PLANTS IN THE CLASSROOM CAN IMPROVE STUDENT PERFORMANCE

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1. SUMMARY

Numerous studies have shown that indoor plants provide a number of benefits for health and wellbeing. However, there has been almost no research conducted on the potential benefits to school student wellbeing of indoor plants in their classrooms.

The aims of this project were to investigate the effects of indoor plants on classroom performance in Year 6 and 7 students. The trials were conducted in three independent schools in the Brisbane region, with a total of over 360 students in 13 classes. Half of the classes received 3 plants per classroom, and students were tested with standard tests before plant placements and re-tested after about six weeks of plant presence (or absence). Test measures included spelling and mathematics in all three schools, while in one school tests of reading were also included, and in another school, tests in science.

In two of the schools, significant improvements were found with plants present, as compared with classes without plants, with increases of between 10 and 14%. Improvements of 10% or more in these fundamental subjects are regarded by educationists as significant in student progress. However, one school showed no differences in performance between classes with plants and those without. It seems likely that the reason for this is that the school has an active gardening program, involving both ornamental and vegetable species. These students therefore already enjoy a continuing contact with nature, which is usually in short supply among urban dwellers. This was a preliminary study – the first of its kind to be undertaken, and more work is needed to confirm the results in a wider context. However, the consistency of results among schools, classes, and the large student numbers, it would be reasonable to recommend that indoor plants should be a standard installation of school classrooms.

2. INTRODUCTION

Numerous studies have shown that indoor plants provide a number of benefits for health and wellbeing, including decreases in illness symptoms, increases in work performance and job satisfaction, and lifting of spirits (for review, see, eg., Burchett *et al.,* 2010). However, there has been almost no research conducted on the potential benefits to school student wellbeing of indoor plants in their classrooms. In fact we have been able to find only two reports of any such studies. The first study, conducted in Norway (Fjeld, 2002) found that potted-plants reduced sick-leave absences among primary school children. The second report was from a Taiwanese study (Han, 2009), which found that both class marks and behaviour in junior high-school students were improved when plants were installed in the classroom. However, the second study involved only two classes (one with, one without plants) and the researchers conceded that a variety of other factors (eg a more engaging teacher?) might account for the differences reported.

Plants in the room, however, have been found to improve performance in university students (eg Shibata & Suzuki, 2004), and lower their feelings of physical discomfort (Lohr & Pearson-Mims, 2000). And in another study, the performance of tertiary students was compared in classrooms with and without plants (Doxey & Waliezek, 2009). In this case the authors reported that, although grades were not significantly affected by plant presence, there were significant differences in student satisfaction ratings. Those with planted classrooms rated their lecturers more highly on organisation and enthusiasm than those in the group without plants, indicating perhaps that both staff and students were happier with plants in their workspace.

3. AIMS

The aims of this project were to investigate the effects of indoor plants on classroom performance in composite classes of Year 6 and 7 (ie Middle School & Senior- Primary) students in three independent schools in the Brisbane region (Queensland), with a total of over 360 students in 13 classes.

The participating schools and classes were:

A. All Saints, Albany Creek, Brisbane North, (3 classes each of Grade 6 & 7, with an average of 25 pupils =150);
B. All Saints, Merrimac, Gold Coast (Middle school – 4 classes; 120 pupils).
C. St Joseph's Tobruk Memorial School, Beenleigh, Loganlea (3 composite classes, Grades 6 & 7; 90 pupils).

4. METHODS

Human Ethics approval for the project was first obtained for the schools concerned. A period of about two months was needed to formulate and process the test structure, with different school education systems, and variations in curriculum presentation and timing across the various school cultures. A standard testing method was devised, across the curriculum, to test the consistency and robustness of the trial. Half of the participating classes then received a total of 3 plants per classroom, while the remaining classes received no plants.

'Planted' classrooms were supplied with one of each of the same three species and sizes, as follows:

- 1x 300mm staked – Epipremnum aureum (Scindapsus, Golden Pothos)
- 1x 300mm – Dracaena fragans 'Janet Craig'
- 1x 250mm – Spathiphyllum sp.

