Effects of Noise Sources on the Perceived Task Performance of Students during Online Class

Jeunise A. Piamonte, Eunice Gabrielle A. Reyes, Krizia Ein Z. Saguibo, Clarice Ann M. Verdeflor, and Ma. Janice J. Gumasing
School of Industrial Engineering and Engineering Management
Mapúa University
Intramuros, Manila, Philippines 1002
jpiamonte@mymail.mapua.edu.ph, eareyes@mymail.mapua.edu.ph,
kezsaguibo@mymail.mapua.edu.ph, camverdeflor@mymail.mapua.edu.ph,
mjjgumasing@mapua.edu.ph

Abstract

The online learning system has been implemented since the sudden global spread of the coronavirus in 2020, forcing students to continue school in their households. This study assessed the relationship between household noise levels and the perceived task performance difficulty of undergraduate students from select private schools in the Philippines. An online survey was conducted, and 202 respondents participated in the 3-part questionnaire consisting of demographics, Noise Exposure Scoring, and Task Performance Difficulty questionnaires. The last two sections were in the form of a 4-point Likert Scale. Statistical analysis included descriptive statistics to demonstrate the result summary in each category and correlation for determining if there is a significant relationship between noise levels and the perceived task performance difficulty. The results showed a moderate positive association between total noise exposure and memorization, analysis, and organization. On the other hand, noise exposure was found to have a weak relationship to judgment and theory application. The result indicated that the students' total noise exposure significantly affected the difficulty of their task performance. Thus, evaluating the impact of noise on cognitive and performance functions would help explain the mental consequences of poor performance.

Keywords
noise exposure, task performance difficulty, online class, noise sources

1. Introduction
The coronavirus disease 2019 (COVID-19) has continuously disrupted almost all existing systems: economic, social, agricultural, and public health, after its sudden unexpected onslaught, and it primarily modified the means of communication and engagements of various sectors and industries (International Labour Organization 2021). The unprecedented health crisis has pushed governments of each country to implement lockdowns, which consequently included the indefinite closures of all educational institutions, forcing schools to resort to the abrupt execution of remote learning (Donnelly et al. 2021). All face-to-face learning activities in the classroom have been halted to prevent COVID-19 transmission among students and school employees, and all classroom instruction is mandated to occur at home.

This current online learning environment leverages internet access, technical devices and resources, several online learning media for synchronous and asynchronous instructional delivery, and academic program management (Huang, 2019; Usher & Barak 2020). Synchronous online learning entails real-time interactions between the teacher and the students, whereas asynchronous online learning takes place without a set schedule for different students (Singh & Thurman 2019). One of the countries which were quick to adopt this system was the Philippines, but this was recently changed through the approval of the Commission on Higher Education (CHED) of the limited face-to-face classes for all degrees in tertiary education back on November 5, 2021 (Rocamora 2021)

With that, the lengthy closure of schools has significantly and continuously affected students' learning progress because although online learning deems efficient, the sudden shift in learning systems has drastically affected students as many still fail to adapt. Regarding economic ramifications, students from lower-income households struggle to find internet access and learning gadgets (Fowler 2020). The health sector was also not free from the reverberations of the ongoing health crisis, as the exposure of students to prolonged screen time contributed to their increasing anxiety and stress (Mheidly et al. 2020). From a small-scale perspective, individual households of students have also affected their progress and task performance in online learning. It decreased student engagement, which hindered their social development and caused feelings of isolation, and loss of motivation (Maryville University 2021).
Additionally, various factors inside the household also play vital roles in determining the progress and performance of a student. Each student can have different levels of performance in the online setting as there exists a variation in environment temperature, personal studying place, comfort levels, and even noise levels of each household (Hendrix 2019). Such factors are deemed crucial in determining a student's learning in the online system, most especially the noise exposure, as it disrupts reading ability and memory, reduces performance accuracy, and causes startle responses that lead to distraction and loss of focus (Jafari et al. 2019).

To expound, noise is an unwanted sound characterized as an annoyance and a stressor in the environment, determined by the intensity, periodicity, frequency, and sound duration (Stansfeld & Matheson 2003). Sound is produced due to changes in air pressure induced by vibration. It generates discomfort, affects communication, and disrupts learning — making it a problem for students participating in online classes (Basrur 2000; Shield & Dockrell 2004). Unwanted background noise in the common learning environments in the Philippines routinely surpasses the World Health Organization's (WHO) limit level during teaching or studying sessions (Ibrahim & Richard 2000). Students engaging in online classes in their households are disturbed by noise pollution. Consequently, continuous exposure to household noises leads to poor learning environments, which place students' cognitive, academic, and professional development at high risk (Cowan 2013).

