



Future of Schools

ARUP

This report is a product of collaboration between Arup Foresight, Research and Innovation, and education experts from Arup and external collaborators. We would like to thank all authors and experts for their contributions and dedication.

Foresight, Research and Innovation is Arup's internal think-tank and consultancy which focuses on the future of the built environment and society at large. We help organisations understand trends, explore new ideas, and radically rethink the future of their businesses. We developed the concept of 'foresight by design', which uses innovative design tools and techniques in order to bring new ideas to life, and to engage all stakeholders in meaningful conversations about change.

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Executive summary



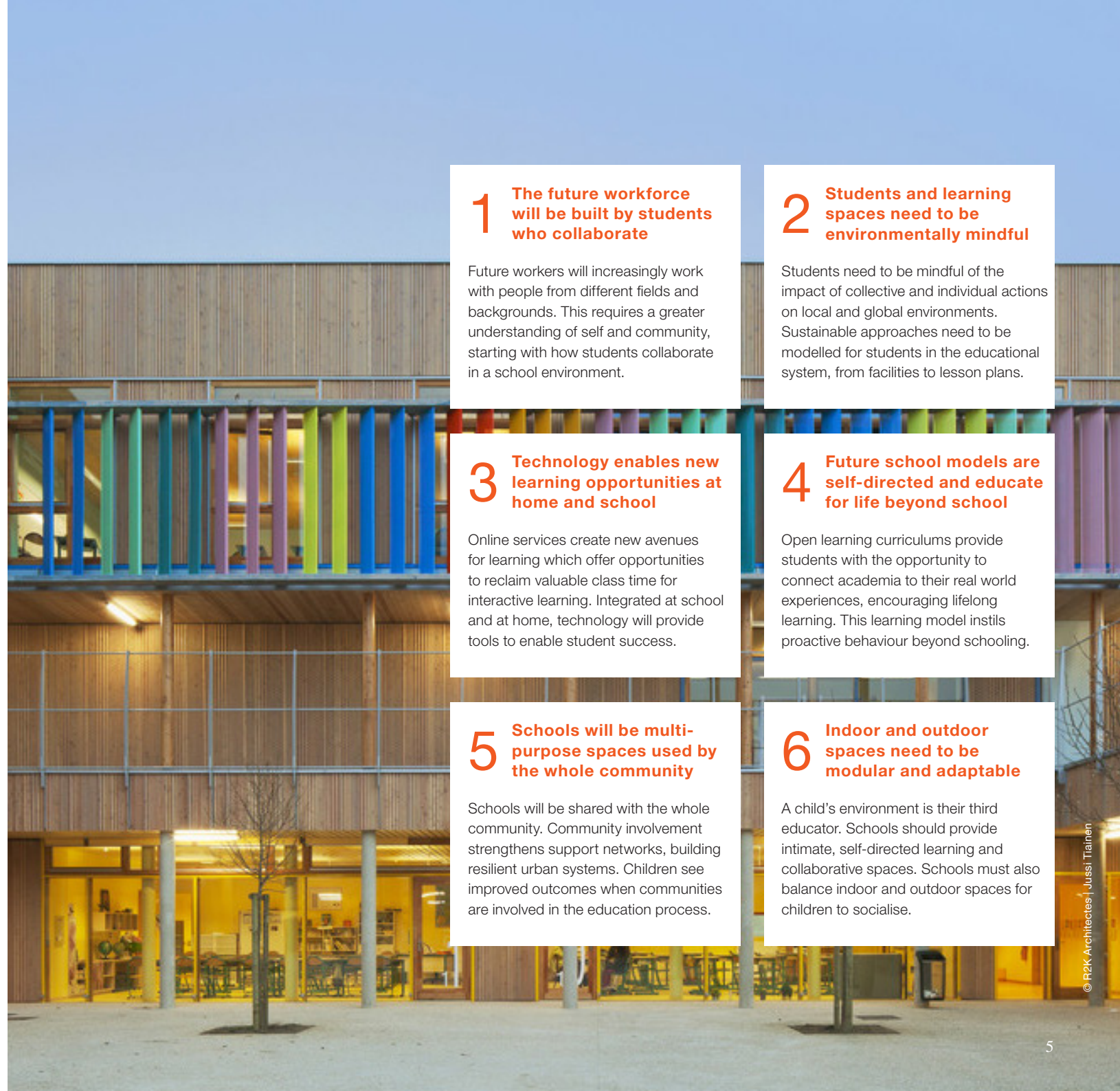
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Equipping students with the skills needed to thrive in a rapidly changing and unpredictable work landscape is an ongoing challenge for schools. We have a duty to not simply teach students what to think, but how to think, in order for them to deal with growing complexity. This report identifies the key drivers shaping the future of schools, focusing on pre-tertiary education, and how our understanding of education is evolving.

To foster self-directed learning, we can look at how school environments are becoming increasingly adaptive and modular and are adopting new technologies and sustainability practices. Open learning — a shift away from exam-centric objectives — will enable more diverse curriculums that focus on the development of real-world skills and involve whole community participation. Further, as access to online learning platforms continues to grow, we can reconsider how class time is most effectively spent and the environments where learning is best undertaken.

Insights into the challenges faced by students and educators alike demonstrate the need to proactively shape school environments to offer opportunities that develop future skills and nurture self-reliance.

The six key findings of this research are summarised as follows.



1 The future workforce will be built by students who collaborate

Future workers will increasingly work with people from different fields and backgrounds. This requires a greater understanding of self and community, starting with how students collaborate in a school environment.

2 Students and learning spaces need to be environmentally mindful

Students need to be mindful of the impact of collective and individual actions on local and global environments. Sustainable approaches need to be modelled for students in the educational system, from facilities to lesson plans.