Students were tested with standard tests before plant placements and re-tested after about six weeks of plant presence (or absence). Test measures included spelling (South Australian Spelling Test, SAST) and mathematics in all three schools, while in one school tests of benchmark reading, and in another school tests in science, were also included.

5. RESULTS

Differences in student responses to plant presence were found among the three schools.

In schools A and B marked improvements were recorded in scores in spelling and mathematics in classrooms with plants present, as compared with classes without plants. However in School C, no differences were found in spelling, mathematics (or reading, which was also tested), between classes with plants and those without. Possible reasons for this situation in School C are discussed in Section 5.

A comparison of results for the two schools showing improvements with plants present is presented in Table 1. In four of the five sets of scores influenced by plant presence, the improvements obtained ranged from 10 to 14%. Figures 1 to 3 highlight comparisons between planted and unplanted classrooms, in the two schools which showed improvements in scores with plant presence. Figure 1 shows that, in School A, while baseline scores had been similar across the classrooms before plants were installed, at mid-term, classes with plants showed higher scores than those without. By the end of term, although both sets of classes had further progressed (as would be expected by their teachers!), the classes with plants retained their lead over those without. The end of term results for spelling showed a parallel difference between the two groups of classes. The results for School B in end of term science and mathematics tests are shown in Figure 3. Again an improvement in both subjects can be observed

with plants in the classrooms. The slightly lowered score for mathematics recorded for the non-plant group is not statistically significant; however the difference between classrooms with and without plants is a statistically significant increase.

Table 1. Summary of percentage differences in each of two schools, in scores on three standard tests, in classrooms with and without plants (Means± Standard Error); 2-3 classes per school per treatment; totals 60-80 students per treatment.

Tests/Differences in Scores	% Increase in Scores with Plants Present
Mathematics	
School A	*14 (±1.2)
School B	5 (±0.8)
Spelling	
School A	*10 (±1.5)
School B	*12 (±1.7)
Science	*11 (±1.2)
School B	

*indicates difference is statistically significant ($p \leq 0.05$).

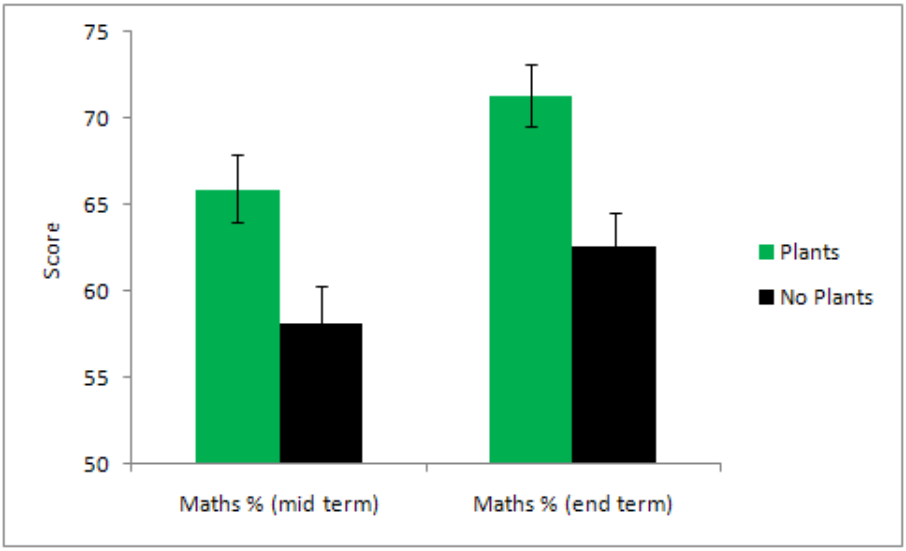

Figure 1. School A: Comparison of changes in mid-term and end of term mathematic scores in classes with and without plants.
(Means and SE; n = 69–72.)