Although numerous studies have assessed the relationship between noise pollution levels and exposure to the cognitive ability of people, only a few studies focus on its relationship with students' task performance. Fewer are those assessing the relation between noise exposure and student performance during the COVID-19 period, as most studies focused on the impacts of varying noise levels on students enrolled in the traditional face-to-face learning system. No study has explicitly focused on the effect of noise exposure and pollution on undergraduate students during the new online educational system, which this study aims to pursue.

This study mainly intends to assess the relationship between various noise pollution in the household during online classes and its effects on the perceived task performance difficulty of the engineering students of select private schools. Moreover, this paper also aims to determine if its impacts significantly affect the task performance difficulty, namely: memorization, analysis, synthesis and organization, judgment making, and theory application, of the students.

2. Literature Review

2.1. Noise Exposure

According to Jafari et al. (2019), noise has various harmful impacts, ranging from disrupting cognitive processes to harming mental and physical health. Noise pollution is a concern in many workplaces and non-workplace settings. In the United States, 22 million workers are exposed to hazardous noise. The World Health Organization (WHO) estimates ambient noise costs at least 1 million healthy life-years annually in high-income Western European countries. Low noise levels are not as adequate as high noise levels in terms of impairment of cognitive function and power spectral density of the brain, implying that low noise levels are not as acceptable as high noise levels. One of the most familiar environmental exposures in the United States is noise or unwanted sound. Approximately 100 million people are exposed to environmental noise such as traffic and various personal listening devices (Hammer 2014).

According to Khajenasiri et al. (2016), at Shiraz University of Medical Sciences in Shiraz, Iran, 50 average students are 22±4.4 years of age and still in good health. The researchers discovered that a sound level of 110 dB significantly contributed to people's performance, resulting in reduced performance. On the other hand, sound levels of 70 dB and 90 dB exhibited no statistically significant relationship with the mistake rate and length of the performance.

2.2. Task Performance

Braat-Eggen et al. (2017) investigated the correlation between noise disturbance and noisy sources perceived by students when performing academic tasks. According to their findings, when complex cognitive tasks such as studying for an exam, reading, and writing, around 38% of the students were affected by the noise and voice in the background. This coincides with a study by Realyvásquez-Vargas et al. (2020), which analyzed 206 university students online to determine the environmental factors impacting the students' online class performance. Questionnaires were used as the method of data gathering. The researchers found that Mexican students who take online courses are exposed to a higher noise level. Thus, a higher level of distraction negatively impacted the students to accomplish their daily tasks.

2.3. Academic Workload

According to Megaw (2005), workload components are the essential task features influencing human performance that dictate how people complete needed labor and how a person comprehends the task. Task demand is the ratio between the time required to perform a job and the available time to complete it. At the same time, the workload is defined as a combination of an operating system's available resources, task demand, and people's capacity. Workload influences and reduces an individual's ability. An increase in task demand may result in errors and an increase in response time. Furthermore, excessive job workload and complexity are essential variables in performance quality decline (Both et al. 2009).

2.4. Learning Environment

Individual disparities in academic performance have been connected to variances in intelligence and personality (Chukwudi, 2013). He explained that individuals with more vital mental talents (fast learners) as measured by IQ tests and those with higher conscientiousness (related to effort and achievement motivation) tend to perform well in academic environments. Early academic success boosts later success, and many elements play a role in this. It has also been shown that some factors can affect students' academic success at different levels of schooling. Such components include the school environment, curriculum development and implementation, peer influence, home environment, socializing patterns in the home, the location of the house, and technological devices (Anene 2005).