3 Technology enables new learning opportunities at home and school

Online services create new avenues for learning which offer opportunities to reclaim valuable class time for interactive learning. Integrated at school and at home, technology will provide tools to enable student success.

4 Future school models are self-directed and educate for life beyond school

Open learning curriculums provide students with the opportunity to connect academia to their real world experiences, encouraging lifelong learning. This learning model instills proactive behaviour beyond schooling.

5 Schools will be multi-purpose spaces used by the whole community

Schools will be shared with the whole community. Community involvement strengthens support networks, building resilient urban systems. Children see improved outcomes when communities are involved in the education process.

6 Indoor and outdoor spaces need to be modular and adaptable

A child's environment is their third educator. Schools should provide intimate, self-directed learning and collaborative spaces. Schools must also balance indoor and outdoor spaces for children to socialise.

A different world

“School will be a different world within 10 years... If it still exists.”

—Professor Neil Selwyn,
Monash University

The world is in a constant state of flux. Automation is changing the jobs market. It is predicted that 375 million workers will need to change their occupation by 2030.¹ Students need to learn to be ready for new jobs but also to be flexible as the employment landscape continues to change. There are many examples of jobs that didn't even exist 10–12 years ago: app developers, drone pilots, social media managers.² This evolution of jobs is only going to increase as technology advances. Schools need to

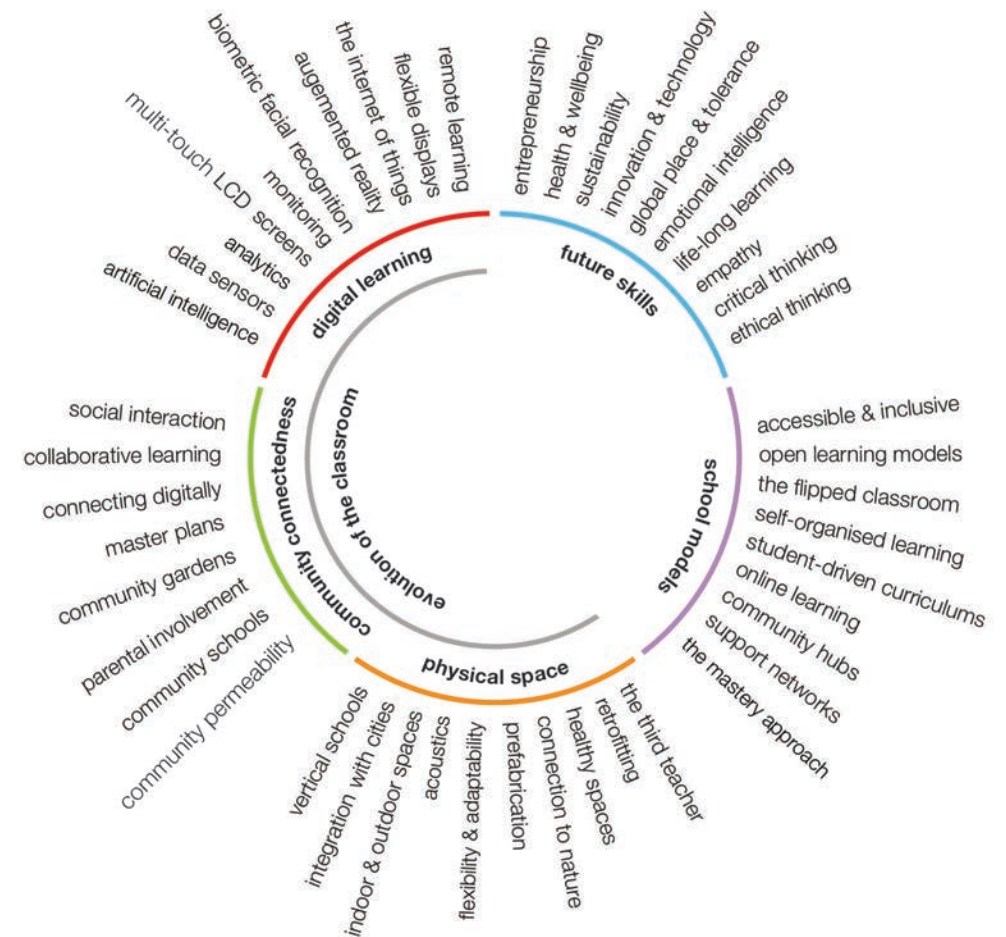
prepare students with the skills to succeed in a rapidly changing world.

Just as the way we live and work have become more flexible and adaptable, school models and space must evolve to reflect these characteristics. School models should allow for education to be accessible and inclusive to all while taking advantage of technology to create new opportunities for inclusive and mobile education. School models that drive more independent thinking often move away from the teacher-led model and allow the student to take a larger role in guiding their learning.

To support the changing curriculum and teaching styles the classroom and built environment must evolve. This adaptation is a complex mix of changes in the physical space, connection to the wider urban realm and community and an understanding of the digital technologies that play an integral part in the schools of the future.

The themes and topics explored in this publication are complex and many overlap, however for the purpose of this study they have been identified and classified as shown in the following diagram.

Future of schools: themes and topics explored





Future skills

An inquisitive mind

It is essential that students are exposed to an environment that promotes and inspires the development of skills for the future.

The education system must equip students with the skills necessary to address the shifting needs of society. To attain these skills, the teaching of content must reflect the diverse learning styles of the students.

The most significant hurdle to providing students with a competitive edge to succeed in the global marketplace is the uncertainty of what the future will hold. A future-proof curriculum can only be based on speculation. Thus the creation of a rigid curriculum that only prepares students for the present and predictable future is not the answer. Instead, educators must work to facilitate students' ability to be adaptable and prepared for the unknown. Equipping students with an initial skillset will provide them with the tools necessary to thrive in a rapidly changing global landscape. Instilling a desire for life-long learning should be a primary concern

for schools. Children must be encouraged to take control of their own learning and be pushed to source their own knowledge. They must be taught to teach themselves.³

“We can't give our children a career to prepare for, when we don't know what the future will bring. But we can prepare them to adapt to anything, to learn anything, to solve anything, and in about 20 years, to thank us for it.”

