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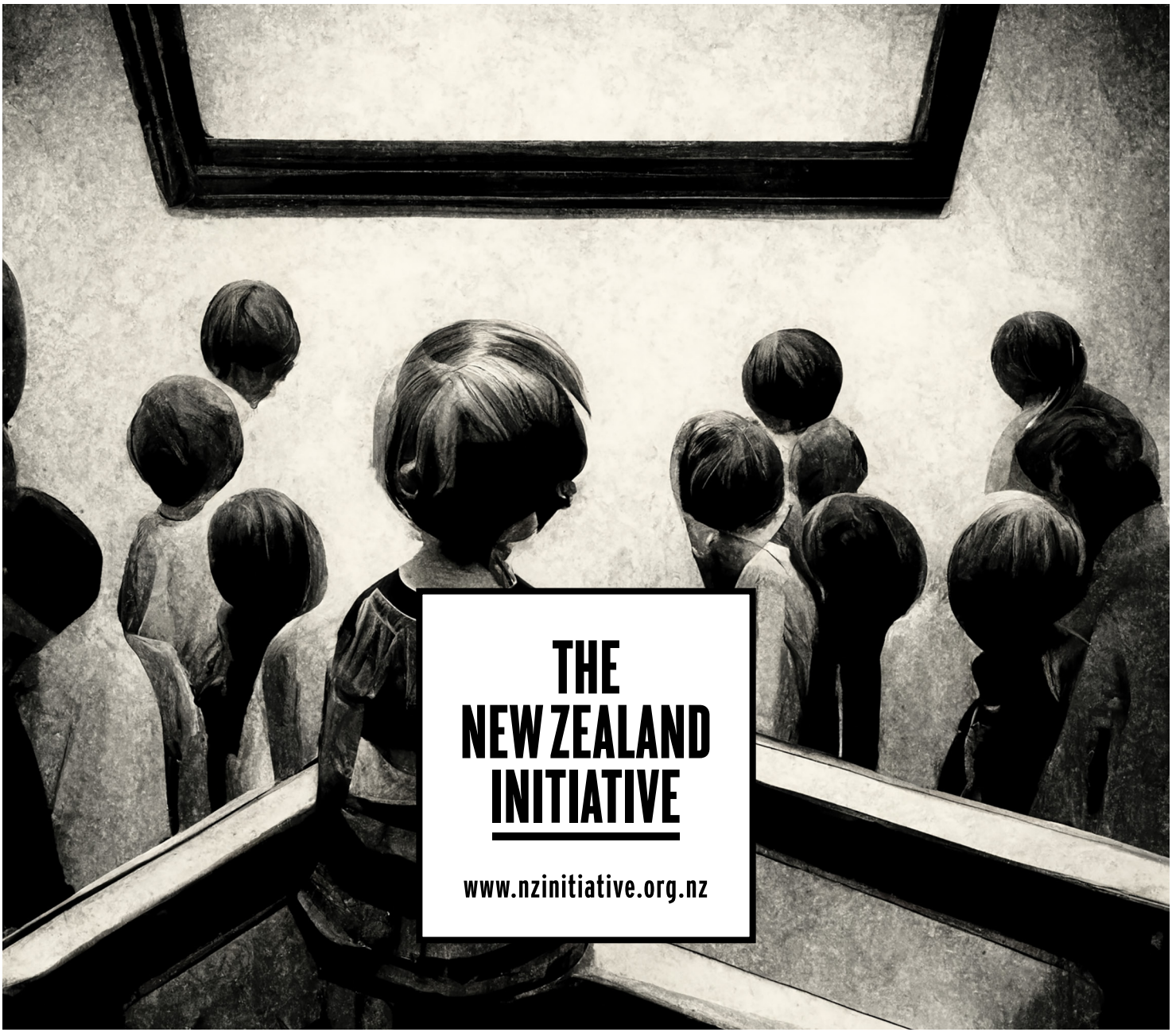
Lessons from the 'Modern Learning Environments' experiment

Michael Johnston
Foreword by Neil Paviour-Smith



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About the New Zealand Initiative

The New Zealand Initiative is an independent public policy think tank supported by chief executives of New Zealand businesses. We believe in evidence-based policy and are committed to developing policies that work for all New Zealanders.

Our mission is to help build a better, stronger New Zealand. We are taking the initiative to promote a prosperous, free and fair society with a competitive, open and dynamic economy. We are developing and contributing bold ideas that will have a profound, positive and long-term impact.

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Foreword

I commend this latest research into the effectiveness of strategies promoted by the Ministry of Education (MoE) into the school system. You are left with an overwhelming sense that a relatively uncontrolled experiment has been undertaken in our schools in the past decade.

My insights on this matter were formed through a 14-year stint (2006-2020) on the Board of Trustees at Wadestown School in Wellington, including 10 years as the Board Chair. Wadestown School is a 140-year-old full primary school which had a roll averaging around 350 students during my tenure.

My early experience with "modern learning environments" (MLEs) was positive. The directive from the MoE that Board's needed to prioritise their cyclical property capital expenditure on acoustics, heating, lighting, structural safety, upgraded toilets etc was commendable and sensible. These factors directly affect the learning environment for all students and teachers.

However, the evolution of MLEs into ILEs through the MoE's 2011 property strategy was troubling. School communities were pitched with language that "Innovative Learning Environments" were a strategy for "21st century learning", that aging classrooms would be upgraded and children would engage with "self-directed learning".

In fact, classrooms were always being upgraded although the MoE controlled how much funding schools received on a 5 year capex cycle, usually below what was sufficient. And many senior teachers noted that this latest centralised push for open learning environments was far from a '21st century' approach – noting it had been dismissed by many as a failed costly approach from the 1970s.

Of particular concern to our school at the time was the lack of evidence pointing to the results or benefits of open learning environments and self-directed learning. Dr Johnston's report points to there being no sound evidential basis for promoting such a system-wide approach. It surprised me at the time that the MoE didn't invite schools to participate and then reflect on the findings before launching into a massive campaign of change.

The approach ran directly in the face of Tomorrow's Schools which makes school boards accountable to their communities for their strategic plan and the approach their schools deploy. Schools (like Wadestown School) which had committed to a teacher-led, single-cell learning environment were now in conflict with the preference of MoE policy.

It is troubling that Dr Johnston's requests for the MoE to provide information on ILEs has been unfruitful although it does not come as a surprise. The fact that the MoE was unable to furnish data on the numbers of ILEs, the aggregate cost/investment into these or the effectiveness of them in relation to student outcomes needs to be called out. If a school Board failed to self-assess like this, the Education Review Office would rightly be deeply critical, the school's reputation would be tarnished and it would lead to appropriate change. Teachers are now burdened with an enormity of assessment and reporting. Yet the MoE cannot provide basic information.

As the years passed, our Board observed some of the outcomes with open learning environments. Whilst I have no doubt that for some communities and school leaders, this type of classroom environment worked for their schools and students, we experienced an influx

of enrolments at the school. We had a waiting list for balloted places for out of zone entry. The school roll bulged and nearly reached 400 students for the first time. High quality teacher applicants were attracted by our expressly stated single-cell classroom environment. Some teachers stated exhaustion and frustration from very large open plan learning environments. In 2016 the school received an outstanding ERO review and placed the school on a rare 5-year callback.

But despite all that, when the school had two new classrooms built in 2017-2018, the MoE dictated that these would be open classrooms (without a wall between them), ignoring our request for single classrooms, because this was the future way and the Board should consider all the benefits of this modern approach. We were dismayed at this dogmatic approach and lack of respect for the school's wishes. But we had little choice, other than to make a lot of noise. The final outcome was a pair of lockable sliding doors – which cost more than a wall.

I attribute the school's positive progress entirely to the calibre of the school's teachers and leadership. Our board invested as much as we could in teacher professional development and I consider these factors were predominant in explaining excellent student achievement outcomes. And that is the point I would reflect on the most.

Again, I draw the conclusion that the MoE's focus on open learning environments, alongside prioritising (financially incentivising) other unproven initiatives such as 'Communities of Learning' reduce the importance of, and amount of funds available to commit to, developing our teaching community. There can be little doubt that teachers make the greatest difference to learning outcomes. The billions being invested in unproven initiatives means billions less available to attract and retain the best teachers and invest in their own development. As is often stated, most people can remember a teacher who inspired them and made a difference.

Dr Johnston's report, and public concerns generally about falling educational outcomes, demonstrate the need for an objective evidence-based review of these policies and consideration of international evidence that points to where sustained improvement in teaching and learning is available. That would truly be an exciting development in seeking a 21st century learning environment.

Neil Paviour-Smith

Executive Summary

In 2011, the Ministry of Education adopted a 10-year property strategy. It had as its central goal the mass conversion of New Zealand's classrooms to an Innovative Learning Environment (ILE) model. ILEs were conceptualised not only as a way to rejuvenate New Zealand's ageing classroom estate, but also as a vehicle for enacting a radical constructivist '21st century learning' curriculum and an associated 'self-directed learning' pedagogical approach. Concurrent with the implementation of the strategy was a projected increase in the number of students in New Zealand's schools. The scarcity of suitable land for new schools and the associated expense created an economic imperative to increase the population density of schools. This may have contributed to many of New Zealand's classrooms being rebuilt as large, open-plan environments with far larger numbers of students than is usual in traditional classrooms under the ILE model. These large ILEs also typically employ multiple teachers using 'team teaching' approaches.

In response to a request under the *Official Information Act* lodged in support of this report, the Ministry was asked to supply information regarding the existing number of ILEs; how they are distributed among primary, intermediate and secondary schools, how many students are being educated in them; and how much money has been spent on them. The Ministry claimed that it does not hold any of this information. Nor did it furnish any reliable or generalisable research evidence on which it based its strategy to develop ILEs. Finally, the Ministry confirmed that it has undertaken no evaluation of the educational effects of adopting ILEs, nor any survey of community or parent views of these classroom environments.

In this report, several assumptions regarding ILEs are examined. One is that spatial flexibility in classrooms and team teaching enhance students' learning. Another is that the constructivist curriculum and 'self-directed learning' pedagogy with which ILEs were designed to align are effective approaches to teaching and learning. There is a great deal written in favour of ILEs, in both the peer-reviewed and 'grey' literatures, and in the popular media. However, neither of these assumptions is supported by any substantive evidence. There is some evidence that self-directed learning can be motivational for young adults and mature students, but very little that it enhances learning, even for older students.

A third assumption of the ILE model – that integrating technology into classrooms is beneficial – has more in its favour. However, the main benefits of technological integration relate to explicitly technological learning and to classroom management. There is little evidence that technology enhances the acquisition of key skills like literacy and numeracy, or disciplinary learning at the secondary school level. A preponderance of evidence shows that, to be used effectively, technology in the classroom must be properly managed, and that it is no substitute for direct instruction by expert teachers.

Establishing large, open-plan classrooms populated by commensurately large numbers of students was not an explicit part of the Ministry of Education's 2011 property strategy.[1] It has, however, been an outcome of it. The research literature offers no sound, generalisable evidence in favour of these environments. There is no evidence that team teaching is more effective than individual teaching and no evidence that children learn better in large, open classroom environments. There is evidence, however, that children with specific learning disabilities such as

Auditory Processing Deficit are badly affected by these environments.