2.5. Noise Environment

Home noise levels appear higher than the recommended indoor noise levels, putting young people at risk of noise-induced discomfort and learning impairment. It concluded that more people in the house reported increased noise levels (Pujo et al. 2014). This is qualitatively poignant in the context of COVID-19, when families may be gathering in homes to support one another during the pandemic and isolating lockdowns. Ali (2013) stated that noise levels were dramatically lowered by eliminating neighboring outdoor road traffic and trains. Students have conveyed that environmental noise levels have negatively affected their academics. Besides studying and learning, the home is designed to provide a variety of activities such as preparing meals, cleaning clothing, resting, playing, practicing hobbies, etc. As a result, unlike a school, the house is not designed to promote academic learning and block distracting noises (Dale et al. 2015). While it is evident that noise has a poor influence on the nuisance and academic performance of the students, it is also crucial to remember that the impact in the general home environment may be considerably more significant (Casey et al. 2017).

3. Methods

3.1. Conceptual Framework

Figure 1 below shows that the research will focus on the noise level in the household and the task performance difficulty of the undergraduate students of select private schools and universities. According to Realyvásquez-Vargas et al. (2020), a study area designed in which unpleasant and uncontrollable environmental elements harm practical human resource sustainability. In this situation, the academic performance of undergraduate students is the aspect that is affected.

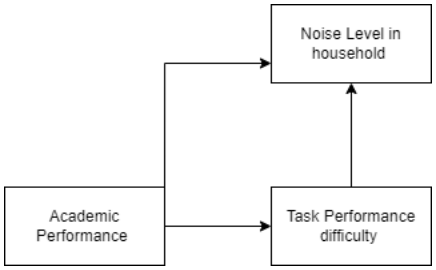

Figure 1. Conceptual Framework

3.2. Respondents of the Study

A survey questionnaire containing two (2) components is utilized in this study: (1) noise exposure and level and (2) student task performance difficulty. First, the demographics section involves age, sex, and college department inputs. The Noise Exposure and Level Scoring Questionnaire utilized in this study is based on the study of Chere and Kirkham (2021) about the impact of noise levels on adolescents' executive function. This first portion consists of 13 items that determine the noise exposure levels of the students in their households, answered by how likely the noise sources occur in their houses. The Student Task Performance Difficulty Questionnaire contains five items in a Likert Scale form. This is based on the Likert Scale by Fox and Hackerman (2003), which evaluates the task performance of undergraduate teaching. The survey was distributed through Google Forms to at least 200 undergraduate students currently enrolled in the 3rd Quarter of the Academic Year 2021 to 2022.

3.3. Ergonomic Tools

In this study, the primary ergonomic tool utilized is the Noise Exposure and Level Scoring Questionnaire, which is in the form of a 4-point Likert Scale. This assesses the noise level the students are exposed to in their household by determining the varying sound levels in their homes characterized by various noise sources indicated in the questionnaire. Noise is categorized under the physical work environment in ergonomics, and in this study, the noise environment of students in their respective households is evaluated.

3.4. Statistical Treatment of Data

Using tabulated descriptions, descriptive statistics are utilized to characterize and summarize the data acquired throughout the survey. They are handy compared to analyzing numerous raw data numbers as they allow a more accessible and efficient understanding of data collection.

Pearson correlation analysis was also used in the study to determine whether the corresponding noise exposure of students has a significant effect on their perceived task performance difficulty. Here, the response variable is the five categories of perceived task performance difficulty. The independent variable is each respondent's total accumulated noise exposure level acquired from their responses. The acquired Pearson Correlation score will determine whether the two variables mentioned have a significant relationship. A negative coefficient value indicates that the relationship between the variables is indirectly proportional and has an inverse relationship. If it is in the positive range, the relationship between the variables is directly proportional and has a direct relationship. A Pearson Correlation score in the range of ± 0.7 to ± 1 indicates a strong relationship between the two variables. If it falls between ± 0.3 and ± 0.7, there is an intermediate relationship between the two variables. And on the other hand, if the score acquired is between 0 and ± 0.3, the relationship is weak.

The Pearson Correlation score is computed by dividing the mean of the XY column by the square root of the product of the sum of the values in the column. The p-value is also assessed as a value lower than 0.05 would mean that the effect of the independent variable on the response variable is statistically insignificant. The correlation analysis is done through the Minitab application, wherein both the Pearson Correlation value and the p-value are shown as the results.