—Leo Babauta, Zen Habits

With this in mind, the role of the teacher in the educational establishment must also evolve. A move towards teachers as educational facilitators, rather than providers of knowledge, will encourage students to become self-aware. In doing so, students will learn to develop appropriate study skills suited to their individual learning styles, equipping them for continual learning into the future.⁴

Traditional standardised testing generally focuses on testing memorised information. Governing bodies use these test results to evaluate the performance of teaching and learning. These comparisons do not promote or assess abilities such as creativity, innovation and problem-solving.⁵ Curriculums and assessment methods must evolve to promote these new skills.

Traditionally school curriculums are designed for the average student, but Harvard Professor Todd Rose describes this as the “flaw of averages”. Very few students are in fact average.⁶ Students learn at different speeds, through different teaching methods, and have different interests. Therefore, significant benefits can be achieved through modern methods that allow for individualised learning. This teaching method is supported by a number of high profile organisations including the Chan Zuckerberg Initiative and the Gates Foundation as well as over 23% of school district leaders committing to this method of “personalised, digital learning”.⁷

Innovation, technologies and education are fundamental to creating sustainable economies.⁸ Therefore it is desirable for innovation capabilities, including creativity

“With a shifting work landscape... organisations need to tap into much more human skills of intuition, empathy, innovation and creativity to provide better products and services.”

—Jon Williams, Financial Review

and imagination, to be stimulated in an educational setting. In order to achieve this, value must be attributed to the process of learning, rewarding students for their ideas and effort, not only for reaching the correct answer. Technology, when used effectively, can promote innovative tendencies and equip students with attributes that are needed for future success.

One example is the rise of the ‘Maker Movement’, where students are steered towards an enhanced understanding of the technology they use. The premise of the movement sees the adoption of critical thinking skills and traditional DIY principles,

The Fab Lab, New York

Marymount School in Manhattan dedicates an entire floor to Maker space for students to tackle real-world projects. Each year, the school sets a service project for their seventh-graders. In 2013, they built a light kit for a community centre in Zimbabwe.

The students researched innovative solutions in third world countries and chose to make a solar-powered 'sun jar.' The circuit boards were manufactured externally, and completed kits came with instructions to teach the end user how to assemble a 'sun jar', offering a long-term solution rather than the end product. The Maker movement blurs the traditional separation of subjects, combining maths, engineering, design, fabrication, aesthetics and documentation. This gives students the ability to complete tasks that solve real problems and to have a positive social impact.⁹



enabling students to use their curiosity to explore, learn and invent.¹⁰ This can take place in the home, a shared working space or fabrication lab in the school setting. Makers seek to reject generic, mass-produced merchandise, instead utilising open-source learning and readily-available personal technology such as 3D printers to enhance existing creations or develop and disseminate their own designs.¹¹

Children are naturally inquisitive.¹² Schools need to feed this enthusiasm to challenge existing norms, however instead

they can instil a fear of failure by teaching that there is a right and wrong answer. This can lead to anxiety and stress, particularly in high achieving students.¹³ A preferred approach would be to encourage students to share what they have learnt by taking risks in "failure clubs" such as in the Stanford University Resilience Project.¹⁴

To foster entrepreneurial skills, students must be provided with an appropriate physical environment that permits such actions to take place. The continued creation of adaptable working spaces can allow an array of group-work related tasks to emerge. By creating room for social interactions, these adaptable spaces can stimulate student networking ability and relationship skills by providing appropriate places for social interaction during breaks. The resulting networking and relationship skills are both considered to be attributes conducive to entrepreneurial success.¹⁵

The implementation of entrepreneurial tasks as a key component of the school curriculum will ready students for the encounters that may take place should they pursue an entrepreneurial venture. This also opens new opportunities for job creation in a market where the future disruption to current occupations by automation is inevitable.¹⁶ Ultimately, encouraging the development of human capital that promotes entrepreneurship will empower youth to think creatively and ambitiously about the future they can help to shape.

“To succeed, we must make friends with failure. Failure makes you a better, kinder, stronger and wiser human being. Now, get out there and fail!”

—Ainissa Ramirez, Edutopia

Case study

Green School, Bali

Founded in 2008, this 400-student school both practices and teaches sustainability principles, including food cultivation, waste and water usage, animal husbandry, and design with renewable resources.

Alongside existing solar panels, the school is developing sustainable hydropower.

The primary structural material is bamboo sourced from the local environment along with rammed earth, mud walls and volcanic stone. Reflecting traditional Balinese architecture, very few buildings have external walls allowing the rest to enjoy natural light and ventilation and to forge a closer connection between students and the outside world.¹⁷



Problem solving, self-evaluation and important life decisions are facilitated by critical thinking. Without critical thinking, students may passively accept information without questioning it. In the information age where so much data exists it is important that students learn to evaluate information and think critically about its authenticity.

Global citizens

In an increasingly global world, it is important for students to learn both their position in the world and how to relate with other cultures. To do this, they need to develop emotional intelligence, which includes self-awareness, self-management, social awareness and relationship management.¹⁸

By becoming self-aware, students can connect with their emotions and express themselves appropriately when faced with new circumstances that might see them collaborating with students from a diverse range of backgrounds or interacting via technology. The development of such a trait is incredibly valuable in an increasingly automated environment, equipping students with the ability to handle interpersonal relationships empathetically and offer sincere feedback. This is only one example of an attribute that humans can offer over artificial intelligence and robotics.

