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Evaluating the Benefits of Intelligent Acoustic Technology in Classrooms: A Case Study

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Abstract : Intelligent Acoustic Technology (IAT) is a novel architectural device used in buildings to automatically vary the acoustic conditions of space. IAT is realized by integrating two components: Variable Acoustic Technology (VAT) and an intelligent system. The VAT passively alters the RT by changing the total sound absorption in a room. In doing so, the Reverberation Time (RT) is changed and thus, the sound strength and clarity are altered. The intelligent system detects sound waves in real-time to identify the aural situation, and the RT is adjusted accordingly based on pre-programmed algorithms. IAT - the synthesis of these two components - can dramatically improve acoustic comfort, as the acoustic condition is automatically optimized for any detected aural situation. This paper presents an evaluation of the improvements of acoustic comfort in an existing tertiary classroom located at Auckland University of Technology in New Zealand. This is a pilot case study, the first of its' kind attempting to quantify the benefits of IAT. Naturally, the potential acoustic improvements from IAT can be actualized by only installing the VAT component of IAT and by manually adjusting it rather than utilizing an intelligent system. Such a simplified methodology is adopted for this case study to understand the potential significance of IAT without adopting a time and cost-intensive strategy. For this study, the VAT is built by overlaying reflective, rotating louvers over sound absorption panels. RT's are measured according to international standards before and after installing VAT in the classroom. The louvers are manually rotated in increments by the experimenter and further RT measurements are recorded. The results are compared with recommended guidelines and reference values from national standards for spaces intended for speech and communication. The results obtained from the measurements are used to quantify the potential improvements in classroom acoustic comfort, where IAT to be used. This evaluation reveals the current existence of poor acoustic conditions in the classroom caused by high RT's. The poor acoustics are also largely attributed to the classrooms' inability to vary acoustic parameters for changing aural situations. The classroom experiences one static acoustic state, neglecting to recognize the nature of classrooms as flexible, dynamic spaces. Evidently, when using VAT the classroom is prescribed with a wide range of RTs it can achieve. Namely, acoustic requirements for varying teaching approaches are satisfied, and acoustic comfort is improved. By quantifying the benefits of using VAT, it can confidently suggest these same benefits are achieved with IAT. Nevertheless, it is encouraged that future studies continue this line of research toward the eventual development of IAT and its' acceptance into mainstream architecture.

Keywords : acoustic comfort, classroom acoustics, intelligent acoustics, variable acoustics
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