4. Results and Discussion

4.1. Demographic Profile of Respondents

The researchers surveyed 202 undergraduate students from select colleges and universities in the Philippines. 24.80% are from Industrial Engineering and Engineering Management (IE-EMG), 20.80% from Electrical, Electronics, and Computer Engineering (EECE), 14.90% from Civil, Environmental and Geological Engineering (CEGE), 10.90% from Chemical, Biological, and Materials Engineering and Sciences (CBMES), 5.90% from Architecture, Interior Design and the Built Environment (ARIDBE), 4% from Social Media Studies (SMS), 4% Enrique T. Yuchengco School of Business and Management (ETYSBM), 3% from School of Social Sciences and Education (SSSE), and 3% from School of Information Technology (SOIT). As for the sex, 53.50% of the respondents are female, while 46.50% are male. Since the study targets undergraduate college students, most of the respondents are above 20 years of age, with 51.50% being 20 years old, 12.90% being 21 years old, 11.90% being 22 years old, 1% being 23 years old, another 1% are 25 years old, 19.80% are 19 years old, and 2% are 18 years old.

4.2. Noise Exposure Results

The second part of the data gathering utilizes the Noise Exposure and Level scale from the study of Chere and Kirkham (2021) about the effect of noise levels on adolescents' executive function. The researchers have modified the scale to fit the respondents for this study. In this portion of the questionnaire, 13 noise sources were used as factors to characterize the noise exposure of the students in their household, namely: sound device presence, frequency of house guests, loud conversations, people leaving and entering the house, traffic noise, opened doors and windows, door noises, call noises, noise from the people outside, running water noises, appliance noises, exterior house noises, and hobby noises from people in the house. The respondents were required to rate how likely they hear the mentioned noise sources in their household with the following ratings: 1 = not at all like our household; 2 = rarely like our household; 3 = somewhat like our household, and 4 = very much like our household. The summary of the results is shown in Table 1 below.

Table 1. Summary of Noise Exposure Results

Noise Level Rating	Sound Device Presence	Frequency of House Guests	Loud Conversations	People Leaving & entering	Traffic Noise	Opened Doors & Windows	Door Noises
1	7	27	8	10	25	20	11
2	24	48	34	39	38	27	33
3	31	22	36	32	19	29	24
4	39	4	23	20	19	25	33

Noise Level Rating	Call Noises	Hobby Noises	Appliance Noise	Exterior Noise	Running Water Noise	Noises from people outside
1	8	19	20	27	38	13
2	27	28	36	41	36	36
3	32	26	32	16	16	31
4	34	28	13	17	11	21

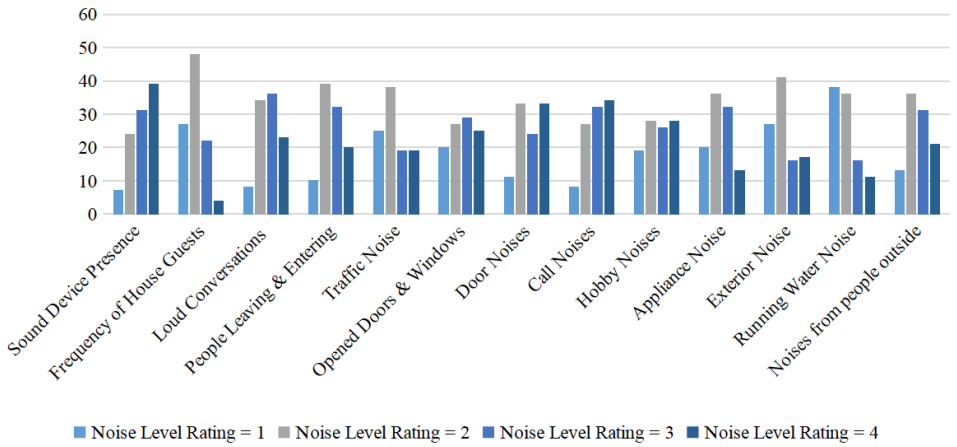

Figure 2. Clustered Chart Representing the Noise Level Rating for Each Noise Source

Based on Table 1 and Figure 2, it was found that 38.61% of the respondents said that sound device is always turned on in their houses, while 30.69% said that sound devices are turned on only sometimes, 23.76% said rarely, and 6.93% said that sound devices are not turned on in their homes at all. Next, only 3.96% of the respondents said that they always have guests in their home, while 21.78% said this is only the case sometimes, 47.52% said that this is rare, and 26.73% said that they do not have guests in their homes at all. As for loud conversations, 22.77% said that the people in their house constantly engage in loud conversations, which causes the disturbance. In comparison, 35.64% said that this only happens sometimes in their house, 33.66% said that it is rare that people talk loudly at home, and only 7.92% said that no one engages in loud conversations in their households. Next, 19.8% of the respondents said that people are always leaving and entering their house, which disrupts their activities because of the footstep noises, while 31.68% said that people only enter and leave their house sometimes, 38.61% said that it is rare that people enter and leave their home, and only 9.9% said that people do not often enter and leave their house.