In addition, it is vital that students learn tolerance for one another and to appreciate each other's unique experiences, so as to create respect in an expanding multicultural

society. Students who are socially aware, have a willingness to learn new things, and be accepting of unknown cultures and ideas will be capable of becoming world citizens, who are prepared to tackle the unknowns of the future.¹⁹

The health and wellbeing of students should be of paramount importance to schools of today and the future. Individuals who value their bodies and strive to care for themselves physically and mentally will have more ability to adapt and thrive.²⁰

With the increased prevalence of obesity and diabetes worldwide²¹, it is crucial that physical activity continue to be included in schools of the future. In doing so, schools solidify their role in counteracting the vulnerabilities caused by insufficient physical activity.²²

Future schools must also consider the connection between classrooms and the outdoors with the potential to integrate outdoor learning spaces into daily teaching practices. This has been shown to have a positive impact on mental wellbeing.²³

Unwell workers reduce the economic output by as much as 15%, and therefore wellness has grown to be a US\$43.3 billion market globally.²⁴ It is crucial that schools follow in the footsteps of the corporate marketplace by integrating wellness initiatives to ensure that students have the ability to maximise their productivity and learning opportunities whilst at school.

The integration of vertical farming and

rooftop greenspaces will deliver vital access to the outdoors and will cultivate the feeling of connection between students and nature, whilst promoting a healthier lifestyle.

Schools also hold responsibility for assisting in the shaping of students' attitudes towards the consumption of food and their daily eating habits. To help with the adoption of a healthier lifestyle, school canteens should offer a variety of nutritious options. Initiatives such as integrating food products sourced by school vegetable gardens that are grown and cared for by the students would grant them responsibility and the opportunity to work as part of a team. Alongside a continual learning of health and wellbeing in the classroom, individuals can become aware of their own needs and how to effectively care for themselves.

Today's children are our future leaders. As such, there is a vital need to learn sustainable living practices and responsible consumer habits among students to curb the harmful anthropogenic impact on the natural world. Non-renewable resources will become increasingly scarce in the future should our current dependency continue. It is necessary for future generations to learn to do more with less. This can be achieved through teaching sustainable practices centred on the conservation, protection and regeneration of resources with the educational system leading by example.

The design of future schools with sustainable building practices in mind will expose students to approaches that reduce dependency on non-renewable energy

Case study

Australian eChallenge



The Australian eChallenge, established by the Entrepreneurship, Commercialisation and Innovation Centre (ECIC) at the University of Adelaide, has introduced young students to entrepreneurship since 2001. The Australian eChallenge is a step in the right direction for future skill development, allowing participants to probe early-stage ventures through collaborative interaction with team members, networking opportunities and mentorship. South Australian schools can enter teams of 2-6 students who submit a business plan with the support of local experts. Teams pitch their proposals to judges who are business professionals within the community. Such an initiative responds to the need for a skills-oriented programme that promotes the development of ideas that seek to solve issues that deeply concern students.²⁵

Case study

Churchie, Brisbane



Brisbane's Anglican Church Grammar School, nicknamed 'Churchie,' is seen as a prestigious school and consistently achieves outstanding academic results, adopting a problem solving and project-based nature. The school sees the importance of not only focussing on academic achievement but also in building character and resilience. Churchie has partnered with Swinburne University to research the importance of emotional intelligence further and have identified that adolescence is the most critical time in a boy's emotional intelligence development. Comprehensive emotional intelligence programmes are provided throughout the curriculum, to prepare students for any future struggles.²⁶

sources. The integration of passive heating and cooling systems alongside renewable energy sources in the school context can normalise sustainable practice and create more environmentally conscious students.

The whole student

Data is known as the “new oil” with a quadrillion bytes being produced every day. Up until recently technology companies had rarely been held accountable for poor data handling however, the Facebook Cambridge Analytic scandal is thought to be a turning point.²⁷ From now on it is likely that technology companies will be expected to be responsible with data management and to do this correctly will require a deep understanding of ethics.

Ethics are the moral principles that guide our actions. AI’s will be programmed to analyse the abundance of data that exists in order to be able to understand it and use it to improve our designs. Programmers will be required to write code that is unbiased and fair, and they will be required to treat the data that they have available to them with great care.²⁸

Empathy is now recognised as an important skill to learn at school. According to a leading researcher in the field, Dr Karen Gordan, empathy can be considered in three components: the head, the heart and the hand. This means that students must first understand what it means to share another’s feelings but also to feel those feelings and take action as a response.²⁹ Although with

AI, robots are now able to recognise human emotions, their complex nature means that the ability for a robot to empathise is a long time away if not impossible to achieve.

Key takeaways

1 Technically skilled

Students understand how the systems behind the technology they use operate, tailoring their experience through coding.

2 Environmentally mindful

Aware of the impact their actions have on their surroundings, students are more likely to adopt life-long sustainable practices.

3 Collaborative learners

Working with others from different backgrounds and experiences fosters a greater understanding of self and community, on emotional and intellectual levels.

Case study

KANO, Montenegro



KANO is a learning kit used in a similar way to Lego, where children teach themselves through practical building. It is a computer designed for ease of construction, building apps and learning how to code. KANO is run on the Raspberry Pi platform, a customisable single-board computer that allows the user to add components. In adopting such practices, a number of future skills can be encouraged whilst capitalising on young people’s imagination and curiosity.³⁰

Case study

Wootube, Sydney



Eddie Woo is the head teacher of mathematics at Cherrybrook Technology High School in Sydney, Australia. He films his classes and uploads them to his YouTube channel which is available for students and teachers to access around the world. His website acts as a database for teachers and students to access his videos as well as a platform for hosting forums where teachers can ask questions about running classes and using his materials in their own lessons.³¹



School models

Power to the student

It is imperative that our schools create graduates who hold the essential skills and knowledge necessary for future success. To achieve this, school models of the past are evolving and new models are emerging.

