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HOW TO TEACH COLLEGE AVIATION STUDENTS ABOUT SITUATION AWARENESS IN A VIRTUAL CLASSROOM SETTING

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Creating a group class project to demonstrate situation awareness (SA) can be an effective pedagogical approach. By engaging students in such projects, they can understand the meaning of SA — comprehension of relevant information in a dynamic environment (Durso et al., 2007). In an SA class taught at an aeronautical university during the past several years, students engaged in observational and interactive projects. However, COVID-19 has prohibited in-person activities. In lieu of such in-person activities, students enrolled in a virtual SA class during summer 2020 utilized online road cameras found at traffic intersections in Madrid, New York, and Tokyo. This alternative approach allowed students to observe apparent SA of pedestrians across different cultures. Distinct differences were found. Pedestrians in New York seemed to have better SA than pedestrians in the other cities. Pedestrians in Tokyo seemed more compliant; whereas pedestrians in Madrid were less compliant and appeared to have poor SA. This virtual group project satisfied a viable approach to collecting SA data, as well as an effective pedagogical lesson for teaching SA.

A typical graduate college course includes lectures, discussion, assigned papers, and individual and group projects. Group projects can be an effective pedagogical tool because it permits students to participate in active learning. Active learning engages students to be creative in a meaningful learning process through relevant activities (Robertson, 2018). As part of the course objective of a "Situation Awareness and Performance" class taught at an aeronautical university, students engaged in collaborative learning such as group projects. By engaging students in such projects, they can develop a deeper appreciation of theories and applications related to situation awareness (SA). In past years, class projects included observations and surveillance at EPCOT (Dattel et al., 2017), a baseball game, a gambling casino night cruise, and at a paintball range. These group outings to achieve the goals of the project were conducted in person. However, due to COVID-19 the class decided to conduct a real-time virtual observation that would be an effective alternative to the previous classes' SA projects to develop SA skills. This paper discusses two objectives: a) benefits and techniques of learning SA in a virtual group project and b) the results found from the research design.

SA is an important aspect of safe operation of an aircraft**.** Endsley (1988) defined SA as "the perception of elements in the environment within a volume of time and space; comprehension of their meaning; and projection of their status in the future" (p.97). Durso, Rawson, & Girotto (2007) stated that SA is the comprehension of relevant information in a rapidly changing environment. The Federal Aviation Administration (1991) considers SA as a key element to safe decision making. The "Situation Awareness and Performance in Aviation/Aerospace" class taught during the last several years included students with a variety of interests and occupation, including instructor pilots, airport managers, aviation technicians, and air traffic controllers. Student course evaluations invariably included two main themes: how little knowledge of SA students realized they had before enrolling in the course (especially students such as instructor pilots who thought they were quite knowledgeable about SA prior to enrolling in the course); and how much better their task performance was by successfully applying SA to their current jobs.

In addition to aviation, SA is also utilized in other fields such as healthcare. Chang et al. (2017) conducted a study that revealed the advantages of simulation-based training of SA over lecture-based training. Chang et al. found that simulation-based training of SA yields better SA at the perception level compared to lecture-based training. Unfortunately, there is almost no research available on teaching SA in the aviation domain. Lectures and scenario-based training are targeted at improving decision-making ability and the application of learning. However, it would be beneficial to develop training that is primarily aimed at improving SA of student pilots, as well as instructor pilots.

Virtual learning (VL) has been a mode of delivering education for several years. The current COVID-19 pandemic situation has prompted online learning to become more practical and probable in many educational institutions. Several universities have transitioned to teaching online applications using internet platforms (e.g., Zoom, Microsoft Teams). The number of virtual schools in North America has increased significantly since 1995 (Beck & LaFrance, 2017). VL is a process conducted through a digital platform that commonly takes place in an online environment. There appears to be no specific benefit or detriment to online learning other than convenience. If designed properly, online student satisfaction and academic performance are equal to traditional in-person class instruction (Hara & Kling, 1999; Nguyen, 2015). Petrides (2002) argued that students felt it was more convenient to collaborate with classmates in an online course because the arrangement of in-person schedule would not be required. Online learning can be a good substitute for the traditional classroom learning, especially in circumstances like a pandemic situation.