As for the traffic noise, which a commonly known as noise pollution, 18.81% of students said they always hear traffic noise from vehicles in their house, the same number of students said that they sometimes hear the traffic noise, 37.62% said that traffic noises could rarely be heard in their homes, and 24.75% said they never hear traffic noises in their house. For the next noise source, which is opened doors and windows, 24.75% of the respondents said that this always occurs in their households. In comparison, 28.71% said that this only happens sometimes, 26.73% said this is rarely the case in their households, and only 19.8% said that the doors and windows in their houses are never left open. Concerning the previous noise source, door sounds can also be considered as 32.67% of the respondents said that their doors make loud noises when opened and closed, while 23.76% said that their doors sometimes make noise, then 32.67% said that this is a rare occurrence in their houses. Only 10.89% said that the doors in their houses do not make sounds when opened and closed. For the next noise source, which is the calls received at home, 33.66% said that the people in their house often make and receive calls, while 31.68% said that this only happens sometimes, then 26.73% said that it is rare that people make and receive calls in their house, and only 7.92% said that calls are not made and received in their households.

Family members have different hobbies, which can contribute to the noise level of the house. It was found that 27.72% of the respondents had a family member with a noisy hobby in their house, while 25.74% said that sometimes the hobbies of the people in their house are noisy, then 27.72% said that this is rarely the case in their household. Only 18.81% said that the people in their house do not have hobbies that have loud noises. Next, it is normal for households to have appliances for their daily chores, and with that, 12.87% of the respondents said their household appliances emit loud noises, while 31.68% said that this is somewhat the case in their household, then 35.64% said that it is rare for their appliances to emit loud noises, and 19.8% said that their appliances do not emit loud noises at all. On the other hand, noises from the exterior of the house can also contribute to the noise level of one's household, as 16.83% confirmed this is very much the case for them. In comparison, 15.84% said that this somewhat occurs in their household, the majority, 40.59%, said that this rarely happens in their case, and 26.73% said that this does not occur in their households at all.

Another noise source contributing to households' noise levels is the noise from running water. In the survey, only 10.89% of the respondents said that running water noises are prevalent in their houses. In comparison, 15.84% said that it is somewhat prevalent, then 35.64% said that this is rarely the case in their households, and 37.62% said that running water noises is not prevalent in their houses. Lastly, noises from the people passing by outside is also a problem that many students consider noise pollution. It was found that 20.79% of the respondents stated that they could very much hear neighbors from the other houses even if they were inside, while 30.69% stated that their neighbors could somewhat be heard even if they were inside, then 35.64% indicated that their neighbors inside their homes could rarely be heard, and only 12.87% said that their neighbors could not be heard inside their households at all.

4.3. Task Performance Difficulty Results

The last part of the questionnaire is the task performance difficulty, which utilizes a 4-Point Likert Scale. This portion of the questionnaire has five items aimed at understanding the perceived task performance difficulty of the students in the academic activities for the current school year. This scale was based on the study by Fox and Hackerman (2003), in which they evaluated the undergraduate teaching task performance in science, technology, engineering, and mathematics. The five items used as factors in this portion are memorization, analysis, synthesis and organization,

judgment making, and theory application. The descriptive counterparts of the ratings are 1= I do not find it difficult, 2 = I rarely find it difficult, 3 = I find it quite difficult, and 4 = I find it very difficult. The summary of how many students voted in each of the four ratings of the 5 task performance difficulty categories is shown below in Table 2.