“Every learning experience is about getting the pupils to have an emotional connection to it because if the heart is excited then the mind always remembers.”

—Ivanka Rancic, Delany College

New school models change the emphasis from exam results to self-directed learning and foster the idea that education is a lifelong pursuit. There is a rise in models that accommodate a student’s personal interests, aspirations and family environment. In these models, personalised learning objectives take precedence over adhering to a rigid curriculum. Blended models that find the optimal balance between learning approaches will most likely see great success in future schools.

Open learning models allow students to determine the path of their own education and address their needs as they perceive them. An educational system that is generically streamlined does not allow for this level of personal exploration, resulting in graduates that lack clear goals and career direction post-school.³² The effect of this extends to the workforce. Only 30% of Americans are ‘engaged’ in their work which is defined as “emotionally invested in their work and focused on helping their organisations improve”. The rest are unmotivated or unhappy and, in-turn, not productive.³³

Open learning allows children to flourish in chosen areas where they feel emotively connected and enthusiastic about their

studies. To develop this, schools are giving students increased control over how and what they learn. Many alternative school models believe that a student-directed model can overcome the challenge of predicting future skills by giving students more say in their educational journeys. The Sudbury model, for example, treats students as adults, letting them be involved with all decisions including budgeting, administration and disciplining.³⁴

Many education models revolve around cradling children's innate passion for learning by providing children with the resources and environment for learning without putting a traditional teacher in place. The role of a teacher is shifting; they should demonstrate how to learn as opposed to dictating what to learn.³⁵ By giving students increased independence, we can ideally nurture young children's curiosity into lifelong learning habits and self-reliance.

The school environment should facilitate self-driven learning and inspire children to explore their interests in spaces filled with natural light, order and beauty. School environments should also house authentic tools and materials that signify to children that they are considered capable.³⁶ Alternative school models such as Montessori, Reggio Emilia, Sudbury, Harkness, and Steiner, all challenge traditional school models by championing adaptive environments and working collaboratively with students to develop personalised curriculums.



Case study

SOLE, New Delhi to New York

Dr Sugata Mitra conducted an experiment in Kalkaji by placing a computer in a 'hole-in-the-wall' and observing how children, armed with curiosity, were seen to teach themselves. The participating children learned the basics of computing by becoming their own teachers to the point that they developed their own terminology for things like a "cursor". The term SOLE (Self-Organised Learning Environment) was coined to describe environments where students taught themselves, independently or in groups, through online technology.³⁷ Following repeat experiments, The School in the Cloud was established as a platform to share experiences from SOLE sessions around the world. Here, we see the children of PS 197 in Harlem, New York, posing their own questions to research and presenting their findings to each other.³⁸

Case study

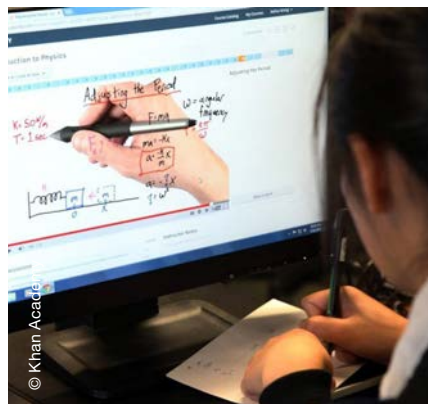
Oak Hill School, California



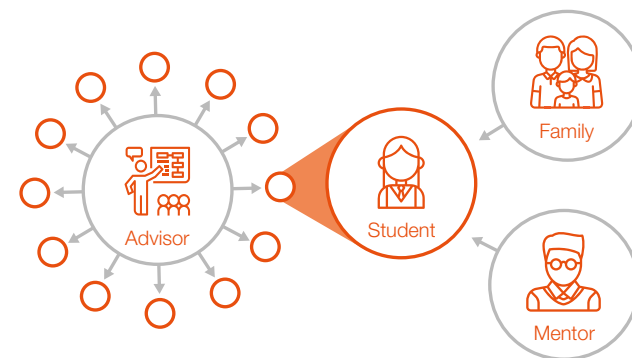
Oak Hill School for children with special needs, in San Anselmo, California, provides a unified educational environment, where all needs are catered for within one place. Autistic children can find mainstream school difficult and often their needs are not catered for. While carers have to taxi children to and from necessary appointments, their time in education is lost. Schools such as Oak Hill School provide a more manageable environment where all attendees feel included, however, it is expensive and, because of this, not accessible to all.³⁹

Case study

Khan Academy, California



The Khan Academy is a free, online education service. Flexible, mobile learning empowers students around the world and benefits disadvantaged communities in particular. The system can be personalised to allow each student to learn at their own pace by tracking results and highlighting strengths and weaknesses. As has been demonstrated in a programme called AltSchools, this tracking is also valuable to parents and supports parental involvement, which has been proven to increase performance and school attendance independently of income or background.⁴⁰



Strong school support networks for students. Schools need to develop strong support networks to facilitate self-directed learning with teachers advising students' personal pursuits and mentors providing expert knowledge⁴¹

Supported learning

“Students in schools with a strong sense of community are more likely to be academically motivated; to act ethically; to develop social and emotional competencies; and to avoid a number of problem behaviors”

—Eric Schaps,
Creating a School Community

Methods of educating in Asia tend to be more strict than westernised approaches. The Maths Mastery approach is a method of education that uses physical props to encourage problem solving when teaching mathematics. The method requires students to meet a 90% mastery threshold before progressing to new skills. It has been used since 1968 in Singapore and China, and has seen more limited application in the UK.⁴³ A recent study by University Collage London and University of Cambridge, found that children using this method increased their speed of learning by around 10%.⁴⁴

The flipped classroom model involves consuming educational material outside of the classroom through technology and providing opportunities during class time to gain a deeper understanding through discussion and collaborative problem-solving. This flexible model rethinks how to most effectively use the precious contact time between teachers and students.⁴⁵ Clintondale High School in Detroit implemented the flipped classroom school-wide in 2011. Following the flip in 2011, Principal Greg

Green stated “On average we approximated a 30% failure rate...with flipping, it dropped to under 10%.” One advantage reported by students is that they often feel shy to ask questions in class; but with a flipped classroom, they can watch videos numerous times until they gain a sound understanding.⁴⁶

Student’s comfort with technology is a significant reason to employ the flipped model. Students practice self-directed learning by engaging with reading, audio and video material at their own convenience in a comfortable format. With an incredible quantity of information available online, a new kind of learning is available.