The 2011 property strategy was entirely justified in its aim to improve the heating, ventilation, structural, lighting and acoustical properties of New Zealand's decaying classroom estate. However, under the strategy, the Ministry also embarked on an expensive redevelopment of schools to shift teaching and learning in a direction that is fundamentally unsupported by research evidence. Its aim to improve the integration of technology into classrooms could have been accomplished without wholesale reconstruction. Similarly, a degree of 'flexibility' in classroom configurations could have been accomplished with new furniture arrangements, without costly rebuilding.

The lack of an evaluation of the impact of the ILE project is a particularly striking failure on the part of the Ministry. A *prima facie* case based on research evidence and a sound monitoring and evaluation framework should be in place prior to the implementation of any major initiative like the ILE project.

Summary of recommendations

1. The Ministry of Education should make schools and teachers aware of the lack of research evidence for self-directed learning as a pedagogical strategy, especially for primary-aged children. In the absence of such evidence, it should cease promulgating this approach.

2. The Ministry should fund a systematic programme to understand pedagogical approaches supported by scientific research in both ILEs and traditional classrooms.

3. The Ministry should fund a systematic programme of professional development for teachers, whether they are operating in ILEs or traditional classrooms, to ensure that evidence-based pedagogy is employed, and that integrated classroom technology is used in a way that enhances teaching and learning.

4. The Ministry should provide resources and professional development for teachers in ILEs to support the learning of students with learning disabilities such as Auditory Processing Disorder and Attention-Deficit Hyperactivity Disorder. They should fund classroom enhancements, such as sound field systems, without financial imposts on schools.

5. The Ministry should undertake a comprehensive retrospective evaluation of teaching and learning in ILEs, supported by the integrated database infrastructure, using data from the National Monitoring Study of Student Achievement at Years 4 and 8, and from NCEA at Years 11–13.

6. No teaching and learning initiatives should be undertaken by the Ministry of Education without a *prima facie* case made on the basis of generalisable research evidence and a monitoring and evaluation framework in place.

Introduction

In 2011, the New Zealand Ministry of Education laid out a 10-year strategy for school property.[2] The strategy was for all state-funded schools, from early-childhood education through to secondary schools, including Kura Kaupapa Māori. The strategy document focused on the ageing building infrastructure of schools. Many school buildings, especially those dating from the post-war boom in student numbers, had inadequate insulation and poor energy efficiency, and needed extensive remedial work. The strategy expired in 2021.

The governance context of the strategy was the Tomorrow's Schools model, which was introduced in 1989 and remains extant in 2022. Under Tomorrow's Schools, every school has a Board that appoints and employs the principal. The legislation enabling the Tomorrow's Schools model also established the Ministry of Education, which succeeded the Department of Education as the preeminent government education agency responsible for developing and implementing education policy in New Zealand.

Tomorrow's Schools splits responsibility for a school's property between its Board and the Property Division of the Ministry. D. Lange laid out the way in which this split responsibility works.[3] Normally, the Crown owns school property, including land and building infrastructure. The Board of Trustees is responsible for operational maintenance – painting, repairs and the like – using funding provided through the school's bulk grant. Importantly, though, responsibility for capital works, including the provision of new buildings, rests almost entirely with the Ministry of Education: The Ministry is responsible for designing, funding and building new school infrastructure. The Tomorrow's Schools model does require it to negotiate an occupancy agreement with each Board of Trustees. Lange stipulated that "this agreement will include the right of the board of trustees to approve final plans for any capital works."[4]

In 2018, an independent taskforce conducted a system review of Tomorrow's Schools. The taskforce recommended removing property responsibility from Boards of Trustees altogether.[5] This recommendation has not been implemented. Even so, the 2011 strategy had already shifted the split responsibility for property somewhat in the Ministry's direction. Under the first goal of the strategy, to ensure that "school property is well managed,"[6] schools, especially smaller ones, were allowed to contract Ministry-accredited third parties to manage their property. The strategy also signalled a new audit function "to ensure schools comply with the Ministry's requirements for school property."[7]

As well as addressing the often-poor state of New Zealand's school infrastructure, the strategy placed a great deal of emphasis on classroom environments that teachers find inspiring to teach in, and in which students enjoy high-value learning experiences. In this vein, the procurement strategy was designed "to *deliver the requirements of a modern education* system that ensures capital is used efficiently and effectively" (emphasis added).[8] A key initiative of the strategy was to "[ensure] that decisions about how school property should be used will improve education outcomes for students."[9] This signalled an intention by the Ministry to establish a degree of control over the design of new classrooms to align them with 'modern learning'.

This intention is fleshed out under the second goal of the strategy, to ensure that "schools are fit for purpose."[10] A Modern Learning Environment

Standard, with which new school buildings were required to comply, had already been implemented in 2010. Features of the standard include configural flexibility (to allow them to be used in different teaching and learning formats); environmental qualities (lighting, acoustics and heating); and being wired for computer technology. The Ministry claimed that these features are "critical to modern educational delivery and will ensure that the physical environment is linked to educational outcomes."[11]

The strategy required schools to upgrade learning spaces that fell short of the Modern Learning Environment Standard as a financial priority. This requirement is reflected in a comment by Hekia Parata responding to a parliamentary question as Minister of Education in 2014: "Every new school building must meet the Modern Learning Environment standard and every existing school must prioritise the property funding they receive from the Ministry of Education to upgrade their buildings to the Modern Learning Environment standards …"[12]

The requirement to improve the sensory environments of classrooms so that students are not too hot or cold, and so that they can see, hear and pay attention, was clearly justified. However, there are three assumptions on which the Modern Learning Environment Standard was based that require examination. The first is that spatial "flexibility" is essential. This relates strongly to a second assumption, that the learning requirements of students are different than they were in the past, and specifically, that they are different in ways that flexible spaces would address. The third assumption is that it is essential to integrate computer technology into pedagogy. Missing from the strategy was any indication of a research or evidence base to evince these assumptions.

Even so, then Minister of Education Hekia Parata cited the improvement of educational achievement as justifying the allocation of $1.137 billion to rebuild Christchurch schools as MLEs following the 2011 earthquake: "The Government looked at a range of options for education renewal, and it chose the most comprehensive option requiring the biggest investment *because it will generate the greatest lift in educational achievement* … The delivery of safe and inspiring, modern and connected learning environments *will support a lift in student engagement and drive up achievement levels* across Greater Christchurch" (emphasis added).[13] Claims that flexible spaces, student-centred pedagogy and integrated technology improve students' learning are examined in detail in this report.

There is another aspect of new classroom designs in New Zealand that is *not* a central feature of the Modern Learning Environment Standard, but which has become a hallmark of the implementation of the strategy. Many new classrooms are large and accommodate more students than a traditional classroom. These classrooms have more teachers, commensurate with the greater numbers of students, and often employ team-teaching approaches. About a quarter of the 337 schools surveyed in 2016 by Chris Bradbeer and colleagues reported having learning environments of this kind, although many reported also having bi-folding walls, allowing for a more traditional configuration.[14]

Establishing larger classrooms might be seen as way to meet the requirement for spatial flexibility under the Ministry's 2011 strategy, in that it potentially allows for different classroom configurations.[15] Indeed, Gabriella Wall has argued that flexible learning spaces need to be large enough to accommodate a range of activities and configurations of students, and that these spaces would typically include more than one teacher.[16] A third goal of the strategy – to achieve a "high-performing portfolio of schools" – might also help explain why that occurred.[17]

The strategy noted projections that student numbers would rise markedly during the 2010s,

which they did. Clearly, additional students require additional classroom capacity. However, as the strategy also noted, new land for schools is difficult and expensive to acquire. Redeveloping existing sites was therefore seen as a desirable option. In particular, "old buildings that do not support education and are expensive to modernise [could] be retired in exchange for *modern facilities that could be attended by a larger number of students*" (emphasis added).[18] It was also argued that "savings could be achieved through fewer site purchases and through economies of scale achieved by merging and closing some nearby schools that could be amalgamated into the redevelopment."[19] In this part of the strategy, then, a pragmatic solution to increasing population – higher-density schools – coincides with a pedagogically motivated requirement to make classrooms more 'flexible'. The outcome has been larger, more populated classrooms.

Nomenclature

A range of terminology has been used to refer to the new kinds of classrooms that are being established in New Zealand schools. According to the Education Hub,[20] the terms Innovative Learning Environment (ILE), Modern Learning Environment (MLE), and Flexible Learning Environment (FLE) are more or less interchangeable. They note that none of these terms should be taken as synonymous with the open-plan classrooms of 50 years ago, however. As is evident in the Ministry of Education's property strategy, the newer environments are intended, not only to encompass the physical space of a classroom, but also the social, pedagogical and curricular aspects of educational environments.[21] The strategy referred to MLEs, but ILE seems to be the preferred term in later documentation.

More recently, the Ministry of Education[22] has distinguished ILEs from Quality Learning Environments (QLEs). The latter term refers specifically to physical classroom environments. Considerations relevant to QLEs are more operational and economic than educational. Their fitness for purposes as learning environments remains an important consideration, but there is no emphasis on pedagogy or curriculum in evaluations of QLEs. In this regard, it is noted that the 2011 property strategy has now expired, and the new emphasis is on QLEs rather than ILEs.

In this report, the term Innovative Learning Environment (ILE) will be used to refer to classrooms that have been physically redesigned in compliance with the Ministry's strategy.[23]

Scope of the report

This report examines New Zealand's redesigned classrooms. The limited evidence on how numerous they have become, what kinds of spatial configurations they comprise, how large they are, and how are they being used will be discussed.

The assumptions on which the requirement for flexible learning environments is predicated are also examined. The Ministry of Education has asserted *self-directed learning* as a desirable pedagogical approach, and the new classroom designs are intended to accommodate it. But is self-directed learning really effective? If so, for which students, and for what kinds of knowledge? The integration of technology into classrooms is another explicit motivation for ILEs. But can integrating computer technology into classroom pedagogy enhance teaching? If so, in what circumstances and for what kinds of learning?

The most important question about flexible classrooms is whether they improve teaching and learning. Unfortunately, published evidence on this question is minimal. Nonetheless, the available evidence is reviewed in this report.

Where benefits have accrued from adopting new classroom designs, an attempt is made to identify the effective elements of those designs that have delivered benefits.

Students have a range of characteristics that affect the conditions – both physical and pedagogical – in which they learn most readily. Arguably, the greatest determinant of these conditions is their age and level of maturity. The age of students, however, is correlated with the type of curriculum and pedagogy they experience. At primary school, curriculum is less differentiated than it is at secondary school, and specialist teachers are much less predominant. The analysis of the research on the educational impacts of ILEs, therefore, investigates the extent to which flexible learning environments impact differently on students in different age groups, taking into account the different requirements of teaching and learning at different stages of schooling.

Other variables that might play into the effect of flexible learning environments are students' cognitive, affective and behavioural challenges. The impact of different classroom designs on students with Auditory Processing Disorder is considered in particular.