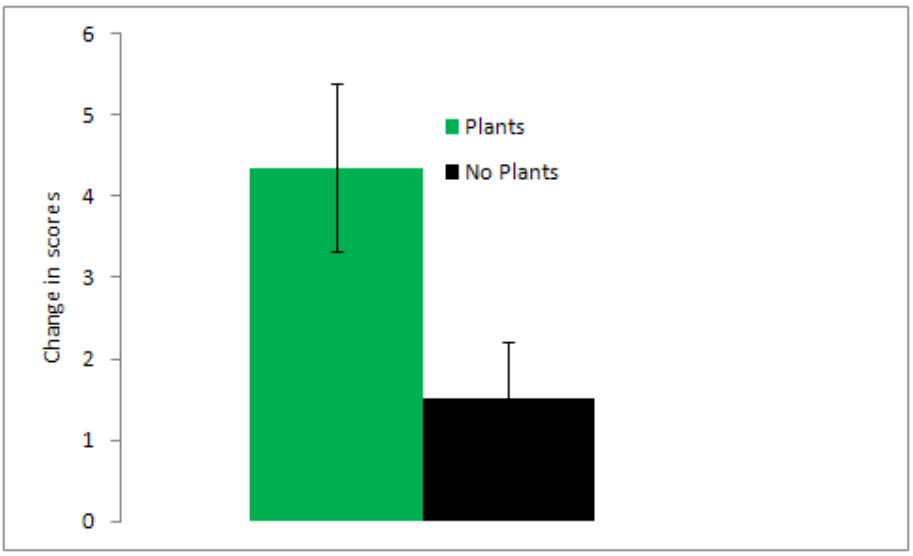

Figure 2. School A: Comparison of end of term spelling scores, in classes with and without plants.(Means and SE; n = 69–72.)

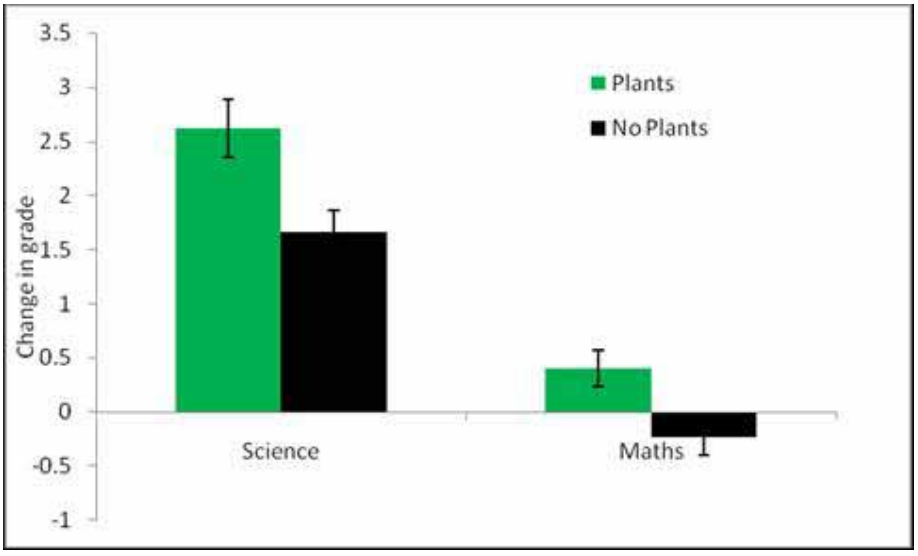

Figure 3. School B: Comparison of end of term science and mathematic grades, in classes with and without plants.(Means and SE; n = 149.)

6. DISCUSSION

Because of the number of classes and students involved, the differences can be accepted as real improvements in classroom performance resulting from plant presence. Improvements in performance of 10% or more in the fundamental tasks of spelling and mathematics are generally regarded by educationists as significant in students' progress in education.

How might such an influence of plants in the classroom come about?

