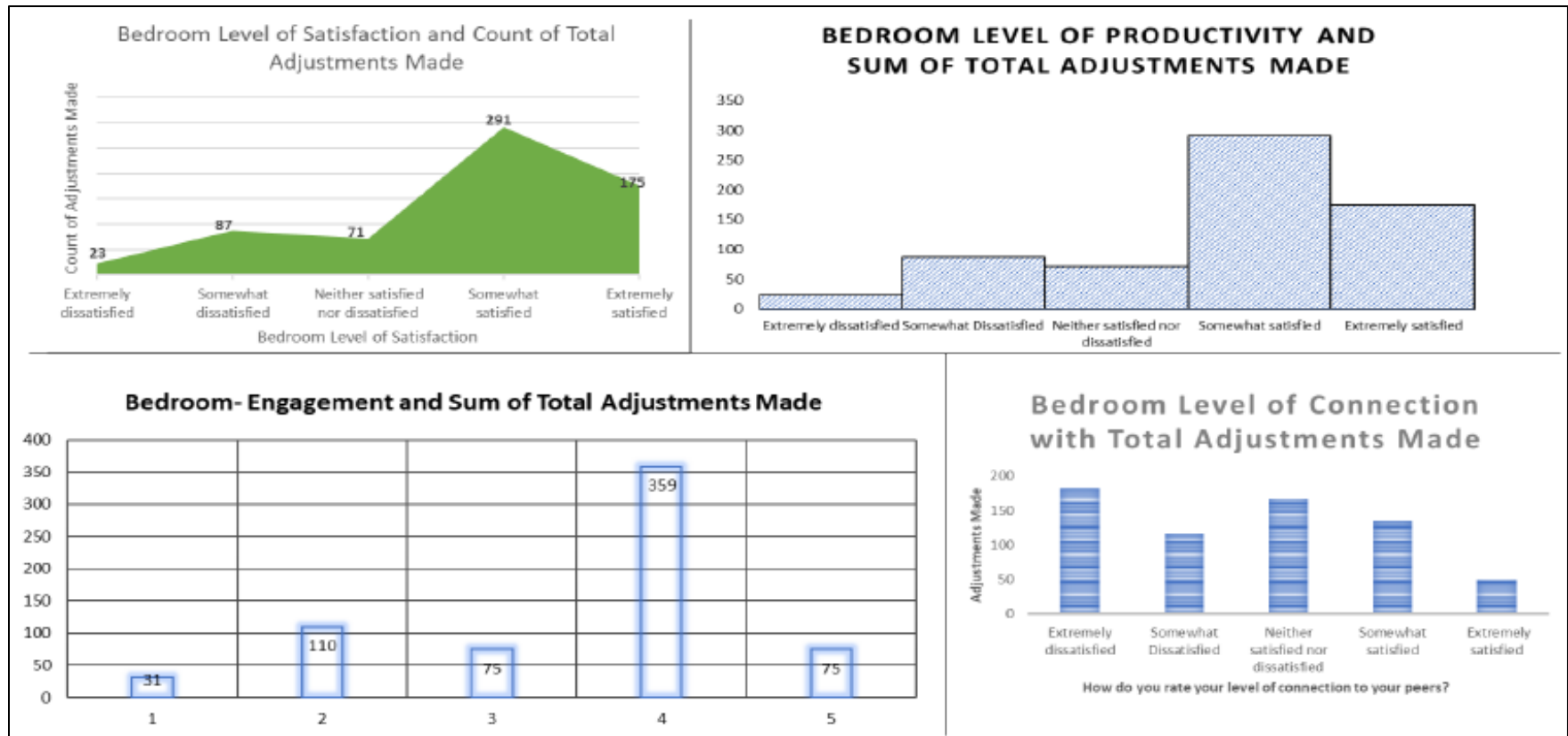


Figure 7. Adjustments made to the bedroom space were positively correlated to overall satisfaction with the space, feelings of productivity in the space, and engagement in coursework during remote work sessions.

In the short term, tracking changes in the same population studied in this project, perhaps by re-administering the survey in a year through the same mechanisms, could provide insight into ongoing patterns of behavior, what changes to the physical environment remained in place, and whether students still preferred to study at home versus on campus or at a coffee shop, even after the greatest pandemic threat has passed.

Conducting a photo-analysis of the actual study spaces that students use at home could provide keen insight into environmental choices that students make when setting up a supportive study space. Identifying common themes that emerge from the photographs could also provide insight into what students are capable of executing within their home space, and what general preferences show up across multiple types of spaces. This information could be used to generate a set of best practices for students who would like guidelines on how to set up a supportive study space within a typical residence.

It is known that campus facilities impact recruitment and retention, which impact the institution's bottom line. What we learn about student study spaces in a remote setting can inform future renovations to areas such as dormitory rooms, common spaces, campus study zones, and tertiary areas including on-campus and off-campus dining and social gathering spaces in which students have been known to study in prior to the pandemic. What is learned about furnishing and features of preferred remote study spaces can also inform selections for a range of institutional interiors. Mock-ups are a common tool used by residence hall furniture manufacturers to communicate with non-designer stakeholders and to test different products and hypotheses related to on-campus residential spaces. Such mock-ups may need to include a broader range of so-called *resimercial* options – blending a residential feel with a commercial durability – in order to accommodate changing needs of this generation of post-pandemic learners.

The population studied in this research was located in the United States. The social practices of American college students and their perceptions of home as learning spaces may not be generalizable to other cultures and geographic locales. Future research could explore how the pandemic has shaped learning in non-US based higher education.

Conclusion

The physical environment matters. Whether that environment is the oft studied institutional study space or the lesser examined residential-study space, when people have the opportunity to shape their space to work in the most supportive way, they tend to be more satisfied, productive, and engaged. In the time of COVID-19, home became the classroom, the library, the learning commons,

and the dining hall. And students who took steps to shape their space to be more supportive reported higher measures of success. In Darwin's Theory of Evolution, this is called survival of the fittest: those who adapt and evolve, survive.

As we see the light at the end of the pandemic tunnel, we must not lose the lessons we've learned during this unprecedented and trying time. Perhaps helping students shape their residential study spaces, even after the threat of a global pandemic has subsided, can enable a generation of empowered students who take ownership of their personal spaces in an effort to succeed academically and professionally. Perhaps in the short-term, by empowering students to make adjustments to their study space we can enable them to emerge from this global threat stronger and more fit than before, educating the learners to become better learners.

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