Table 2. Summary of the Number of Students Voting from the Ratings of the Task Performance Difficulty Categories

Task Performance Rating	Memorization	Analysis	Synthesis & Organization	Judgment Making	Theory Application
1	6	0	2	0	3
2	16	14	21	21	18
3	44	47	49	48	35
4	36	40	29	32	45

4.4. Pearson Correlation Analysis Result

The task difficulty factors were tested to determine whether they have a significant association with the total noise exposure score of the respondents, such as memorization, analysis, synthesis and organization, judgment making, and theory application. The null hypothesis states no significant relationship exists between the total noise level scores and the task performance difficulty. Pearson correlation analysis had found a moderate association between noise exposure and memorization ($r=474$, p-value<0.001), noise exposure and analysis ($r=412$, p-value<0.001), and noise exposure and synthesis & organization ($r=405$, p-value<0.001). On the other hand, judgment making and theory application had a weak correlation to noise exposure having an R-value of 0.209 and 0.258, respectively. The results are shown in Table 3.

Table 3. Pearson Correlation Scores and P-Values: Total Noise Exposure Score vs. Task Performance Difficulty

Factor	Pearson Correlation	P-Value	Interpretation
Memorization	0.474	<0.001	significant
Analysis	0.412	<0.001	significant
Synthesis & Organization	0.405	<0.001	significant
Judgment Making	0.209	0.082	Insignificant
Theory Application	0.258	0.093	Insignificant

According to the findings, students are particularly affected by the noise of individual external events, which negatively impact undergraduate students' performance during online learning. Overall, the study's findings confirmed the effect of noise on performance, which was validated by the study of Muzammil (2002). Therefore, if safety concerns are not addressed in online learning environments where students are exposed to external noise generated by the environment, performance and productivity will suffer significantly.

An institute that offers online courses should pay close attention to the audio quality during classes. The most objective method of identifying quality issues is to use an online audio quality monitoring tool that analyzes and displays multiple quality parameters such as noise level, echo level, voice level, jitter, and delays. Corrective action can be taken based on the monitoring tool's findings. Such actions could be reactive to sporadic quality issues or proactive to deal with recurring quality issues.

5. Conclusion

Overall, the present study assessed the relationship between the noise exposure of students in their households during online learning and the perceived task performance difficulty in five categories: memorization, analysis, synthesis and organization, judgment making, and theory application. Data used were gathered from 202 undergraduate students in select universities through an online survey. The survey consisted of 3 portions: demographics, Noise Exposure Level Scoring, and the Task Performance Difficulty questionnaire. The Noise Exposure and Level Scoring consisted of 13 items wherein the likelihood of the occurrence of 13 different noises in the households of the students was asked. These 13 items were namely: sound device presence, frequency of house guests, loud conversations, people leaving

and entering the house, traffic noise, opened doors and windows, door noises, call noises, noise from the people outside, running water noises, appliance noises, exterior house noises, and hobby noises from people in the house.

Pearson correlation analysis found a moderate association between noise exposure and memorization, noise exposure and analysis, and noise exposure and synthesis & organization. On the other hand, judgment making and theory application had a weak correlation to noise exposure. Thus, it can be inferred that the noise level exposure and the various noise pollution sources in the online class environment significantly impact their task performance difficulty.

This confirmed the principal concept of the impact of noise in the physical work environment as it is expected for noise sources to cause physiological and psychological effects on humans. Some possible effects that can be presumed in the case of students include distraction, annoyance, and interference with people's thinking and cognitive processes, which students are expected to experience when engaging in online classes inside their households. In conclusion, the formulated null hypothesis for the correlation analysis was accepted, and the alternative hypothesis was rejected as the results suggest that the total noise exposure and level of the students have no significant impact on their perceived task performance difficulty. It should be considered that the sample size for the respondents is relatively small because of the time constraints, and it should be noted that this might have contributed to the results of the study.

References

Ali, S. A., Study effects of school noise on learning achievement and annoyance in Assiut City, Egypt. Applied Acoustics, 74(4), 602-606, 2013. doi:10.1016/j.apacoust.2012.10.011

Anene, G. U., Home environment and the academic performance of a child, Journal of Home Economics Research, 6(1), 99-100,2005. Retrieved from http://www.sciepub.com/reference/224125

Basrur, S.V. (2000), Health Effects of Noise, City of Toronto Community and Neighborhood Services Toronto Public Health, Health Promotion and Environment Protection Office

Braat-Eggen, P. E., Van Heijst, A., Hornikx, M., & Kohlrausch, A., Noise disturbance in open-plan study environments: A field study on noise sources, student tasks and room acoustic parameters. Ergonomics, 60(9), 1297-1314,2017. doi:10.1080/00140139.2017.1306631

Both, F., Hoogendoorn, M., van Lambalgen, R. M., Oorburg, R., & de Vos, M. (2009). Relating Personality and Physiological Measurements to Task Performance Quality. In N. Taatgen, & H. van Rijn (Eds.), Proc. of the 31th Annual Conference of the Cognitive Science Society, CogSci, 09(2819-2825). Cognitive Science Society.