Future schools have a responsibility beyond education. They must prepare students for living as socially responsible citizens and respond to the needs of the ‘whole child’.⁴⁷

Schools often act as a community’s central hub, where people of all generations can congregate for educational and community events. The community school model was developed by The Christian Aid Society to denote schools where physical assets and human resources are shared.⁴⁸

Increased community involvement provides opportunities for students to access new technologies and share facilities in new ways.⁴⁹ Providence Mount St. Vincent, in Seattle, offers a pre-school inside a nursing home with residents taking on the role of teachers.⁵⁰ Collaborative spaces that build relationships between schools, families and

communities have positive academic and social outcomes for all parties.

Primarily, schools should address the community which feeds them, to which they form a vital service. Secondly, schools across the globe need to respond to their immediate environment. Schools that are integrated into the community and take advantage of the facilities and environment surrounding them, for social and educational purposes, will form a greater connection with their community.

Knowledge of and respect for different cultures and disabilities should be instilled in staff and students and anti-social behaviours must not be tolerated, in order to create a harmonious learning environment. In addition, facilities must be accessible to all and not put any student at a disadvantage. Additional facilities, to cater for religious acts and individual needs, such as a space for prayer or an accessible ramp, should be made available when required.

As student needs adapt and change, school buildings must form flexible and adaptable environments to cater for variance in specific student needs and an evolving education system. For example, they need to have the opportunity for expansion, should the population grow, to avoid exclusion of children for which there is no room.

As each and every student is different, education should be tailored and allow students to progress at their own pace. Providing generic lessons which are too

Case study

Forest school, UK

Deeper connections with nature are thought to have further benefits. Forest schools offer an innovative educational approach which is set in woodland environments. The approach follows the belief that being connected to nature is nurturing, therapeutic and educational, providing an ideal, healthy and natural base for a child’s education. They aim to inspire and encourage students through outdoor experiences, capitalising on the positive benefits of engaging with nature.⁵¹



Case study

Innova Schools, Peru

The global consulting firm IDEO have designed the Innova Schools system in Peru where standardised education was failing. The entire school system of classrooms, curriculum and teacher-training strategies were developed simultaneously resulting in a scalable school model. The tech-heavy school design is adaptable and modular; a champion for blended learning models. There are now twenty-nine Innova schools throughout Peru. In 2013, the national average of students that reached proficiency in federal maths exams was 17%. Second-grade students in Innova schools had a 61% proficiency rate which illustrated the direct effect of Innova schools on education.⁵²



easy for some could lead to boredom and disinterest, where work which is too difficult can cause frustration.

Schools must be accessible to all, cater for disabled students and have facilities for religious acts. In addition, school buildings must cater for a large variance of activity, which may be performed by the community.

Key takeaways

1 Shift to open learning

Future skills are attained through self-directed learning, providing students with flexible learning environments that are tailored to individual needs and interests.

2 Community spaces

Create opportunities for students to relate their skills to real world problems and careers, fostering engaged workers and communities.

3 Integrating new technology

Online services create a new form of school, forcing us to re-evaluate how we spend precious class time by flipping the traditional model.

Evolution of the classroom

“Successful educators need to rethink the entire model of education and redesign it so that it is more student-centered.”

—Ethan Dunwill, eLearning Industry

The physical space

The physical environment has such an impact on its occupants that it has been described as a ‘third teacher’. The quality and feel of the space can enhance learning. Good daylight, air quality and comfort have all been proven to improve learning and concentration by at least 16%.⁵³

In light of this, the school building must also operate as a teacher of sustainability and should be designed in a way that highlights sustainable practice. Too often, unnecessary energy and effort are being put into creating a consistent internal environment for schools; one that is unnatural, unsustainable and for which the necessity must be questioned.

A greater focus on involving students in controlling the internal environment can inform them about environmental factors and the built environment, and normalise sustainable practice.

The addition of interactive environments, where objects to see, hear and touch are integrated into learning spaces, should keep students alert but not overstimulated. By providing an environment where students can interact with their surroundings, it is possible for students to drive their own personalised education experience.

As students spend so much of their day at school it is very important that these places are healthy environments. A healthy space needs an optimal mix of climatic conditions. It should be thermally comfortable, have

Case study

Ørestad Gym, Copenhagen

More than 1,100 students at Ørestad Gymnasium spend half their time learning in an expansive glass cube. By encouraging students to collaborate in wide, open settings, the school hopes students will take on an active role in their own education and be equipped to think flexibly on diverse topics. Headmaster Allan Kjær Andersen states that “It’s not enough to give them knowledge, you also have to give them a way of transforming knowledge into action.” The open spaces which are adorned with ‘drums’ allow students to break off and form makeshift classrooms with movable walls and bookshelves; the space is at once collaborative and intimate.⁵⁴



Case study

St George's School, Perth

Arup was involved in the modification of a 1980s office building in the Perth CBD. Here the St George's Anglican Grammar School settled and created the first inner-city school in Perth in over 100 years. The school's location was chosen for its proximity to public transport for staff and students accessibility. The adaptive retrofit project resulted in a learning space that enabled student collaboration and physical activity. A 360sqm external deck with basketball hoops was created at roof level, covered by cable netting, to allow children to play and prevent balls from falling. Sun shading was provided and the lift extended up to the roof level. Students can take in panoramic views from the roof deck and undertake a range of outdoor activities. This shows a good example of how spaces can be utilised in a vertical school model.⁵⁵

This example of retrofitting was designed to accommodate future expansion of the school. Plans were put in place for the number of students at St George's to double between 2015 and 2017.



adequate light levels and good air quality. Related to the quality of air, there should be an adequate air change rate, to prevent the build-up of pollutants and reduce the spread of disease between occupants.