CHAPTER 1
The reality of ILEs

The Learning Environments Applied Research Network[24] (LEaRN), based at Melbourne University, comprises a group of researchers who gather and publish evidence on the impact of learning environments on learning itself. One of its initiatives is the Innovative Learning Environments and Teacher Change (ILETC) project. The Ministry of Education is one of 15 partner organisations involved in this project. The aim of ILETC is to identify teaching methods that are effective in ILEs, as well as the kinds of professional development teachers need to enact these methods.

Bradbeer et al. reported on the initial stage of the ILETC, which, among other purposes, aimed to undertake a census of ILEs to determine their number, location and physical characteristics, and the ways in which they were being used.[25] A respondent from each of 337 schools, usually the principal, classified the classroom configurations in their schools, matching them to one of five templates, ranging from traditional, enclosed classrooms to fully open plan. Respondents also estimated the proportion of total class time at their school spent in each type of environment, and the teaching configurations – whole class, small group, individual, etc. – typically used.

Surprisingly, the Ministry was unable to supply Bradbeer and his colleagues with information about the number, location and configuration of ILEs despite its School Property Division being responsible for building them. In 2012, then Associate Minister of Education Craig Foss responded to a Parliamentary question from Labour member Chris Hipkins, enquiring as to the number of schools meeting the MLE standard. Foss said that he had been "advised that the Ministry will not have this information until all schools have completed the Modern Learning Environment assessment process in 2015, as a by-product of renewing their ten-year property plans"[26] Bradbeer et al. unsuccessfully sought this information in 2016, a year after, according to Foss, the Ministry had advised that it would be available. The same information was requested in 2022 under the Official Information Act (OIA) to support the present study, again without success.

Bradbeer et al. reported that "ILEs exist in a confusing array of designs, from huge open spaces to highly flexible arrangements of classrooms, corridors, student retreat spaces, 'maker' spaces and much more."[27] This, in itself, suggests that the Ministry's approach to establishing ILEs has been rather *ad hoc*. A primary justification for redesigning classrooms was that 'traditional' spaces are not adequate for 'modern' learning. It might, therefore, be expected that ILEs would be constructed using a more constrained range of designs that *are* considered adequate.

Just over two-thirds (68%) of the respondents to Bradbeer and colleagues' survey indicated that their classrooms were largely traditional in design. Just under a quarter (24%) reported open plan designs. The remaining respondents indicated hybrid designs. Some of the open-plan designs included bi-folding walls, allowing the classrooms to be converted into more traditional arrangements.

More up-to-date information on the number of ILEs has proven impossible to obtain. As noted above, as part of information gathering for this report, a request to the Ministry of Education under the OIA was made.[28] The request inquired as to how many contributing primary, full

primary and secondary schools have ILEs, how many students at each year level spend a majority of their class time in ILEs, and how ILEs are distributed by school decile. For the purposes of the OIA request, an ILE was defined as "any classroom designed to be occupied by more students than would normally be in a class with a single teacher under a standard teacher-student ratio." The OIA request also inquired into the distribution of room capacity – that is, the number of ILEs designed to accommodate 31–50 students, 51–75 students, and so on.

The Ministry did not supply information on any of these questions. They claimed that "the Ministry does not record, track, or monitor the design aspect of the property portfolio at a national level." So, the Ministry has promulgated a 10-year strategy to establish ILEs and made property funding contingent on schools acquiescing to 'flexible' classroom designs without collecting information on progress against this strategy.

Also requested under the OIA was information on the amount of money spent on establishing ILEs. The Ministry did not supply that information, either, again claiming that they do not hold it. By 2016, however, $5 billion had been spent on the 2011 property strategy. Then Associate Minister of Education Nikki Kaye announced in Parliament that she was "pleased to advise the House that this Government has committed around $5 billion to school property—significantly more than any previous Government."[29] Much of this money would have been spent irrespective of the ILE project, given the parlous condition of the classroom estate and the damage caused to Christchurch schools by the 2011 earthquake. No accurate estimate of the cost of the ILE project, as such, is available.

The best available information on the number and configuration of ILEs remains Bradbeer and colleagues' report.[30] The data for their study were collected in 2016, roughly halfway through the time period covered by the 2011 property strategy. It might be assumed that the rate at which ILEs were established during the second half of that time period was commensurate with the rate at which they were established during the first. If so, then by the end of the strategy's timeframe in 2021, about half of New Zealand's classrooms would have been ILEs. That assumption cannot, however, be reliably made. There is really no way to know what the actual predominance of ILEs is without undertaking a census or a representative survey.

In addition to their estimates of the proportion of New Zealand classrooms that have ILE designs, Bradbeer et al. included some information about the configurations of ILEs. The most widespread learning configuration was small-group discussion facilitated by a teacher (30%), followed by teacher-led instruction (23%), and collaborative student-led learning, with some teacher support (21%). Only small proportions of time were reported as being spent in team teaching (7%) or individual learning, which includes self-directed learning and one-on-one instruction (9%).

Unfortunately, the researchers did not explicitly compare the relative predominance of the different types of types of teaching in the different classroom environments. They did comment that "there was a discernible number of schools with fairly traditional … spaces which still identified that a team-teaching approach was their school's dominant pedagogical approach."[31] Even so, it may be surmised that team teaching is more likely in open plan environments, simply because those are the environments in which there is typically more than one teacher. Similarly, teacher-led instruction seems more likely in a traditional classroom with a reasonably traditional furniture arrangement. But there is no way to tell for certain from this research. It was also unclear whether schools with open-plan rooms that could be reconfigured into more traditional classrooms using folding walls were more often used in their open arrangements or their traditional arrangements.

The Ministry of Education's 2011 property strategy, which mandated the establishment of ILEs (called MLEs at the time) as a financial priority for schools, had a 10-year lifespan.[32] The strategy expired in 2021. The Ministry has now de-emphasised its previous claims regarding the link between ILEs and the pedagogical practices it promotes through the New Zealand Curriculum[33] and other advice on teaching and learning. Jo Fletcher et al. cited a source on the Ministry's website "[contending] that the New Zealand National Curriculum underpins the move to innovative learning environments."[34] That link is no longer live.

In fact, the Ministry seems to have started to move away from seeing ITEs as a means of enacting its preferred pedagogical practice some time before the 2011 strategy expired. New requirements and guidelines for school infrastructure were published in 2015,[35] while the 2011 strategy was still in play. This document sets out efficiency, durability and cost effectiveness as the imperatives for education buildings. It refers to the 2011 strategy but does not mention ILEs (or MLEs) and makes no explicit link between particular classroom features and learning outcomes, except those relating to standards such as heating and acoustics.

The Ministry, then, seems largely to have ceased using either of the terms ILE or MLE in relation to classroom design. This does not, however, mean that open-plan ILEs are no longer being built. Current advice, guidelines and requirements for school infrastructure use the term Quality Learning Environment (QLE). On its webpage titled "Designing Learning Environments," the Ministry explicitly refers to the relationship between ILEs and QLEs:

> The concept of quality learning environments (QLE) is not a direct replacement for innovative learning environments (ILE). ILE is a term used in New Zealand and internationally to refer to the wider ecosystem of people (social), practice (pedagogical) and physical/property. QLE relate to the physical (only) learning environments.
>
> Equally, ILE doesn't explicitly consider or emphasise the condition or operational efficiency of property, as these concerns better reflect the building owner and bill payer perspectives, rather than student and school staff perspectives.[36]

The new emphasis for the Ministry when it comes to learning environments appears to be on the physical aspects of the buildings – in particular, whether they have adequate heating, lighting and acoustics, and how efficient they will be to operate and maintain. The relationship to pedagogy and learning is still mentioned, but it is emphasised much less than it was in the 2011 strategy and few, if any, explicit links between the physical contents of classrooms (including technology) and learning outcomes are made.

What has led to this change of emphasis is hard to tell and the Ministry does not explicitly say. It might be surmised, however, that a lack of evidence for the efficacy of ILEs in enhancing learning outcomes as promised in the 2011 strategy has influenced the retreat. Some Ministry documents supporting pedagogical approaches that, the Ministry claimed, justify the adoption of ILEs are no longer available on its website. For example, Louise Starkey and Bronwyn E. Wood refer to a 2016 document in which the Ministry claimed that it is desirable to have "multiple concurrent learning activities" in a classroom.[37] Starkey and Wood pointed out that there is no reliable research evidence in support of this claim, and the Ministry document they refer to is no longer available.

There is some evidence in Hansard that the shift from ILEs to QLEs may have been concurrent with the election of the Labour government in 2017. Late in the final term of the Key/English National government, Education Minister Nikki Kaye told Parliament, "We are the Government

that will have the strongest legacy in terms of upgrading and fixing our schools to modern learning environments [MLEs]."[38] At the time then, the political rhetoric was still in favour of ILEs (MLEs being a synonym).

By 2018 though, the political narrative was changing. National opposition member Simeon Brown asked Minister of Education Chris Hipkins, "What plans, if any, does the Minister have to amend Ministry of Education guidelines regarding Innovative Learning Environments in New Zealand?". Hipkins replied, "I am advised that the Ministry of Education is updating the Innovative Learning Environment Assessment Tool (originally introduced in 2010 as the Modern Learning Environment Assessment Tool) to better measure the alignment of a school's current property to its educational vision and practices. The revised tool will provide the Ministry with information on aspects of fitness for purpose, including objective measurements from data-loggers on acoustics, lighting, thermal comfort and air quality."[39] Hipkins does not refer to pedagogy here, but only to the physical properties of classroom, which is consistent with the Ministry's move towards Quality Learning Environments (QLEs) around this time. Again, QLEs are defined only in terms of their physical properties, without an explicit expectation of any specific pedagogical approach.

By 2021, Hipkins was using the updated terminology (QLE), and clearly signalled that the policy change had taken place in 2018: "In 2018, the Government set the target of all schools having *quality learning environments* by 2030. This was informed by a wide range of research, including two reports the Ministry of Education published in late 2016. These followed a review of local and international literature and some supplementary research" (emphasis added).[40]

It is regrettable that neither the previous National government, nor the Ministry of Education commissioned such a review before embarking on a costly building project. Apart from the waste and disruption the strategy has entailed, schools are now left with classrooms that are set up for a dubious pedagogical approach (self-directed learning) and which most teachers have not been trained to use.

CHAPTER 2
Examining the assumptions

As noted in the Introduction, in explicitly linking classroom design to objectives for enacting its preferred pedagogy, the Ministry of Education's 2011 property strategy rested on some critical assumptions.[41] One is that a constructivist pedagogical philosophy – 'self-directed learning' – is effective. The other is that integrating computer technology into curriculum and pedagogy will improve learning. Both these assumptions are examined below.

What is the evidentiary basis for the self-directed learning pedagogy that flexible spaces are designed to accommodate?

When the Ministry produced its 2011 property strategy, it was clear that many classrooms in New Zealand were not fit environments for children to learn in. Poor insulation and temperature control; inadequate ventilation, lighting and acoustics; and general disrepair were widespread. As Wall noted in her literature review of the ways in which physical environments affect learning, students (unsurprisingly) learn better in higher-quality buildings.[42] This is partly a matter of physical comfort and of being able to see, hear and attend adequately, but there is also a psychological dimension. Wall noted that students feel more valued when the buildings in which they are being educated are of high quality and asserted that "cosmetic quality is more important to outcomes than structural quality."[43]

Had the Ministry's strategy simply aimed to rejuvenate a classroom estate, replacing ageing and decaying classrooms with warm, well insulated, well lit, acoustically adequate, and aesthetically attractive classrooms, it would have been uncontroversial. However, the strategy went much further than this. It set out an agenda to reconfigure classrooms to enact pedagogical approaches considered appropriate for the 21st century, with an emphasis on student-led and collaborative learning.