Casey, J. A., Morello-Frosch, R., Mennitt, D. J., Fristrup, K., Ogburn, E. L., & James, P., Race/ethnicity, socioeconomic status, residential segregation, and spatial variation in noise exposure in the contiguous United States. Environmental Health Perspectives, 125(7), 077017,2017. doi:10.1289/ehp898

Chere, B., & Kirkham, N. (2021). The negative impact of noise on adolescents' Executive Function: An online study in the context of home-learning during a pandemic. Frontiers in Psychology, 12. doi:10.3389/fpsyg.2021.715301]

Chukwudi, O. C. (2013). Academic Performance of Secondary School Students: The effects of Home Environment. Ibadan, Nigeria: Double Gist.

Cowan, N., Working memory underpins cognitive development, learning, and Education. Educational Psychology Review, 26(2), 197-223,2013. doi:10.1007/s10648-013-9246-y

Dale, L. M., Goudreau, S., Perron, S., Ragettli, M. S., Hatzopoulou, M., & Smargiassi, A., Socioeconomic status and environmental noise exposure in Montreal, Canada. BMC Public Health, 15(1). doi:10.1186/s12889- 015-1571-2,2015.

Fowler, S. (2020, June 23). Effects of poverty on education during distance learning. Retrieved from https://www.adoptaclassroom.org/2020/06/23/effects-of-poverty-on-education-during-distance-learning/

Fox, M. A., & Hackerman, N. (2003). Chapter 13: The College Student Report 2001. In Evaluating and improving undergraduate teaching in science, Technology, engineering, and Mathematics (pp. 147-150). Washington, D.C.: National Academy Press. Retrieved from https://nap.nationalacademies.org/read/10024/chapter/13.

Hammer, M. S., Swinburn, T. K., & Neitzel, R. L., Environmental noise pollution in the United States: Developing an effective public health response. Environmental Health Perspectives, 122(2), 115-119,2014. doi:10.1289/ehp.1307272

Hendrix, E. (2019, December 19). How your surroundings affect the way you study. Retrieved from https://www.ucas.com/connect/blogs/how-your-surroundings-affect-way-you-study

Huang, Q., Comparing teacher's roles of F2F learning and online learning in a blended English course. Computer Assisted Language Learning, 32(3), 190-209,2019. doi:10.1080/09588221.2018.1540434

Ibrahim, Z. H., & Richard, H. K., Noise pollution at school environment located in residential area. Journal of Civil Engineering, 12(2), 47-62,2000. Retrieved from https://engineering.utm.my/civil/mjce/wp-content/uploads/sites/40/2013/10/Noise-Pollution-at-School-Environment-Located-in-Residential-Area.pdf

International Labour Organization. (2021, July 3). COVID-19 and the world of work. Retrieved from https://www.ilo.org/global/topics/coronavirus/lang--en/index.html

Jafari, M. J., Khosrowabadi, R., Khodakarim, S., & Mohammadian, F., The effect of noise exposure on cognitive performance and brain activity patterns. Macedonian Journal of Medical Sciences, 7(17), 2924-2931,2019. doi:10.3889/oamjms.2019.742

Khajenasiri, F., Zamanian, A., & Zamanian, Z., The effect of exposure to high noise levels on the performance and rate of error in manual activities. Electronic Physician, 8(3), 2088-2093,2016. doi:10.19082/2088

Maryville University. (2021, March 29). Impact of online education on families. Retrieved from https://online.maryville.edu/blog/impact-of-online-education/

Megaw, T. (2005). The definition and measurement of mental workload (J. R. Wilson & N. Corlett, Eds.). Evaluation of Human Work (3rd ed.), 525-551. doi:10.1201/9781420055948.ch18

Mheidly, N., Fares, M. Y., & Fares, J. (2020). Coping with stress and burnout associated with telecommunication and online learning. Frontiers in Public Health, 8. doi:10.3389/fpubh.2020.574969