Beyond climatic conditions, the psychological effect of a space should be carefully considered. In the media today, it is not unfamiliar to learn of instances where school attendees have become victims of depression, for various reasons. Inclusive and empowering environments that promote collaboration can assist in improving student mental health.⁵⁶

Internationally, some schools are not even safe places due to poor construction methods and environmental risks. For example, in Ghana there is a moderate seismic risk and low-quality buildings. These schools should be a focus for good construction because in the event of a natural disaster they can not only provide a safe refuge for students but also become a safe place for the wider community to take refuge.⁵⁷

As we work to develop a more sustainable future, it is necessary that we examine the potential to retrofit existing building stock. Retrofitting ensures that a school's learning spaces can meet the functions and needs of its future users. This in turn establishes areas that evolve over time in line with the learning models that best meet student learning styles. Redeveloping a school entirely to adopt a new learning approach can prove risky if unsuccessful and financially draining.

A lack of available funds means that for many schools, retrofitting can be achieved through a phased approach. However, less costly initiatives can still create extensive change to the school environment. Technology-centred approaches such as enabling entire-school internet connectivity through Wi-Fi can facilitate new learning models. The Department of Education in Nepal has developed a comprehensive plan for retrofitting 900 school buildings in the Kathmandu Valley in five years and 60,000 buildings in the whole country in the next 15 years. They have adopted a phased approach to each retrofitting project beginning with the most critical requirements and later proceeding with additional developments.⁵⁸

Schools need to allow students to connect with nature in a range of ways. Even just being able to look out a window onto greenery has been shown to have positive effects on mental health and concentration levels.⁵⁹

Urban greening has advantages including reducing air pollution, alleviating urban heat island effect and mitigating acoustic effects.⁶⁰ All these aspects are important for schools as traditionally many schools have significant hard stand areas that make them less comfortable. With climate change impacts increasing, urban heat island effects will become more significant and will need to be addressed through urban greening solutions.

Portable, pre-fabricated buildings were traditionally used to cope with peaks and troughs in enrolment numbers. This means that they were commonly poorly connected with the remaining school and had poor environmental performance, acoustics, lighting and air quality, creating an undesirable internal environment. However, advances in modular design mean there is the opportunity to create well-designed modules which are purposeful, can be mass produced, easily transported and overcome the perceived environmental limitations. They can be built off-site for reduced disruption to an existing school, as well as being adaptable, allowing relocation or modification to meet changing requirements. Efficient production also means that construction waste can be reduced by up to 40% making this a more sustainable construction method.⁶¹

As the curriculum adapts and we step forward into the unknown future of education, it is vital that schools are flexible to cater for variance in teaching purpose, styles and trends and have the capacity to adapt for major changes in future needs. School buildings for the future have to cater for an unknown curriculum and activities; they should also be open to a complete change of use, should the school no longer be required. The key to creating schools that achieve this goal is to design buildings which can be easily transformed.

There are ways in which the flexibility and adaptability of a building can be improved. These include: structural design that allows for changes in loads, lightweight non-loadbearing partitions which can be easily

removed or relocated, ensuring building services and technology are capable of catering for a change in load; making provisions for upgrading technology as it advances; ensuring furniture and resources are lightweight, easily transported and functional, allow to control light levels, temperature and air quality to cater for different uses and environmental changes; and consider climatic conditions that may be affected by climate change in the design of school facilities.