The notion that teaching and learning behaviours can and should be shaped by classroom design has its roots in a school of architectural theory called *architectural determinism*. In general terms, the doctrine of architectural determinism is a that the function of a space follows from its form. Applying this doctrine to schools, the ways in which teachers teach and in which students learn are regulated by the design and contents of their classrooms. A converse doctrine called *architectural functionalism* holds that the form of a building ought to follow its function. So, whereas an architectural determinist would see classroom design as a vehicle for enacting a desired pedagogical approach, an architectural functionalist would observe the behaviours and manifest needs of teachers and students, and design classrooms accordingly. Ian Cooper provides a detailed analysis of the implications of each of these doctrines for classroom design.[44]

These two architectural doctrines have quite different political and psychological ramifications. The determinist stance, which seems to underpin the Ministry of Education's 2011 strategy, seeks to impose particular pedagogical strictures through classroom design.[45] Arguably, this stance is out of keeping with the Tomorrow's Schools philosophy, under which each school is responsible for its own pedagogical approaches. A functionalist approach to classroom design, enabling schools to choose designs best suiting the behaviour of their teachers and students, seems more compatible with Tomorrow's Schools.

If there is compelling evidence in favour of a particular pedagogical approach, the imposition of mechanisms to enforce that approach might seem justified. This would include adopting architectural determinism as the doctrine driving classroom design. Just as health authorities are justified in insisting that health practitioners use research-based approaches to treatment, education authorities are justified in insisting that teachers use research-based teaching methods. In the absence of such research evidence, though, such an authoritarian stance would be unjustified and arbitrary.

From a psychological perspective, the culture of teachers and students must be considered a pragmatic constraint on the way in which an architectural determinist approach to classroom design might be expected to play out. If teachers and students resist the adoption of approaches to teaching and learning that a mandated classroom design is intended to impose, then its implementation will be suboptimal at best. As Cooper pointed out, "teachers are quite capable of holding, and of imposing on their [students], patterns of use contrary to those intended or expected…"[46]

Rachael French et al. noted four possible scenarios for the alignment, or otherwise, of pedagogy with classroom design.[47] One is 'traditional' pedagogy enacted in 'traditional' classrooms with rows of desks facing the teacher. Another is more personalised 'student-led' learning enacted in an ILE. In both scenarios, classroom design is aligned with the pedagogy it is designed to support. The other two scenarios are mismatches in this regard – 'student-led' learning in a traditional classroom, or 'traditional' pedagogy in an ILE.

At the very least then, any attempt to change teaching and learning behaviour through an imposed classroom design must involve clear articulation to teachers, both of the pedagogy that the new design is intended to enact and of its empirical justification. Appropriate professional development must also be undertaken to ensure that teachers know how to use new classroom environments in the intended ways.

Notwithstanding these political and psychological factors, when a physical classroom space is redesigned, some change in teaching and learning behaviour is inevitable. As French et al. have noted, a 'traditional' classroom, with its rows of desks and the teacher positioned at the front, is set up for a teacher-led, direct instructional approach.[48] Such an approach is obviously much more difficult when a room is large and students are dispersed across different areas or engaged in different activities. A learning environment of this kind is much more aligned with a 'self-directed' approach to learning.

The Ministry has signalled an intention to design physical environments that bring about the alignment of "social, pedagogical, and physical elements in the whole school."[49] If an architecturally-determinist stance to new classroom design is to be taken, then the most effective pedagogical approach should be identified before designing a physical learning space.

The Ministry's 2011 property strategy asserted that classroom practice has moved away from the "teacher-centred system that revolved around structured classroom lessons" prevalent in the mid-to-late 20th century.[50] Little detail was offered in the strategy itself regarding what ought to replace this more traditional approach. Even so, in signalling a shift away from 'teacher-centred' pedagogy, the strategy implied that the school system in which ILEs are designed to operate is 'student-centred'. Self-directed learning is a hallmark of student-centred pedagogy.

Some researchers have been more explicit. For example, Leon Benade asserted that 'transmission' models of teaching are outmoded, and that open school design is required for students to develop the 'life-long' skills required

in the 'knowledge economy' of the 21st century.[51] These include "critical thinking and problem solving; collaboration and leadership; agility and adaptability; initiative and entrepreneurialism; effective oral and written communication; accessing and analysing information; and curiosity and imagination."[52]

Benade favours team teaching, with multiple classes occupying common spaces and plenty of technology as the best environments in which to impart these skills. His evidence for these claims was obtained from interviews and focus groups at two schools. Both had flexible spaces that could be reconfigured for different purposes, with up to 90 students occupying the same space. The spaces also had integrated technology.

Teachers expressed various challenges associated with learning to use these classroom environments. No data on student achievement were explored to support Benade's assertions that 'transmission' teaching is outmoded, that the skills Benade considers necessary in the 'knowledge economy' are actually what schools should focus on, or that open learning environments are pedagogically effective.

Benade's research approach is typical of studies investigating ILEs and their effects on teaching and learning. It was qualitative, meaning that views and perceptions of research participants (typically teachers, students or both) were canvassed through conversations (interviews and focus groups). Qualitative data gathering and analysis is time and resource intensive so most qualitative studies are, perforce, based on small and non-representative samples. Another issue is that qualitative research has little in the way of mechanisms to control researcher bias – especially confirmation bias – in the interpretation of results.

Quantitative research approaches are not entirely immune to these effects. Quantitative researchers' biases can arguably affect their conclusions through their choice of measures, methods of analysis, and interpretations of results. Nonetheless, quantitative research methodology has many design features and research conventions that limit the influence of researcher bias, extraneous variables, and statistical noise on the conclusions of research.

A crucial ideological bias evident in much of the qualitative research on ILEs in New Zealand and elsewhere is that it takes for granted the efficacy of a strongly constructivist philosophy of curriculum and pedagogy. Benade is one example.[53] The study of French et al.[54] and that of Jeremy Kedian and John West-Burnham[55] are two more. Given that the adoption of ILE architecture for classrooms is predicated on this kind of pedagogy, the assumption that it is an effective approach to teaching requires examination. French et al. rightly observe that maintaining traditional pedagogy in an ILE represents wasted investment in classroom redesign. What they overlook, however, is that the investment may have been misguided in the first instance, and that it might have been better to use evidence-based pedagogy in a traditional classroom design, perhaps with modifications to the configuration of furniture.

In fact, there is a paucity of evidence for nearly every aspect of the pedagogical approach espoused by the Ministry of Education as justifying ILEs. One of these aspects – 'collaborative teaching' – requires particular comment because the Ministry has used it to support its case for large, open-plan classrooms. Yet, as Starkey and Wood[56] observed, there is no reliable research supporting the Ministry's[57] claims that having multiple teachers in the same classroom with standard teacher-student ratios does anything to enhance learning.

Neither is there any evidence that such environments foster collaboration between students, as Starkey and Wood also pointed out. Indeed, Gary James Harfitt reported that student

collaboration sometimes *decreases* as the number of students in a class increases.[58] Harfitt's research was qualitative, meaning that it cannot reliably be generalised. Nonetheless, there is no evidence for the converse claim, made by the Ministry, that larger and more populated classroom environments enhance student collaboration.

A full critique of constructivist curriculum and pedagogy is well beyond the scope of this report. Recent examples of critique in the New Zealand context include Briar Lipson's commentary[59] on the influence of constructivist philosophy on the New Zealand Curriculum[60] and Helen Walls and Michael Johnston's discussion[61] of its deleterious effects on literacy learning. The latter authors also report on an empirical study demonstrating the efficacy of direct instruction and timely feedback in the teaching of writing. For present purposes, one aspect of constructivist pedagogy – 'self-directed learning' – is especially relevant.

In the Introduction to this report it was noted that the Ministry of Education has retreated from using the term 'ILE', which explicitly invokes the integration of pedagogical and material considerations in classroom design. Instead, the Ministry now endorses QLEs, which focus squarely on material considerations. Nonetheless, at the time of writing there was still information on the Ministry of Education's TKI website evincing that a strongly self-directed learning philosophy influenced the emphasis on ILEs (MLEs) in the 2011 property strategy.

Advice to schools and teachers on "getting started in an ILE"[62] is informative in this regard. Teachers are exhorted to give students "more agency to plan what they need to work on, how they will do this, and where they will do this." They are advised to plan for "a greater focus on self-directed learning, including emphasis on learners taking more responsibility for accumulating evidence of their learning for assessment purposes." It is asserted that students should be involved in decision-making about "what is learned, how learning occurs [and] where learning takes place." There is even an example of a school that collaborated with its students to design their ILE. It is asserted that "Students know the kind of environments and approaches that work best for them to learn."

In another case scenario, two teachers describe their engagement in team teaching, noting that "supporting students to be self-directed learners is their underpinning pedagogy." "Using technologies as part of learning," "collaborative learning," and "working independently" were all taken into account in consultation with students. Conspicuously absent, however, is any reference to the role of teachers in curriculum planning and pedagogy.

This information leaves little doubt that the pedagogical focus in ILEs is intended to be on self-directed learning. This entails teachers stepping into the role of 'guide on the side' rather than staying in their traditional role as 'sage on the stage', to use a specious framing beloved of progressive educationalists. Indeed, *specious* is a word that might be used to describe a great deal of the justification for self-directed learning. Self-directed learning sounds appealingly democratic, whereas 'teacher-centred' learning and 'direct instruction' sound cold and authoritarian. However, as is so often the case with constructivist ideas in education, while 'self-directed learning' sounds appealing, it often does not serve students well.

Educators, parents and policymakers all want children to learn to be collaborative, independent and adept with technology. One of the main reasons for the disjuncture between the idealism of constructivist ideas and their actual effects is that terms such as *self-direction* and *independence* are aspirational. They are qualities we want students to *acquire* from their educational experiences. It is naivety inherited from Rousseau, however, to believe that children are born with these qualities. Rousseau might be forgiven for his

ignorance of the capacities that human beings are, or are or not, born with. He did not have access to the many decades of evidence from cognitive psychology and educational research that we do. Contemporary policymakers have no such excuse.

Malcolm Knowles, cited by Hannes van der Walt, defined self-directed learning as:

> … a process in which individuals take the initiative, with or without the help of others, (1) in diagnosing their own learning needs, (2) formulating learning goals, (3) identifying human and material resources for learning, (4) choosing and implementing appropriate learning strategies and (5) evaluating learning outcomes.[63]

Again, each of these five defining features of self-directed learning represents a desirable goal for education. However, Knowles was principally interested in adult learning. None of the characteristics of self-directed learning is pedagogically realistic, either at primary school, where children must master literacy and numeracy. They are no more realistic at secondary school where they learn epistemic disciplines such as mathematics, science and history, and aesthetic disciplines such as the visual arts and drama.