The importance of online learning needs to be acknowledged for two reasons. First, the current unprecedented pandemic situation can impose difficulties to host traditional in-person class meetings; thus, virtual education needs to be incorporated to manage the situation. Second, online learning should be maintained even after the pandemic is over if the benefits of this education mode can be extended. Our experience of online learning currently has prepared us to adapt this learning mode as an effect pedagogical approach to future education. Muthurprasad, Aiswarya, Aditya, and Jha (2021) analyzed the benefits of online learning including the time flexibility and convenience where students could study at their own pace at their own convenient time and locations. Conversely, conflicting factors such as technological constraint, lack of direct interactions and engagement, and students' inefficacy toward learning were

impacting the effectiveness of online education. VL expands education accessibility which primarily benefits students in rural areas, assuming they have a stable internet connection. The asynchronous courses allow students to participate according to their own time suitability, which can improve time management skills. Accessibility of internet during a learning process can offer opportunities for students to explore broad information related to the curriculum. VL encourages the development of student's digital skills and independence.

Due to COVID-19, many educational institutions have been forced to restructure in-person teaching and VL has been imposed at nearly all levels of education. Because the pandemic has shifted the way of teaching, revised pedagogy and andragogy approaches are constantly being modified that tests the effectiveness of education quality in such unprecedented times. This paper provides an example of a modified approach to learn about SA by conducting a group project in a virtual environment.

Method

Thirteen graduate students were registered for the Situation Awareness and Performance in Aviation/Aerospace class offered in the summer of 2020. Due to COVID-19 restrictions, the class was conducted synchronously online. Students considered several SA projects that could be executed remotely and chose to study pedestrian behaviors via webcam observations at busy crosswalk intersections in Tokyo, Madrid, and New York City. Students agreed to observe the behaviors during a weekend evening local time, when it was expected that residents and tourists would be active. The students also considered a variety of behaviors to observe, ultimately deciding on a set of five behaviors that could be observed at each chosen intersection.

Participants

A total of 7,058 pedestrians were observed at three locations: 5,214 at the Shibuya intersection in Tokyo, 1,548 at the Puerta Del Sol intersection in Madrid, and 296 (small number due to rain) at the 45th Street and 7th Ave. intersections in Times Square in New York City. Pedestrians in Tokyo were observed from 10:00pm – 11:00pm local time on Friday, July 10, 2020. Pedestrian in Madrid were observed from 10:30pm – 11:30pm local time on Friday, July 10, 2020. Pedestrians in New York were observed from 9:50pm – 10:50pm local time on Saturday, July 11, 2020.

Materials and Procedure

Each student agreed to observe two of the three intersections identified; thus, each intersection was observed by eight or nine students. During the hour-long observation, two students were assigned to observe each behavior using the frequency observation method and to record the behaviors using event sampling. The students viewed webcams located at each location in real time. For scoring purposes, the students recorded behaviors through Zoom. The specific pedestrian behaviors observed are indicated in Table 1.

After the initial observations and data collection, six students volunteered to continue work on the project. Each video (recording of a city intersection) was reviewed by two student

researchers for accuracy. Video recording playbacks were conducted for every light change cycle until full agreement of pedestrian behaviors between researchers was established.

Table 1. *Specific Pedestrian Behaviors Observed in Each City*

Questions
How many people were outside the marked lines of the crosswalk when they crossed?
How many pedestrians started to cross before the crosswalk light turned green? (False Start)
How many people hesitated to start crossing once the crosswalk light turned green?
How many people were still in the crosswalk with the crosswalk light turned red?
How many people were trying to overtake others in the crosswalk?

