How healthy is your classroom?

By Shane Byrne and Melanie Hughes, July 2020

As we have been locked down for many weeks, our experiences during the COVID-19 pandemic have highlighted that a conducive and healthy work environment is very important. Recently the DTiF team participated in a discussion with Professor Stephen Heppell from Bournemouth University (UK). Professor Heppell introduced the team to some interesting research he had been doing. The research focused on the classroom environment and its impact on learning.

Before we go into it, think about your most recent experiences of work. Were you at home? With kids hanging around? And the TV on? And trying to balance the laptop on the lounge? How was that for you? Perhaps, like us, you had a meltdown exclaiming that you 'can't work in these conditions and wouldn't the rest of the family like to go on a nice three-hour walk so I can get some work done!'

The focus of Professor Heppell's research is the positive and negative influence of physical factors on learning. So, just what is it that Heppell's research has uncovered? Here is a summary: a poor physical environment hurts learning. If we can optimise that environment, our students will learn more effectively and it will also encourage them to become reflective learners, which improves their learning further. To be more specific, poor light level, wrong temperature, inappropriate sound volume and rhythm, humidity, air pollution, carbon dioxide and air pressure can all impair learning. On their own, each of these factors can affect a student's ability to learn. In combination, the research is expected to show that learning outcomes are even worse for students.

So, what can you do about it?

This knowledge provides a great opportunity for students to participate in some authentic transdisciplinary activities, focused on Digital Technologies, Science and Mathematics, to measure environmental factors and improve their learning spaces. If you get the students involved, they become interested and take responsibility for their own learning environment. Some of this could be done using mobile phone apps and devices such as the Learnometer. Alternatively, you could get your students to measure some of these things for themselves by creating digital solutions. Now that is a powerful, authentic learning project to be part of.

The Learnometer

Partners of Heppell offer the 'Learnometer' – a device that sits happily in your classroom and measures all the physical factors listed earlier. Both versions of the device (see the figure below) feature readouts of the physical environment and can store data in the cloud for later use. For more information, visit the Learnometer website.

Left: early model of Learnometer; right: Learnometer

Classroom ideas for monitoring environmental factors

Following is some further research about a number of environmental factors and some suggestions for how students could investigate further using a micro:bit. The 'create a digital solution' option will provide links to classroom ideas and tutorials on the DTiF website.

Lighting

Poor lighting is a significant barrier to learning. Recent research (Barrett, Davies, Zhang & Barrett 2015) shows that good lighting significantly influences reading, vocabulary and Science test scores. Above 500 lux is reasonable, but above 1,000 lux is desirable.

Download a smart phone app to test, record and compare lux levels in your classroom.

Create a digital solution (light meter) to measure light levels (options for Years 5–6 and Years 7–8).

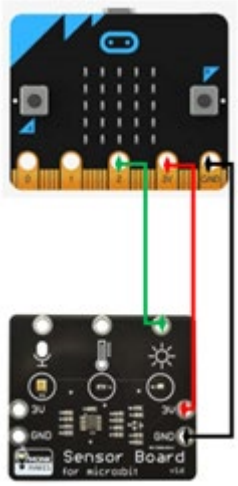

Image: micro:bit (top) and MonkMakes sensor board (bottom)

Temperature

Research by Graff Zivin et al. 2018 suggests that warmer classrooms (above 21°C) have a deleterious effect on learning and this becomes statistically significant above 26°C. Another study confirms that students who experience more hot days during the year perform worse on subsequent standardised exams.

Download a smart phone app to collect and interpret data on the temperature in your classroom.

Create a digital solution (digital thermometer) to measure temperature (options for Years 5–6 and Years 7–8).

Sound

Classroom sound signatures can affect how well students achieve (Picard & Bradley 2001). Studies by James et al. (2012) and Anderson (2001) show that "children from classrooms with poor acoustics have lower literacy and numeracy skills, are less productive in the workforce, and tend to be in lower paid jobs than those from classrooms with good acoustics" (in Mealings 2016). Anything above about 72 decibels starts to get disruptive. Above 50 is annoying for an average person trying to concentrate.

Download a smart phone app to collect and interpret data on decibel levels in your classroom.

Create a digital solution (sound monitor) to measure sound levels (options for Years 5–6 and Years 7–8).

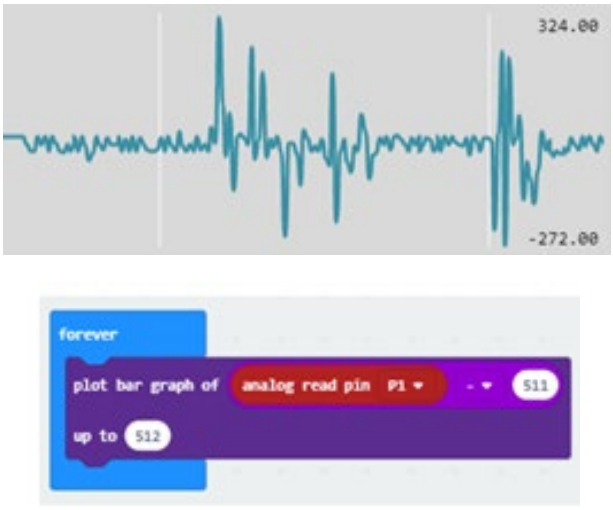

Image: sound level graph and visual coding used to collect the data with a micro:bit

Carbon dioxide

Carbon dioxide (CO_2) levels play a major part in students' abilities to learn. With as little as 1,000 parts per million and arguably lower still, CO_2 induces sleepiness, poor concentration, abnormal heart rates and even nausea. A study from the Harvard School of Public Health supports these claims. Similarly, it appears that air pollution has an enormous effect on learning. A study reported on in *The Guardian* suggests that high levels of urban pollution have a major impact on attainment, with some students dropping a whole year of progress over their school lives.

Create a digital solution (CO_2 monitor) to measure carbon dioxide levels (extension activity for Years 5–6 and Years 7–8).

Air pressure

Air pressure may also play a role in affecting cognitive abilities. This is under research; however, the common complaint of sinus headaches when air pressure changes will obviously affect one's ability to learn. Think about how your students behave on a windy day.

Create a digital solution (air pressure monitor) to measure air pressure (extension activity for Years 5–6 and Years 7–8).

References

- Barrett, P, Davies, F, Zhang, Y and Barrett, L 2017, 'The holistic impact of classroom spaces on learning in specific subjects', *Enivornment and Behaviour*, 49(4), 425–51.
- Carrington, D & Kuo, L 2018, 'Air pollution causes 'huge' reduction in intelligence, study reveals', *The Guardian*, 27 Aug.
- '*Self reported grades with John Hattie*' (2 May) Cognition Education 2012 (videorecording)
- Graff Zivin, J, Hsiang, SM & Neidell, M 2018, 'Temperature and human capital in the short and long run', *Journal of the Association of Environmental and Resource Economists*, 5(1), 77–105
- Heppell, S (n.d.). Learnometer
- Mealings, K 2016. 'Classroom acoustic conditions: Understanding what is suitable through a review of national and international standards, recommendations, and live classroom measurements'. Conference paper, *Acoustics* 2016 Brisbane
- Park, RJ 2019, 'Heat wave: Air conditioned schools would narrow the racial achievement gap', *USA Today*
- Picard, M & Bradley, JS 2001. 'Revisiting speech interference in classrooms', *Audiology*, 40(5), 221–44
- Romm, J 2015, 'Elevated CO_2 levels directly affect human cognition', *Climate Progress*, 26 Oct.

For additional related research, refer to the DTiF classroom idea resource.