These disciplines are part of the cultural inheritance of young people and they are entitled to opportunities to learn them. It is simply unrealistic to believe that they can reconstruct for themselves knowledge that was established over time by people such as Curie, Michelangelo and Darwin, who themselves, in the words of Newton, "stood on the shoulders of giants." Disciplinary knowledge cannot be learned thoroughly or efficiently without expert guidance. Even in adult learners, self-directed pedagogy is often inefficient and ineffective. For example, Curtis J. Bonk and Mimi Miyoung Lee found that, while adult learners enrolled in a massive open online course (MOOC) on computer technology found the opportunity for self-directed learning motivational, learning was neither time efficient nor high in quality.[64]

It is worth addressing Knowles' defining characteristics of self-directed learning one at a time to see how they are misguided if they are used as learning principles for children.

A young person cannot diagnose his own learning needs without knowledge of the parameters of the target knowledge or skill. A five-year-old might be aware that she cannot decipher a written text but will not know what she needs to do to learn to do so. She will not become aware of spelling-sound mappings, for example, without being instructed as to what they are. Similarly, a 15-year-old cannot deduce Newton's mechanics, much less develop sound understanding of them, on his own.

Similarly, formulating goals in disciplinary learning requires expert guidance. Complex systems of skills and knowledge require expertise to be developed piecemeal, and in a strategic manner, to avoid severe difficulties with cognitive load.[65] An expert teacher can structure learning so that important components are mastered and automatised before moving on to learning that will depend on those components. Students who do not yet have an overview of a discipline, cannot typically accomplish this sequencing for themselves. Students can take ownership of limited goals, but the goals themselves need to be developed in consultation with an expert guide.

There is room within a sound, teacher-led pedagogical approach for students to identify learning resources, although an expert teacher is usually the most proximal and easily identified resource. Furthermore, to be able to identify written sources, a student must have sound reading skills, which requires direct instruction in a large majority of cases.[66]

Like the notion that a student can identify his or her own learning needs, the ability to choose

and implement effective learning strategies relies on knowledge that most children do not have. Again, complex systems of skills and knowledge (disciplines) require efficient sequencing of learning to prevent excess cognitive load from becoming a barrier to learning. By far the most dependable and effective way to get this right is to rely on an expert teacher.

The evaluation of learning outcomes is something that teachers and students can profitably engage in together. A child can certainly tell when he or she has mastered a skill or is able to access knowledge fluently. Students should be encouraged to identify when this is the case and to check in with the teacher. Even so, the art of giving effective feedback involves identifying the difference between a current state and a goal state and providing guidance on how best to reduce that difference.[67] Here again, an expert teacher is the most reliable source of this kind of information.

There is no generalisable research on school-aged children to evince the contention that self-directed pedagogy results in effective learning. There is some research that focuses on post-secondary school learning,[68] but this has little relevance to the question of the efficacy of self-directed learning for school-aged children. The maturity, motivation and knowledge base of tertiary students are all such that a self-directed approach is far more plausible than it is for younger students. Even so, for advanced study in disciplinary subjects, the support of an expert teacher is essential in most cases.

Such research as there is on school-aged students tends to focus on surveys of teachers' perceptions[69] rather than directly measuring impacts on learning itself. One study that did focus on learning impacts was that of Van Duar and Murray-Harvey.[70] The study was conducted in South Australia, with 150 students from six intact Year 5 classes, one from each of six different schools.

The six schools were classified as providing low, moderate or high levels of support for inquiry learning. Students' motivation and strategies for learning were also assessed prior to, and on three occasions following, four classes on self-directed learning, which covered motivation and strategies. The instruments used for these purposes were developed by the researchers. Both were shown to be reliable, but no construct-related evidence of the validity of either was offered.

Oddly, the researchers reported that an "explicit teaching" approach was taken to the self-directed learning classes so, while the students were learning *about* self-directed learning, they were not, apparently, learning in a self-directed way.[71] There were trends in the data for students at schools classified as providing 'high' and 'moderate' support for inquiry learning to increase their scores on motivation and self-efficacy following the classes. There was a decreasing trend at the 'low' inquiry schools. There was a trend for knowledge of strategies to increase at all schools in the study following the classes. No hypothesis-testing statistics were employed and, as the authors noted, the sample size was small. This, as well as the fact that direct instruction was used in the classes that comprised the intervention of the study, makes it difficult to know what to make of its results.

No generalisable, empirical studies have been conducted in New Zealand to evince the efficacy of student-directed learning, either prior to the Ministry of Education implementing its 2011 property strategy, or since. Neither is there any robust international evidence supporting this pedagogical approach.

Rather than evincing a self-directed learning approach, generalisable empirical research in the cognitive psychology and educational literatures suggests that emphasis on direct instruction in pedagogy is most effective. As Barak Rosenshine pointed out though, the term 'direct instruction' has been used to mean somewhat different

things in the educational literature.[72] Two of the better-defined meanings, which Rosenshine discusses, have several aspects in common. One of these derives from early research into teacher effectiveness.[73] The other is work on effective instruction in cognitive strategies.[74]

The most effective instructional procedures identified in both strands of research involve the same broad elements. Individually, these elements are in harmony, either with theories of memory and attention based on experimental results in cognitive psychology or with other empirical work in education.

Initial simplification of a task is achieved by a teacher giving an overview of the goals for a lesson and dividing the task into manageable components. The overview sets up an initial mental schema of a task for students, which enables better retention of information.[75] The division into sub-tasks allows each to be addressed without causing cognitive overload.[76] The use of 'scaffolding' and guidance while each subtask is initially practised by students supports them while a sub-task remains unfamiliar, effortful and cognitively demanding. When the target knowledge is declarative ('factual') rather than procedural, 'practice' may involve explaining or writing about a concept; relating it to other, already understood concepts; or generalising it in a range of contexts. These practices all resonate with understandings from classic research in human memory showing that deeper and more elaborate processing of information enhances its retention.[77] Guidance can be gradually withdrawn, as the cognitive load involved is reduced by increasing automaticity. An emphasis on the provision of extensive, independent practice by students reinforces this developing automaticity. Finally, an emphasis on systematic feedback ensures that errors are corrected before becoming entrenched.[78]

It is clear from laying out these elements of direct instructional procedures that they do not simply involve a teacher lecturing to students while they sit passively and receive the information. Students engage in practice – they are fully engaged in the learning process. Under the direct-instruction approach, however, it is acknowledged that the teacher holds the target knowledge and is explicitly tasked with conveying it to students. This contrasts with self-directed learning and many other constructivist pedagogies under which students are intended to 'discover' knowledge for themselves – whether from books or online sources, or from direct experience and observation. As noted above, much of the time this is simply impossible – it is not feasible for students to discover for themselves knowledge that may have taken hundreds of years to develop. Even when it is possible, discovery learning is usually very inefficient. Under direct instruction methods, the teacher tightly controls the learning procedures, the ordering of them, and the rate at which 'scaffolding' is eliminated. Again, this contrasts with self-directed learning, which involves much less structure in the first instance.

The reality of effective, 'direct instruction' pedagogies like that described by Rosenshine is quite different than the, typically pejorative, descriptions of these pedagogies by constructivist theorists. For example, Kedian and West-Burnham argue that traditional teaching, which they called "transmission-based" pedagogies, are philosophically "neo-liberal."[79] They describe traditional schooling as a "factory model" and question whether such "industrial era" schooling can foster curiosity, collaboration and creativity. Perhaps, they speculate, "there is a need to transform our current schools in a somewhat revolutionary way in order to meet the needs of future learners rather than the current view of meeting the needs of the market."[80] All of this ignores the implications of scientific understanding of human information processing for learning, which, as noted above, align well with direct instruction approaches. The argument that curiosity is done a disservice

by direct instruction approaches is presented without evidence. Similarly, the possibility that the expression of creativity is enhanced by knowledge is not considered.

In fact, the disagreement between proponents of ILEs and traditional classroom models goes beyond pedagogy, reaching deep into curriculum. Innovative learning theorists believe that, because future society will be very different from present society, schools must focus on radically different curriculum content to prepare them for this future. For example, Michael Fullan and Maria Langworthy claim that schooling should centre on character, citizenship, communication, collaboration, critical thinking and creativity.[81] Traditionalists, on the other hand, see grounding in disciplinary knowledge as the best preparation for an uncertain future.

Resolving the epistemic differences between curriculum traditionalists and proponents of '21st century learning' is beyond the scope of this report. Nonetheless, the present critique is informed by a critical realist position,[82] which holds that learning 'powerful knowledge' is emancipatory and that especially the most disadvantaged students need such knowledge to break intergenerational cycles of poverty. Powerful knowledge is distinguished from 'common sense' knowledge acquired in everyday experience. It is systematic, with each knowledge system focused on a particular field of enquiry. In other words, powerful knowledge is knowledge of epistemic disciplines. Critical realism, then, is explicitly at odds with '21st century learning'. Even so, it is not precisely a 'traditional' curriculum philosophy, either; it explicitly recognises the risk inherent in the teaching of epistemic disciplines of an 'under-socialised' view of knowledge that fails to recognise the different cultural capital that students bring to school.[83]

From both a pedagogical perspective based on scientific understanding of human information processing, and a critical realist curriculum perspective, the redesign of classrooms to accommodate self-directed or student-led learning has been an expensive mistake. This is not to say, of course, that there is no place in a classroom for collaboration between students, or that they should be placed in straight and silent rows listening to the teacher. But desk configurations that allow a mix of teacher-led and collaborative learning are easy to achieve in 'traditional' classrooms, without fundamentally redesigning the classrooms themselves. There is no evidence that large, open-plan classrooms are required for the most effective pedagogy and curriculum, even in principle.

What is the evidentiary basis for the integration of ICT into pedagogy?

A second pillar of the Ministry of Education's 2011 space strategy was the requirement that classrooms be wired for technology. This requirement is not nearly as expensive to meet as the requirement for flexibility, which necessitated major building works in most schools. Wiring classrooms for technology would not have required much, if any, reconstruction had it been the only element of the strategy. In financial terms, then, this requirement was trivial in comparison. Even so, the motivation for the strategy as a whole was to gear classrooms for modern learning. The integration of computer technology into pedagogy was seen as an essential part of this. An analysis of the claim that such integration leads to better learning outcomes is therefore also necessary.

At the outset, different uses of computer technology in education must be distinguished. There is no doubt that computers now have their place in classrooms. An obvious context in which they are required is in computer studies itself. If students are learning to code or learning about the back-ends of operating systems, they need to use computers to develop their skills and knowledge. Other contexts in which computers

have an uncontroversial role in learning is in teaching students to use applications in particular domains, such as sound engineering or graphic design. Most, if not all, of these kinds of uses of computer technology would have their main applications at secondary school, in specific subjects, often taught in specialised classrooms. It is not necessary for all classrooms to be wired for technology to deliver these kinds of applications.

The idea that the use of computer technology ought to be extended across the whole curriculum and to all age levels requires greater analysis. What, for example, is the evidence that the use of tools such as Google Docs enhances learning? Is it better for students to learn handwriting before they learn to type? Is the learning of mathematical concepts well served by software that produces problems for them to solve, or is there again value in old-fashioned pen-and-paper approaches?