Results

Five types of pedestrians' abnormal behaviors were observed when 7058 pedestrians crossed the roads in three cities. A chi-square test for independence was run. There was a significant difference between the number of pedestrians outside of crosswalks and cities, χ^2 (2) = 1048.06, p <.001. A significant difference was between cities for the number of pedestrians who conducted false starts, χ^2 (2) = 2175.02, p <.001. There was a significant difference between cities for the number of pedestrians who hesitated when crossing, χ^2 (2) = 76.043, p <.001. The chi-square test also showed a significant difference between cities for the number of pedestrians remaining in the crosswalks when the signal turned red, χ^2 (2) = 307.96, p <.001. However, no difference was found between the number of pedestrians who overtook others when crossing in the crosswalks, χ^2 (2) = 3.169, p = .205. Observed frequencies and percentages of pedestrian numbers for each type of crossing behavior are presented in Table 2. The data indicate that pedestrians in different cities are associated with different crossing behaviors. Figure 2 illustrates the percentages of each type of participants' behavior in different cities.

Table 2. *Frequencies for Participants' Behaviors in Different Countries (N = 7058)*

Behaviors	Tokyo		New York		Madrid	
	n	%	*n*	%	*n*	%
Outside of Crosswalks	1640	30.45	14	4.73	1141	73.71
False Start	64	1.23	20	6.76	659	42.57
Hesitation	332	6.37	13	4.39	13	.84
In Crosswalks when Red	1339	25.68	9	3.04	111	7.17
Overtaking Others	103	1.98	9	3.04	24	1.55

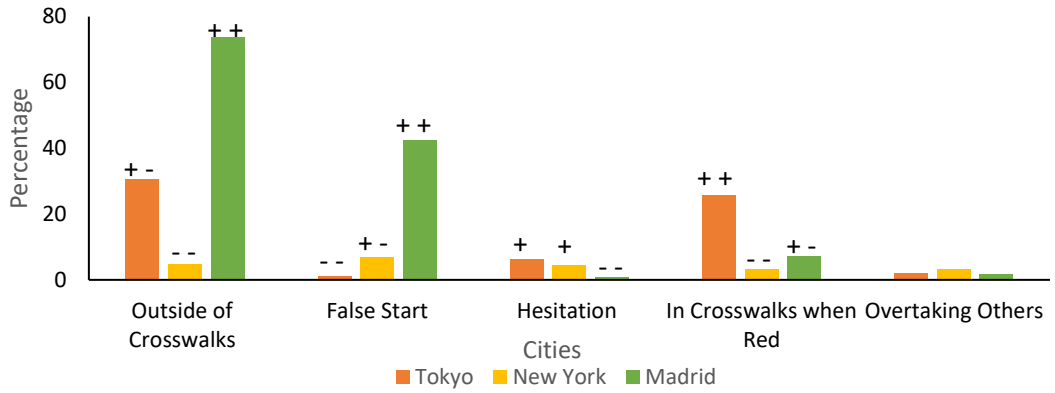

Figure 2. Percentage of Participants' Behaviors in Different Cities. A positive (+) symbol indicates a significant greater number of behaviors than a corresponding negative (-) symbol. For example, Madrid had more behaviors outside of the crosswalk than both Tokyo and New York, and Tokyo had more behaviors outside the crosswalk the New York.

Discussion

The Situation Awareness and Performance in Aviation/Aerospace graduate course has been offered for 5 years. Typically, the course is taught in a seminar format where students and instructor sit at a conference table and share ideas about theories and applications of assigned articles, job–related experiences, and personal insights and intuitions. There were challenges for the most recent class due to the move to a synchronous online environment. Nonetheless, two themes emerged from the course evaluation comments. First, many students felt that the course was quite successful despite it being offered online. Second (as can be seen in Table 3), it is hard to recognize that the course was not offered as an in-person traditional classroom setting.