Muzammil M, Hasan F. Human performance under the impact of continuous and intermittent noise in a manual machining task. Noise Vib Worldwide. 2004;35:10–15. doi: 10.1260/0957456041589836

Pujol, S., Berthillier, M., Defrance, J., Lardies, J., Levain, J., Petit, R., . . . Mauny, F., Indoor noise exposure at home: A field study in the family of urban schoolchildren. Indoor Air, 24(5), 511-520,2014. doi:10.1111/ina.12094

Realyvásquez-Vargas, A., Maldonado-Macías, A. A., Arredondo-Soto, K. C., Baez-Lopez, Y., Carrillo-Gutiérrez, T., & Hernández-Escobedo, G. (2020). The impact of environmental factors on academic performance of university students taking online classes during the COVID-19 pandemic in Mexico. Sustainability, 12(21), 9194,2020. doi:10.3390/su12219194

Rocamora, J. L. (2021, November 05). Limited F2F classes 'in all degrees' approved under Alert Level 2. Retrieved from https://www.pna.gov.ph/articles/1158874

Shield, B., & Dockrell, J. E., External and internal noise surveys of London Primary Schools. The Journal of the Acoustical Society of America, 115(2), 730-738,2004. doi:10.1121/1.1635837

Singh, V., & Thurman, A. (2019). How many ways can we define online learning? A systematic literature review of definitions of online learning (1988-2018). American Journal of Distance Education, 33(4), 289-306. doi:10.1080/08923647.2019.1663082

Stansfeld, S. A., & Matheson, M. P., Noise pollution: Non-auditory effects on health. British Medical Bulletin, 68(1), 243-257,2003. doi:10.1093/bmb/ldg033

Usher, M., & Barak, M., Team diversity as a predictor of innovation in team projects of face-to-face and online learners. Computers & Education, 144, 103702,2020. doi:10.1016/j.compedu.2019.103702

Biography

Jeunise A. Piamonte is a 3rd-year undergraduate college student in Mapúa University, School of Industrial Engineering and Engineering Management, Intramuros, Manila. She is currently taking up Bachelor of Science in Industrial Engineering. Her research interests include engineering management and work study and measurement. She is the academic head of the Philippine Institute of Industrial Engineers - Mapúa Student Chapter.

Eunice Gabrielle A. Reyes is a 2nd-year undergraduate college student in Mapúa University, School of Industrial Engineering and Engineering Management, Intramuros, Manila. She is currently taking up Bachelor's-Master of Science in Industrial Engineering. Currently, she is a member of the Philippine Institute of Industrial Engineers - Mapúa Student Chapter. Her previous studies tackle antibiotic removal in wastewater and comparative analysis on the factors affecting student performance in online classes.

Krizia Ein Z. Saguibo is a 2nd-year undergraduate college student in Mapúa University, School of Industrial Engineering and Engineering Management, Intramuros, Manila. She is currently taking up a Bachelor of Science in Industrial Engineering. She is currently a member of the Production and Operations Management Association of the Philippines – Mapúa Student Chapter.

Clarice Ann M. Verdeflor is a 2nd-year undergraduate college student in Mapúa University, School of Industrial Engineering and Engineering Management, Intramuros, Manila. She is currently taking up Bachelor of Science in Industrial Engineering. She took Practical Research in her years as a Senior High School student at Mapúa University – Makati.

Ma. Janice J. Gumasing is an Associate Professor in the School of Industrial Engineering and Engineering Management at Mapua University. She has earned her B.S. degree in Industrial Engineering, Master of Engineering degree, and Ph.D. in Industrial Engineering from Mapua University. She is a Professional Industrial Engineer (PIE) with over 15 years of experience. She is also a professional consultant for Kaizen Management Systems, Inc. She has taught courses in Ergonomics and Human Factors, Cognitive Engineering, Methods Engineering, Occupational Safety and Health, and Lean Manufacturing. She has numerous international research publications in human factors and ergonomics. She has been awarded a Woman in Academia (WIA) 2019 during the International Conference of Industrial Engineering and Operations Management held in Bangkok, Thailand; the Young Researcher Award at the 2020 International Conference of Industrial Engineering and Operations Management in Dubai, UAE; and the Outstanding Conference Contributor Award at the 2021 International Conference of Industrial Engineering and Operations Management in Singapore.