Like the literature on constructivism and self-directed learning, the literature on integrating computer technology into learning is very extensive and a full survey of it is beyond the scope of this report. Here, two review articles are considered, and some assumptions regarding the place of expert teachers and personal knowledge in a technological society are questioned.

In a review of 19 studies employing either experimental, quasi-experimental or correlative approaches, Christopher Herodotou concluded that the use of tablets can enhance learning in literacy development, mathematics and science for children of five years and under – that is, for children in early childhood education.[84] However, these results are not directly applicable to the school curriculum where learning demands are greater and where effective learning may depend more heavily on instruction by teachers. Björn Haßler et al. conducted a similar review of 35 studies on the effectiveness of tablet-based learning in schools.[85] They also found a preponderance of studies showing that tablet use can enhance learning. Much of the research they reviewed focused at the secondary school level with applications to specialised subjects.

An important caveat on the usage of technology in ILEs comes from a survey of 335 teachers and principals conducted in New Zealand, reported by Fletcher et al.[86] Respondents were generally positive about the affordances of technology for student collaboration and classroom management, but many emphasised that it is no substitute for teachers imparting knowledge directly to students. Some respondents also commented that technology is no more useful in an ILE than it is in a traditional classroom configuration. This research did not directly measure the effect of technology on learning. Even so, as Fletcher et al. noted, the views expressed by their respondents accord with the conclusions in the review of Haßler et al.[87] that technology, while useful in certain contexts, is not an educational panacea. Indeed, if it is not used thoughtfully and strategically, it can be a counter-productive distraction.

Another caveat on technology, related to the warning of respondents in the study of Fletcher et al. that technology is not a substitute for human teachers, is that neither is it a substitute for personal knowledge. Some commentators assume that because knowledge can reliably be sourced from websites like Wikipedia, students do not, themselves, need to hold knowledge. According to Kedian and West-Burnham, for example, "school-aged children now live in a world of almost instant access to information ... the Internet [has usurped] one of the core roles of the traditional school."[88] Like the view that the pedagogical and curriculum needs of children are fundamentally different than they were in the past, this assumption ignores the nature of human cognition.

Unless they hold knowledge personally, students cannot understand how it fits together with other knowledge and cannot use it as a basis

for thinking and conceptual understanding. 'Critical thinking' is one of the key planks of 21st century learning, according to many theorists. But without knowledge, a student has no basis to think critically – there is simply nothing substantial that they can think *about*. Without knowledge, a student has no resources to draw on, to guide counter-argumentation. Innovation and creativity, two other aspects of 21st century learning are similarly bereft of meaning without personally held knowledge.

The research evidence reviewed here suggests that if used judiciously and in a well-planned way, computer technology in classrooms, especially tablets, can have benefits for learning in literacy and numeracy in primary school and in specialised subjects at secondary school. However, there is nothing in this research to suggest that the benefit of such technology is enhanced by the redesign of classrooms, nor that appropriately used technology fundamentally changes the role of the teacher. Indeed, especially with younger children, smaller classrooms with fewer children may afford the oversight by teachers that is required to ensure that technology is used effectively.

CHAPTER 3

The impact of learning spaces on students' achievement

In a publication by researchers affiliated with LeaRN, Bradbeer and colleagues noted that the Ministry's claim that ILEs would be more pedagogically effective than traditional classroom was "largely conjecture."[89] This assertion is supported by the Ministry's response to a request under the *Official Information Act*, made to support this report, for information regarding any "research or analysis regarding the educational effects of ILEs … undertaken prior to investing in their establishment."[90] In its response, the Ministry supplied two references. One was Kenn Fisher's document, comprising a series of infographics, prepared for the Department of Education and Training in Victoria, Australia.[91] The other was a link to Prakash Nair's TEDx talk on YouTube. Neither source can reasonably be characterised as "research" or "analysis."[92]

In his TEDx talk, architect Nair spoke about his consulting business focusing on "[designing] schools according to the research about how children actually learn." He criticised the traditional model of schooling for its cellular classrooms, cheap furniture, timetabling, lack of space per student and, importantly, teacher-directed pedagogy. He claimed that "clearly, this model doesn't work" and that traditional schools with their "cells and bells" are "obsolete."

Nair advocated demolishing as many walls as possible and establishing large rooms to be occupied by up to 150 children. He strongly advocated student-directed, project-based and inter-disciplinary learning and took a forthrightly architecturally determinist stance: "If I mess with classrooms, I have no choice but to reengineer their entire system." Critically though, Nair did not cite any research to evince his assertions in his talk.

Like Nair, Fisher is an architect. His infographic lays out a "curriculum context" comprising a number of principles that are broadly consistent with 21st century learning pedagogy, including sustainability, innovation and community building.[93] While discipline-based learning is mentioned, so is "interdisciplinary" and "authentic" learning, the latter referring to "problem and resource-based learning." His "key pedagogical approaches" include constructivism, team collaboration, and project-based learning, although explicit instruction and discipline specialty are also included. The document then goes on to link pedagogical activities to spatial settings. For example, "delivering" refers to formal presentation and "passive learning," which involves a traditional classroom configuration, with students facing the teacher, whereas "creating" is described as "leaderless" and involving "multiple disciplines," with students seated around tables in small groups. The document then elaborates on the spatial requirements of the various pedagogical approaches he lists.

Fisher's infographic is essentially a pastiche of curriculum and pedagogical approaches, some traditional and others with a 21st century learning flavour, together with a range of classroom configurations that are purportedly appropriate for each. While the configurations are certainly plausible in respect of the curriculum and pedagogies to which they are linked, there is no reference to a research base

evincing the effectiveness of these curriculum objectives or pedagogical approaches.

Bradbeer et al. noted a lack of research on the pedagogical effectiveness of ILE classrooms more generally, especially research using designs that can support causal claims, linking classroom architecture with learning outcomes.[94] Arguably, the Ministry of Education would have served teachers, students and taxpayers better had it commissioned this kind of research and awaited its outcomes before embarking on the wholesale redesign of classrooms. Despite the Ministry's strategy to invest in ILEs being more than 10 years old, there remains little research on their effects on teaching and learning.

Isolating the effects of a particular variable on learning is difficult. This is so for characteristics of students themselves, such as ethnicity or socio-economic circumstances. It is the same for pedagogical methods and curriculum design and for the physical characteristics of schools and classrooms. One reason it is so difficult to measure the effects of single variables is that it is rare that we can isolate the effect of the variable of interest, free from the influence of other, extraneous variables. For example, in New Zealand[95] and elsewhere,[96] there is a clear association between students' socio-economic circumstances and their educational outcomes. This association is likely to be mediated largely by a range of family background variables.[97]

In an exhaustive analysis of the impact of classroom design on educational achievement, potential mediating and moderating effects of demographic and socio-economic variables would have to be accounted for. Family background variables are just one example. The sex of students, their age and the subject they are learning might all interact with any effect of classroom design on achievement. Furthermore, if the changes in classroom design are accompanied by changes in curriculum and pedagogy, the extent to which teachers are prepared for, and enact, such changes are also likely to moderate the relationship between classroom design and learning.

From a scientific perspective, the best approach to measuring the effectiveness of classroom design on learning is experimental. A representative, randomly selected sample of students and teachers would be randomly allocated to different kinds of learning environment. The educational progress made by students over a substantial time period would then be measured in each environment, in a range of curriculum areas. Statistical comparisons of progress would enable inferences to be made as to the most effective kind of class layout.

Factors such as students' age, sex and a range of family background variables could either be built into the experimental design as fixed effects or tested for their influence on the effectiveness of learning environments as covariates. All potential mediating and moderating variables not explicitly included in the experimental design – both known and unknown – would be controlled through the random allocation process.

Unfortunately, true experimental research is unusual in education, for pragmatic reasons. It is not usually practicable to randomly allocate students to different learning environments. Also, representative samples are difficult to establish because neither students nor teachers can feasibly be selected at random to participate.

Beyond experimental studies, we are left with statistically controlling potential mediating and moderating variables. This approach inevitably entails much uncertainty in conclusions; it can account only for the effects of factors included in the analyses. Variables that are not identified are still controlled under a random-allocation (experimental) approach. However, to be included in a statistical model, a factor must first be identified, operationalised and measured.

A starting point for an evaluation of learning environments is John Hattie's synthesis of

meta-analysis findings, which showed almost no effect of learning environment on educational outcomes.[98] This is an important result because it is distilled out of many hundreds of individual research studies. It therefore goes some way towards addressing the issue of extraneous variables that might confound estimation of the magnitude of any effect of classroom environment on learning. It does not, however, deal with these variables in a controlled or representative way. For example, a particular kind of learning environment might be effective for students in the early primary years, but counterproductive in the later primary years. Meta-analyses often wash out details like this because it averages effect sizes over many studies.

Importantly, Hattie's study could not address the question of whether the ways in which non-traditional spaces are used (i.e. the approach to teaching) modulate any relationship with learning outcomes. This issue of teachers' "environmental competence"[99] is an important consideration, especially considering that teachers are not usually given professional development on how to use non-traditional learning environments when they are established. In New Zealand, at any rate, there has been no systematic preparation of teachers to use them effectively.

To build a more nuanced picture, we must analyse a range of smaller-scale empirical studies in more detail. None of these is especially convincing individually, but when we consider their results together, we can begin to establish a picture of factors often associated with non-traditional learning environments (e.g. large class sizes with multiple teachers, group activities, the use of digital technology) that might be beneficial to learning, as well as any that might be detrimental. Similarly, we can reach some conclusions about the effect of these kinds of learning environments on students with different characteristics (e.g. at different ages or in different socio-economic circumstances).

An almost ubiquitous characteristic of research conducted on New Zealand's experiment with ILEs is an absence of evidence regarding the impact of these environments on students' learning. At best, teachers' or students' opinions on learning impacts are canvassed.[100] There is some relevant research from elsewhere, however.

Christopher Neilson and Seth Zimmerman analysed data from a low-socio-economic urban school district in New Haven, Connecticut, which spent $US1.5 billion on school construction over a 15-year period.[101] Their analysis showed an increase in test scores of about 0.027 standard deviation units for each $10k spent on construction per student. While this is a very small effect size, the total per-student expenditure was about $77,800, yielding a total average increase of 0.21 standard deviations. Unfortunately, though, as Neilson and Zimmerman note, their data did not enable a determination of exactly why the increase in test scores had occurred. There is certainly nothing in their research linking learning improvements to specific features of classrooms or classroom contexts.

Wesley Imms and Terry Byers reported on a case study of an independent school in Brisbane, catering to students from kindergarten age, through to the final secondary year.[102] This study was part of the ILETC project. The school had established open learning environments, supported by a range of technology. The school was well resourced and its students were predominantly from family backgrounds associated with high levels of educational success. The changes to their learning environments were informed by a series of trials in which they investigated three kinds of learning spaces. They were supported by university researchers with specific expertise in learning environment design – so their transition to a new learning environment was hardly typical. Thus, this study highlights the difficulty of interpreting data that come from a single school. Another important

consideration in this study was that class sizes were not manipulated – all three participating classes were of a standard (traditional) size.