Table 3. *Students' Comments after Taking the SA Course in a Synchronous On-line Format*

Elements That Most Helped You Learn	Elements That Least Helped You Learn
"I can learn about Situation Awareness through various important articles, and actual examples of aviation. This class has been very helpful for me to understand the subject clearly." "Guided discussion session during class." "Doing it online was different, but I think we achieved the same learning outcome as if we were to do it in person. The professor was engaging and available to answer our questions." "The open class discussions are fantastic. It supports for open-mindedness and a co-creative environment. Really enjoyed the feedback on out presentations." "The readings and class discussions were outstanding! I have learned so much about SA that I didn't know was possible"	"I am very much satisfied with this lecture so I do not have any opinions about this question." "Nothing it was ***** 5 star!! Outstanding."

The group project brought the class "together" in a virtual environment. The class discussed some pedestrian behaviors of SA, even pointing out how several vehicles in Madrid had to stop because pedestrians were in the crosswalk when the vehicles had the right-of-way. Interesting class discussion about cultural differences and possible relationships to SA were proposed. The synchronous online Situation Awareness and Performance class proved to be just as successful as previous in-person class, in addition to being able to complete the class' favorably mentioned and renown group project.

References

Beck, D. & LaFrance, J. (2017). Online schooling in the United States: A response to Saultz and Fusarelli. *Journal of School Choice*, *11*(1), 42-59. https://doi:10.1080/15582159.2016.1272937

Chang, A. L., Dym, A. A., Venegas-Borsellino, C., Bangar, M., Kazzi, M., Lisenenkov, D., Qadir, N., Keene, A., & Eisen, L. A. (2017). Comparison between simulation-based training and lecture-based education in teaching situation awareness. A randomized controlled study. *Annals of the American Thoracic Society*, *14*(4), 529-535. https://doi.org/10.1513/AnnalsATS.201612-950OC

Dattel, A. R., Babin, A., Li, T., Dong, Z, Fussell, S. G., & Yang, Q. (2017). A pedagogical approach to teach aviation students how to conduct situation awareness research. Proceedings paper published in the *19th International Symposium on Aviation Psychology*, 443-448, Dayton, OH.

Durso, F. T., Rawson, K.A., & Girotto, S. (2007). Comprehension and situation awareness. In F.T. Durso, R. S. Nicerson, S. T. Dumais, S. Lewandowsy, & T. J. Perfect (Eds.). *Handbook of Applied Cognition* (2nd ed.) (pp. 163-193). Wiley & Sons.

Endsley, M. R. (1988). design and evaluation for situation awareness enhancement. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *32*(2), 97-101. https://doi.org/10.1177/154193128803200221

Federal Aviation Administration. (1991). *Aeronautical decision making* (AC No. 60-22). U.S. Department of Transportation. https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_60-22.pdf

Muthuprasad, T., Aiswarya, S., Aditya, K. S., & Jha, G. K. (2021). Students' perception and preference for online education in India during COVID -19 pandemic. *Social Sciences & Humanities Open*, *3*(1), 100101-100101. https://doi.org/10.1016/j.ssaho.2020.100101

Nguyen, T. (2015). The effectiveness of online learning: Beyond no significant difference and future horizons. *MERLOT Journal of Online Learning and Teaching*, *11*(2), 309-319.

Hara, N., & Kling, R. (1999). A case study of students' frustrations with a web-based distance education course. *First Monday*, *4*(12). https://doi.org/10.5210/fm.v4i12.710

Petrides, L. A. (2002). Web-based technologies for distributed (or distance) learning: Creating learning-centered educational experiences in the higher education classroom *International journal of instructional media*, *29*(1), 69.

Robertson, L. (2018). Toward an epistemology of active learning in higher education and its promise. In A. Misseyanni, M. D. Lytras, P. Papadopoulou, & C. Marouli (Eds). *Active Learning Strategies in Higher Education: Teaching for Leadership, Innovation, and Creativity*. Emerald Publishing, Ltd.