First, research has shown that plants can significantly improve indoor air quality in office buildings (with or without air-conditioning). Research at UTS has shown that two or three plants in an office can significantly reduce levels of CO_2 and air-borne volatile organic compounds (VOCs) that are continually outgassing from plastic/synthetic surfaces (furnishings, fittings, equipment eg computers, copiers etc). These are the two major types of contaminants always found in higher concentrations indoors than outside, even in the CBD. However, in this project the participating teachers indicated that doors and windows of the classrooms were very often all open, so that this health benefit of plants might not have had much effect on the results obtained. But such benefits could well be significant in closed classrooms with flueless gas heaters on in winter, since raised CO_2 levels cause loss of concentration and drowsiness.

However, other research shows that plant presence is directly linked to improved performance and productivity in office workers (Lohr *et al*., 1996; Bringslimark *et al.,* 2007). Also, a recent UTS study with 55 participants showed that plants in the office resulted in 30 to 60% reductions in feelings of stress, anxiety and low spirits in university staff. Other research indicates that nearby greenery resets our calm' button (Kaplan & Kaplan, 1990), and that indoor plants are also directly attractive, evoking positive responses among building occupants (Dijkstra *et al*., 2008)). In this study we found on visiting the schools, that teachers and students showed great interest in having plants in their classrooms. Students of one class had even named their plants – 'Luigi', 'Mojo', 'Napoleon' and so on.

Urban living involves what has been described as a "disengagement with the natural environment" (St Leger, 2003). Re-establishing 'better links with nature' has become an important international public health concern (Maller, *et al.,* 2005; Frumkin, 2001; Kellert & Wilson, 1995; Kaplan, 1995; Wilson, 1984). Evidence shows that time spent in parks and nature reserves is beneficial to health and wellbeing of city dwellers, with improvements in such physiological measures as blood pressure, and psychological measures such as 'mood states' (Velarde *et al*., 2007; Hartig, *et al*., 2003; Herzog *et al.,* 2002). 'Park time' has also been found to improve concentration performance in children with attention deficit disorders (Taylor & Kuo, 2009). .

In the last two decades of the 20th century the 'Biophilia' hypothesis was developed in environmental psychology, with the proposition that humans have an inherent

affiliation with nature, ie with other living species (Wilson, 1984; Kellert & Wilson, 1995; Grinde & Patil, 2009). In line with this hypothesis, it is not surprising that three of the top-rating family websites are gardening, weekend get-aways, and fishing, all 'back-to-nature' pursuits. In the present project, therefore, it seems likely that the reason School C showed no differences in performance in classes with or without plants, is that this school has an active gardening program, involving both ornamental and vegetable species. Indeed, these students have sometimes sold their vegetables to parents and friends of the school, the money raised being spent on excursions or new materials for the classrooms. Students at the school thus already enjoy a continuing contact with nature, so that the classroom plants represent a pleasing extra. A teacher at the school reported that the students did enjoy the presence of the plants, and whenever they were asked to sit and read quietly, or form small groups to discuss some topic, they tended to cluster on the floor around each of the plants.

7. IMPLICATIONS OF FINDINGS

The trials found that classroom plants consistently led to improved performance in spelling, mathematics and science, ie, across the curriculum, for possibly a variety of interlinked reasons. And from our discussions with staff at the three schools, there seemed to be unanimous agreement among teachers and students that plants in the classrooms improved their appearance and 'ambience'. This was a preliminary study, the first of its kind in aiming to compare performance of school students in classrooms with and without plants. Further studies are needed to provide formal confirmation of the results. However, taken with the findings of other international research on the benefits of indoor plants, it seems reasonable that a recommendation could be made to education authorities for indoor plants to be a standard installation of school classrooms.

Plants in the classroom could, of course, also be used as a teaching tool – in biological science (with observations on growth and flowering; consideration of the requirements of maintenance and growth; caring for a living organism; comparison of high-light vs. low-light plants; geography of origins of various species; environmental principles for vegetation conservation; etc.). A recent Japanese article concerned with changes in school curricula in that country since the World War II, deplored the reduction of studies which develop 'nurturing' or 'fostering' concepts, eg in caring for plants or small animals. The same trends could well have occurred in Australia with increasing urbanisation. The schools garden programs that are growing in this country could be augmented by the inclusion of indoor plants.

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