Three Grade 7 classes were involved in the study, with three others acting as a control group. Each class spent one term in each of three different learning environments. So, over the course of three terms, all three classes experienced all three environments. Teachers moved through the environments with their classes. One kind of classroom was traditional, with students seated in rows facing the teacher. A second was set-up for group work and informal interaction between students and the teacher by installing tables for groups of students to sit around. The third was more flexible, allowing for both traditional and more informal arrangements and incorporated large screens and non-typical classroom furniture. Students in this environment all had tablets to facilitate communication between the teacher and the whole class, the teacher and individual students, or between students. The study was elegant: It was essentially a repeated-measures design, with each student and teacher exposed to all three environments over time. This design controls well for extraneous student- and teacher-level variables.

Measures included a survey of students' classroom experience and mathematics test results. To estimate the impact on learning of each class environment, the survey was run at three-weekly intervals throughout the study and a mathematics test was run at the end of each term.

Survey data showed substantial improvement in students' ratings of the effectiveness of technology usage and, also, attitudes to their learning in the classroom in which screens and tablets were used. Students generally rated teachers' fostering of students' ability to self-regulate more highly in classrooms that employed technology than they did in either of the other environments. They rated teachers' fostering of deep thinking, and their own willingness to take on challenges, more highly in both types of ILE than they did in the traditional classroom. Imms and Byers took the survey results to indicate greater student engagement in ILEs, especially the one that used digital technology, than in the traditional classroom.

The effects on learning in mathematics were less clear. Two of the classes showed significantly higher achievement in all three classroom designs (including the traditional one) than students with matched cognitive ability in non-participating classes in traditional classroom environments. For one of these classes, the effect size for this learning advantage was greater for the ILE without technology than for the other two, which showed comparable effect sizes. For the other, the effect was greatest for the ILE with technology, with the other two, again, being very comparable. The third class showed no significant difference compared with its matched non-participating class in any of the three classroom designs.

From a statistical perspective the analysis of the achievement data was weak. There was, unfortunately, no direct comparison of achievement across learning environments, which leaves teacher effects as a potential explanation for the observed differences. Furthermore, the order in which each of the three classes experienced the three types of class design was not taken into account. Overall, the study suggests that students enjoyed ILEs more than the traditional classroom, especially the one with technology. However, there was no reliable evidence that either environment impacted positively on their achievement.

In a technical report from the LeaRN group, Byers et al. reviewed 20 studies that used quantitative measures to assess the impact of ILEs on learning.[103] They focused on studies with designs that were able to shed light on the relationships between classroom designs and

reliable measures of learning. Out of 5,521 records retrieved through their search process, they found just 20 that satisfied these criteria. This in itself illustrates how little valid evidence there is on the impact of classroom architecture on learning.

Of the 20 studies they reviewed in detail, Byers et al. identified seven as being of high quality,[104] by which they meant that they were large in scale, involved multiple schools, and used standardised instruments to measure student achievement. Six of these studies are worth examining in some detail. Contrary to the assertion of Byers et al., however, Unline and Tschannen-Moran did not collect any student achievement data and is not, therefore, useful for examining the impact of architecture on learning.

Three of the studies – Tanner (2000; 2008) and Cynthia Uline[105] – focused primarily on the impact of architectural features of schools. The two studies by Tanner were conducted in elementary schools in the United States. Both involved investigations of partial correlations between ratings of various architectural features and academic achievement, after accounting for variance in achievement associated with socio-economic variables. Achievement was estimated using the Iowa Test of Basic Skills (ITBS), which measures skills and knowledge in literacy, numeracy and social studies.

Tanner (2000) investigated 44 schools.[106] Each school was rated on each of 39 architectural features, which were investigated for association with the mean ITBS score at each school, using a multiple regression model. Features positively associated with ITBS scores after accounting for the socio-economic variables were freedom of movement between structures, positive outdoor spaces, technology for teachers and 'overall impression' – a rather vague judgment of whether "learning environments are student friendly and teacher friendly and meet the educational program's needs."[107] Tanner's (2008) study was similar, except that it specifically focused on Grade 3 students at 24 schools, and on just four design variables – movement and circulation, large group meeting places, day lighting and views and instructional neighbourhoods (a mix of large- and small-group areas). Each of these four elements accounted for a modest amount of additional variance (2%–7%) in ITBS scores after accounting for socio-economic variables.

Tanner's studies relied on correlations, which are a weak basis for establishing causal relationships. Therefore, a causal link between academic achievement and the architectural features with which they were shown to be associated is not soundly established by these studies. Accounting for variance in achievement associated with socio-economic variables prior to investigating any additional variance accounted for by the features of interest partially mitigates this problem. Even so, it is entirely possible that uncontrolled socio-economic factors – those not captured by the covariates used in the model – as well as any number of other uncontrolled variables, might have mediated the relationship. This is made more likely by the fact that the percentages of variance in achievement accounted for by architectural features were modest, especially in Tanner's 2008 study.[108]

Even if Tanner's findings are taken as *prima facie* evidence for a causal relationship between architecture and achievement, it is difficult to know what applicability these findings have for evaluating the efficacy of New Zealand's ILEs, at least for those aspects of ILEs that purportedly support student-centred learning. Some of the features found to be correlated with achievement were not features of classrooms (movement between spaces, outdoor environment). Others (lighting, circulation) were environmental elements that would be desirable irrespective of pedagogical approach. Neither of these two studies, nor that of Cynthia L. Uline et al.[109] were focused on pedagogy as such, and did not gather any specific data on pedagogical issues. Rather,

all three posited a more general psychological effect of aesthetics and proximity to nature as the principal mechanism linking architecture and achievement. In fact, no conclusions can be reliably drawn from these studies about the nature of that mechanism.

The remainder of the studies identified as having strong designs by Byers et al. were much better placed to support causal conclusions.[110] All employed experimental or quasi-experimental designs. They all comprised a pre-test of academic achievement on both an experimental group and a control group, before the groups were randomly allocated to different learning environments, the control group to a business-as-usual environment, and the experimental group to an environment with certain innovations. Following a period of learning in their respective environments, both groups were given another test of achievement. Using this design, a finding that test scores had improved more for the treatment group than for the control group provides evidence for the efficacy of the innovations. Some of these studies also employed the same teacher in both environments, allowing the researchers to rule out teacher effects as an explanation for any experimental effect.

The studies of Chun-Yen Chang et al.[111] and Chun-Yen Chang et al.[112] focused on Grade 10 science teaching in Taiwan. In both studies, students were randomly assigned to one of two learning environments, both under the same teacher. One environment was 'traditional', using a teacher-transmission pedagogy in an ordinary classroom. The other used a mixture of traditional and 'constructivist' approaches in a laboratory classroom. Both studies used four classes, two allocated to each environment and all four being under the same teacher, the same amount of contact time, and the same learning objectives.

The main hypothesis of Chang et al. was not that one learning environment would be superior to the other in its impact on learning, but rather that students would learn best in whichever environment they preferred. Most students reported preferring the mixed approach pre-intervention, although most had experienced only the traditional approach. All participating students were given an attitude survey and an achievement test, both before and after the experimental intervention.

Neither study demonstrated any direct effect of the learning environment on achievement. Educational progress in the mixed environment was neither better nor poorer than it was in the traditional environment. Chang et al.[113] showed that attitude and achievement both improved more when students were learning in environments that matched their preferences. In the study of Chang et al.,[114] however, this match predicted only an improvement in attitude, not in achievement. An important point made by Chang et al. in both studies is that 'constructivist' and 'traditional' methods in science are not mutually exclusive. The ability to learn theoretical knowledge through direct instruction and to engage in practical investigation in a laboratory are both important aspects of science learning. They might therefore be expected to mutually reinforce one another. Chang et al. also noted that the novelty of the laboratory environment, rather than just the congruence of preferred and actual environments, might have influenced the measured attitude enhancement.

In the study of Fatma Gozalan Cicek and Mehmet Taspinar,[115] participants were 66 Grade 10 students studying a computer education course on web design. A control group was educated with lectures and presentations, whereas the experimental group was trained using a 'laboratory control system'. The control system "[allowed] students to conduct their class activities over a teacher-centred computer."[116] It also allowed them to interact with one another. Cicek and Taspinar noted that the

system afforded advantages in the presentation of materials, enhanced what students could produce, and allowed teachers to monitor and evaluate learning.

The study used a pre- and post-test design, with an attitude scale and an achievement test providing the measures. The experimental group did better on both the achievement test and the attitude scale and showed better retention after five weeks. A flaw in the statistical analysis of this study was that it did not use the interaction term in an analysis of variance to evince a difference in educational progress between the treatment and control groups. Instead, only simple contrasts were reported, using t-tests to compare the groups at each time point. Neither was there any information as to whether the teacher was the same for the two classes, so teacher effects cannot be ruled out as an explanation for the findings. In any event, the feedback provided by the control system was arguably responsible for its apparent success, rather than any more sophisticated aspect of the innovation.

The final study identified by Byers et al.,[117] that of Mehmet A'rif Ozerbas and Bilge Erdogan,[118] focused on a geometry unit in a mathematics course. Participants were 58 Grade 7 students in Turkey divided into a business-as-usual control group and an experimental group that used a 'digital classroom' comprising mobile devices for each student, a personal computer for the teacher, a communications network, a shared screen for the class, and a management system for the teacher to control the other devices in the room. The measures were a test of academic success and an online technology self-efficacy scale. The experimental group improved its understanding of circle geometry more than the control group, evinced by a significant interaction in an analysis of variance. There was no evidence that the digital classroom intervention enhanced self-efficacy for using online technology. Like the study of Cicek and Taspinar, there was no information on whether the teacher was the same for the two classes, so teacher effects cannot be ruled out.

A number of factors common to the studies of Chang et al.; Cicek and Taspinar; and Ozerbas and Erdogan are relevant to interpreting their implications for New Zealand's ILEs. All these studies were carried out in specialist subject areas, and three of the four were in secondary school contexts. These factors are relevant for two reasons. First, teacher expertise is likely to be higher in specialist disciplines than in generalist primary school education. Second, the disciplines of science and computer technology, which were the domains of interest in three of the studies, comprise both theoretical and practical elements. These three studies explicitly mixed direct instruction and constructivist pedagogy.

Another important point is that two of these studies were carried out in Taiwan, and the other two in Turkey. The educational cultures and contexts of these countries is likely to be different in a number of ways. In particular, Chang et al.[119] noted that Taiwanese students are used to a highly test-focused approach, favouring a level of direct instruction that is probably unusual in New Zealand schools. Thus, the 'mixed' approach implemented in the Taiwanese studies may well have been more typical than innovative, had it been implemented in a New Zealand context.

Perhaps most importantly, none of the studies reviewed here in any way supports the notion that putting large numbers of student in large classrooms with multiple teachers will yield any benefit. All these studies are, in fact, silent on this issue. The experimental and quasi-experimental studies were all carried out with standard class sizes and single teachers. They were focused on different pedagogies and the integration of technology in the classroom rather than on the architectural features of learning environments.

Kenneth C. Tanner's studies[120] are very much focused on architectural features, but do not

supply any evidence in favour of open-plan classrooms. In fact, the emphasis in these studies was on sensory and aesthetic environments being most conducive to learning. Arguably, these studies suggest that smaller, quieter environments are more desirable. At the least, these studies suggest that the sensory impacts of large learning environments – noise, in particular – would have to be managed well to prevent them from causing detrimental effects on some students. This is especially so for those with sensory or attentional challenges, and possibly those who are introverted. The likely impact of large, heavily populated environments on students like these is explored in the final chapter.

CHAPTER 4

Auditory Processing Disorder and ILEs

Some students suffer from neurological conditions that result in particular learning challenges. The effects of some of these conditions are likely to be exacerbated in large, open-plan classrooms. In this chapter, the effects of being in ILEs on the learning of children with a commonly diagnosed condition, Auditory Processing Disorder (APD), is considered. The research evidence on APD in ILEs is likely also to be relevant to other common learning disabilities, in particular, Attention-Deficit Hyperactivity Disorder (ADHD).

Auditory Processing Disorder: APD is a disorder of auditory attention. According to a report from the New Zealand Audiological Society, authored by W.J. Keith et al.[121] people suffering from APD often show normal auditory sensitivity in standard audiometric assessments. One typical manifestation of the condition is difficulty in focusing on speech in a noisy environment. Keith et al. reported that about 6.2% of New Zealand children (one in 16) are estimated to suffer from APD.

Keith et al. further report that:

> The auditory environment of classrooms can be particularly difficult for children with APD … Many classrooms exceed [ANSI standards for signal to noise ratio and maximum reverberation times in classrooms] and hence personal amplification systems may be required for children with APD. … The situation is exacerbated when traditional classrooms are replaced by large open plan "modern learning environments" with 60 or more students.

Clearly then, being situated in ILEs is likely to cause challenges for children with APD. Some studies have found comparable levels of noise in traditional and open plan classrooms, but only when there are comparable numbers of children in each.[122] However, normally, there are far more children in ILEs than in traditional classrooms and, unsurprisingly, the noise levels in these more populated classrooms are typically considerably higher.[123] Shield et al. conclude that "studies of open plan classrooms over the past 40 years have shown that intrusive noise from adjacent classesbases [sic] is a major problem, reducing speech intelligibility and privacy and causing distraction and dissatisfaction to both pupils and teachers."[124]

In its online information on ILEs, the Ministry of Education acknowledges that some children with particular learning challenges may struggle in ILEs:

> When you design your space consider how you will create systems and spaces that ensure the needs of all students are catered for. Consider how you will plan and design for: students who are sensitive to noise; students who are easily over stimulated; [and] students who need support to manage themselves and their work.[125]
>
> Unfortunately, they offer little practical advice on how to do this. They do recommend that schools spend money to mitigate the problem for children with APD, by installing acoustic tiles and wall linings or sound field systems.[126]

This, of course, assumes that schools have surplus money in their property grants. In its advice on assisting children with APD, the Ministry makes a number of suggestions, such as positioning children away from background noise and checking that teachers can be heard clearly.

Unfortunately, much of this advice would be difficult to implement in an ILE, where children typically occupy no fixed position and noise levels are manifestly difficult to control. It seems clear that the Ministry did not have ILEs in mind when it issued this advice, nor children with APD in mind when it promulgated ILEs.

Conclusions

The Ministry of Education's 2011 property strategy was appropriate and necessary inasmuch as it focused on rejuvenating New Zealand's ageing classroom estate. New Zealanders want their children to be educated in warm, dry, attractive classrooms with appropriate lighting and acoustics. The focus of the strategy on establishing ILEs, however, was misguided. There is no substantive evidence in favour of most of the curriculum and pedagogical goals with which ILEs are designed to align. Furthermore, the education of children with APD and other learning disorders is more difficult in these environments than it is in traditional classrooms.

The Ministry may have tacitly recognised its error in pursuing this policy. Even before the 2011 strategy expired in 2021, it had moved away from the terminology of ILEs towards 'Quality Learning Environments', a term that refers to the physical properties of classrooms only; it does not signal any particular curriculum or pedagogical commitments. Nonetheless, it is not enough for the Ministry simply to quietly forget its experiment with ILEs. For one thing, many schools – and the Ministry does not know how many – are left with classrooms that may not be fit for the purpose of teaching and learning. For another, if the Ministry does not publicly acknowledge its mistake, it is all too likely to repeat it. Indeed, the shift in the emphasis of classroom design policy, from enacting constructivist pedagogy to the physical properties of classrooms, does not mean that the construction of open-plan classrooms has ceased.

The Ministry must therefore do all it can to correct the record on the lack of evidence for the curriculum and pedagogy it sought to implement through the establishment of ILEs. It must help schools who are left with these environments to use them as well as possible and must assist schools to mitigate the problems that ILEs cause for children with learning disabilities such as APD and ADHD. Most importantly, the Ministry must ensure that all future initiatives are backed by a *prima facie* case, based on reliable and valid research evidence. It must further ensure that initiatives are supported by robust monitoring and evaluation processes. Specific recommendations follow.

Recommendations

1. **The Ministry of Education should make schools and teachers aware of the lack of research evidence for self-directed learning as a pedagogical strategy, especially for primary-aged children. In the absence of such evidence, it should cease promulgating this approach.**

Despite the shortcomings of the Ministry of Education's 2011 property strategy and irrespective of the paucity of evidence for the assumptions on which it was predicated, the classroom spaces that have been established over the last decade will be in use for a long time to come. While some physical modifications could be made, it is not economically realistic to contemplate fundamentally redesigning them. Nonetheless, the pedagogical approach of self-directed learning, which ILEs were designed to enact, should be repudiated. It has no substantive evidence in its favour. Indeed, the precipitous fall in the attainment of New Zealand's young people in literacy and numeracy suggests that its failure has been especially pronounced in primary schools.

2. **The Ministry of Education should fund a systematic programme to understand pedagogical approaches supported by scientific research in both ILEs and traditional classrooms.**

Pedagogies of direct instruction, and those based on the science of learning, should be adopted as preferred methods by the Ministry of Education in all New Zealand schools. Unlike self-directed learning, these methods have substantial bases of research evidence in their favour. Given that ILEs were designed to enact a very different pedagogical approach, the Ministry should undertake research into ways in which a more structured approach to learning can be implemented in these classrooms. As this report has shown, there is nothing about direct instruction and the science of learning that requires students to spend most of their time seated in straight rows listening silently to a teacher, although a certain amount of teacher-to-student transmission of information is certainly important. However, collaboration between students; plenty of active practice in core skills; and timely, interactive feedback from teachers are all important parts of these methods. While in-depth consideration of these pedagogies is beyond the scope of this report, the Ministry should fund a substantial research programme to investigate effective pedagogy and ways in which it can be best implemented in both ILEs and traditional classrooms.

3. **The Ministry of Education should fund a systematic programme of professional development for teachers, whether they are operating in ILEs or traditional classrooms, to ensure that evidence-based pedagogy is employed, and that integrated classroom technology is used in a way that enhances teaching and learning.**

The ILE initiative was not accompanied by any systematic programme of professional development to prepare teachers to use them well. When recommendation (2) has been implemented, the Ministry should follow up with a comprehensive programme of professional development for teachers to ensure that evidence-based pedagogy is in place in all New Zealand classrooms, taking into account their differing characteristics – that is, whether they are ILEs or traditional in configuration. The Ministry should also explore ways to ensure that these understandings can be embedded in Initial Teacher Education programmes.

4. **The Ministry of Education should provide resources and professional development for teachers in ILEs to support the learning of students with learning disabilities such as Auditory Processing Disorder and Attention-Deficit Hyperactivity Disorder. They should fund classroom enhancements, such as sound field systems, without financial imposts on schools.**

As noted in the report, children with Auditory Processing Disorder (APD) are likely to suffer particular educational disadvantages from being placed in ILEs. This is a problem of the Ministry's making. It should therefore provide both professional development and technological solutions, without impost on school budgets to mitigate these problems. The Ministry has a responsibility to ensure that children with APD and other disorders with educational effects that are exacerbated by ILEs do not suffer educational disadvantages as a result of being placed in these environments.

5. **The Ministry of Education should undertake a comprehensive retrospective evaluation of teaching and learning in ILEs, supported by the integrated database infrastructure, using data from the National Monitoring Study of Student Achievement at Years 4 and 8, and from NCEA at Years 11–13.**

The integrated database infrastructure (IDI), maintained by Statistics New Zealand, is a powerful tool that could be used to evaluate teaching and learning in ILEs. Statistical modelling similar to that reported by Joel Hernandez[127] could be undertaken to compare educational progress in ILEs with progress in traditional classrooms. Hernandez used a range of individual-level socio-economic variables stored in the IDI as covariates in a model to remove variance from educational achievement data (NCEA) results and compare school performance across the decile range. He found that once these variables were accounted for, little additional variance was associated with school decile.

An evaluation of ILEs could be undertaken, using the same socio-economic covariates, but comparing ILEs with traditional classrooms rather than schools across deciles. Of course, this analysis would require the Ministry to determine which schools have established ILEs and which students are being educated in them, which according to their response to the OIA request supporting this report, they do not. An initial survey of schools to determine these details may therefore be required.

There is little in the way of consistent assessment in New Zealand schools. At primary level, the National Monitoring Study of Student Achievement at Years 4 and 8 would give the best curriculum coverage. These assessments are high in quality and are calibrated to measurement scales, making them suitable to measure progress. At secondary level, NCEA results would have to be used, although these are not calibrated. Even so, Expected Percentile or WRPI scores could be used to adjust scores according to the varying difficulties of standards.[128]

6. **No teaching and learning initiatives should be undertaken by the Ministry of Education without a prima facie case made on the basis of generalisable research evidence and a monitoring and evaluation framework in place.**

Perhaps the most striking finding of this report is that the Ministry embarked on such an expensive and transformative initiative as that of establishing ILEs without an evidence base. In so doing, it risked deleterious effects on children's education and the wastage of taxpayers' money on an unproven project.

Any new initiative should be supported by evidence. It should also have in place a monitoring and evaluation framework before it is commenced. A degree of independence from the Ministry is desirable in both these regards. The New Zealand Council for Education Research should be resourced to carry out quantitative work of this kind and tasked with doing so under its funding agreement with the Ministry.

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In 2011 the Ministry of Education embarked on a ten-year strategy to rejuvenate New Zealand's aging classroom estate. Part of this strategy involved establishing large, open plan classrooms, populated by many more children than are found in cellular classrooms.

The Ministry conducted no research on the effects of these 'Modern learning Environments' on students' learning prior to compelling schools to adopt them. Neither did they conduct any evaluation of their effects after they were established.

The rationale for Modern Learning Environments was that they promote team teaching and self-directed, student-centred learning. Again, there is no evidence that either of these teaching approaches is effective. On the contrary, a preponderance of research suggests that direct teaching approaches are more effective for literacy, numeracy at primary level and the disciplinary subjects at secondary level.

The strategy under which Modern learning Environments were promulgated has now expired. However, open plan classrooms are still being built, and many of the country's classrooms have already been converted. Schools are therefore left with a permanent legacy of a policy based on ideology rather than evidence.

Future education policy must avoid the mistakes of the Modern Learning Environment experiment. In the future, educational initiatives should not be implemented without evidence that they will be effective and plans to evaluate their implementation and effects.

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