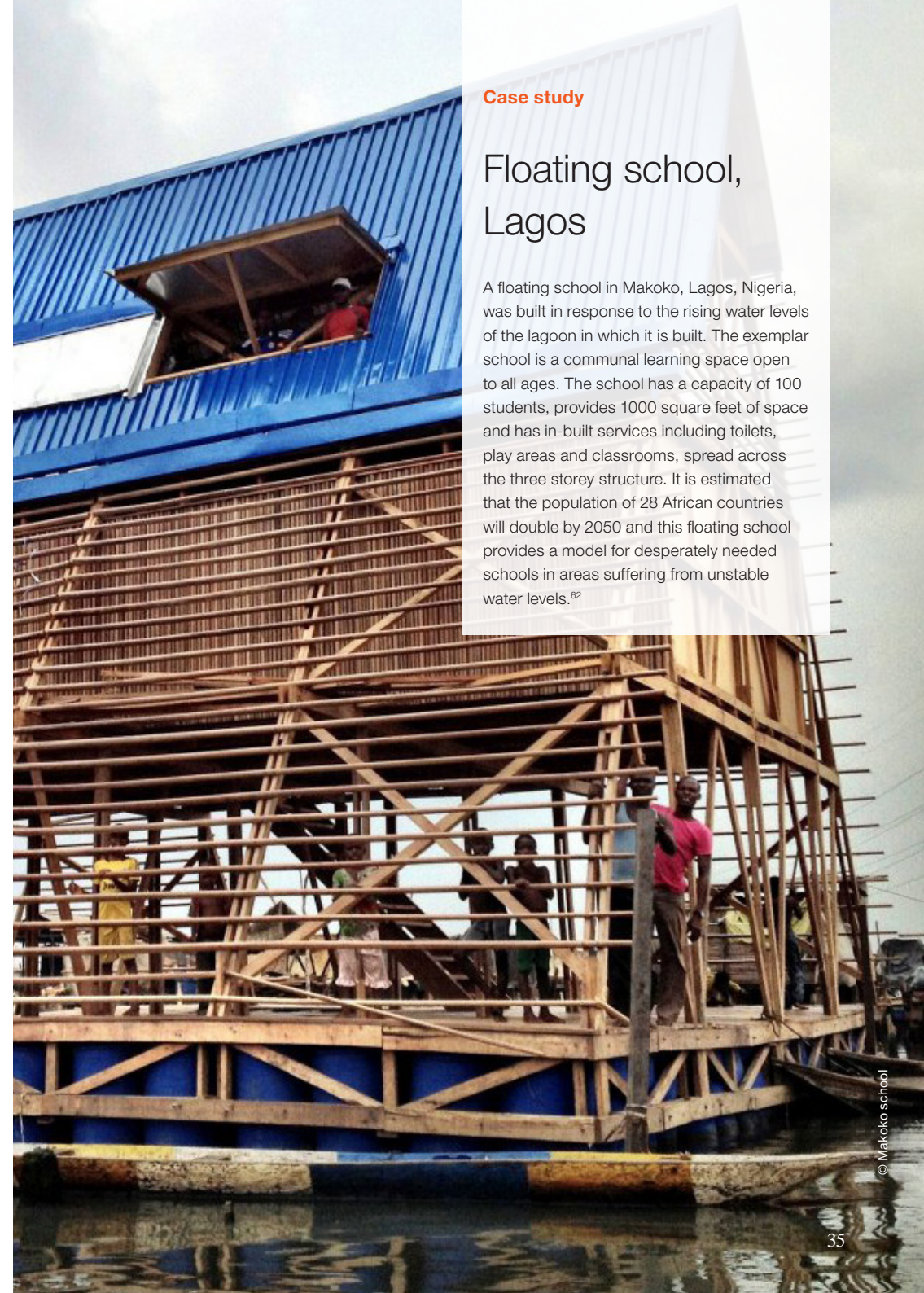
Good acoustics are vital for successful learning environments, both for ensuring the instructor's voice is not drowned, and unwanted noise is reduced. If it is difficult to hear, students will become tired of trying and lose concentration or interest. Attention span increases with age, so it is particularly important for young children to have limited distractions. For children with English as a second language or with hearing difficulties, this problem is amplified. It is currently popular to promote connectivity in buildings with open spaces or large atriums. For schools, extra care needs to be taken to design these spaces so that acoustic distractions are suitably managed. Individual spaces need to be acoustically designed for their intended purpose.

Design criteria for schools often look to create a constant environment maintaining tight thermal set points. This often restricts possibilities for natural ventilation. Although air conditioning may be desirable at times, effort should be made to have operable facades as a degree of environmental variation is pleasurable and natural, like a

Case study

Floating school, Lagos

A floating school in Makoko, Lagos, Nigeria, was built in response to the rising water levels of the lagoon in which it is built. The exemplar school is a communal learning space open to all ages. The school has a capacity of 100 students, provides 1000 square feet of space and has in-built services including toilets, play areas and classrooms, spread across the three storey structure. It is estimated that the population of 28 African countries will double by 2050 and this floating school provides a model for desperately needed schools in areas suffering from unstable water levels.⁶²



Case study

Flexible learning spaces, Bendigo

The advantages provided by the outdoor environment are working to achieve a greater connection is achieved. The Montagne Centre at the Marist College Bendigo, is an award winning project, created by Y2 Architecture. The main aim of the project was to bring down the learning boundaries created by the physical environment and allow learning to take place everywhere. In addition to promoting outdoor learning, the project is an exemplar in community integration and providing flexible spaces.⁶³



summer breeze. This is what Arup's Lisa Heschong, calls "thermal delight."⁶⁴

Some benefits of connecting the internal and external environments are obvious, for example, the availability of natural light and fresh air circulation through openings. Exterior views provide a connection with the external environment and allow people to sense the outdoor climate and time of day. These benefits come with challenges that need to be managed, such as unwanted glare and heat gain/loss. Good design and advances in technology, such as glass performance, has overcome many issues, so these benefits can be enjoyed.

With increased urbanisation schools are more commonly located closer to or within business areas. This provides the opportunity for the schools to integrate within the city including getting students to do work experience at local businesses or alternatively for industry professionals to teach some classes. Further opportunities for integrating within a city include shared facilities such as swimming pools and gyms or school classrooms being used for community meetings, training or flexible workspaces when not being utilised by the school.

Vertical schools are high-rise schools, often located in inner-city blocks. They extend upwards, as opposed to outwards, in response to the lack of available greenfield space in dense urban areas. We have seen the high rise residential tower and the high rise commercial or office tower, now high rise schools are emerging. There is a strong benefit from a city planning viewpoint that vertical schools

should be the future, however, there are concerns over the impact on student health.

Two of the major concerns in the design of vertical schools are student movement and acoustics. Vertical schools have considerably more students and therefore young or shy students may find navigating the space intimidating. They may easily lose their way resulting in them being late for class. Therefore, wayfinding is important as well as detailed planning around timetables. Good acoustic design is required in order to ensure the sound levels are suitable for learning in certain places.

Digital learning

Many students are equipped with their own digital devices which means that they can connect and learn anywhere and at any time. When remote learning is used appropriately, it can have great benefits including flexibility of location or allowing students to learn content from home. This frees up school time for more collaborative work with their peers or focusing on specific areas with their teachers.

Gartner is predicting that by 2020, 21 billion devices will be connected to the internet of things.⁶⁵ Schools will be part of this revolution. Connected devices already include whiteboards, lighting, air conditioning, temperature sensors, printers and personal devices. In the future, this will grow to include wellbeing sensors, attendance tracking and digital fabrication equipment.⁶⁶

There are potential risks with this level of connectivity including security, cost and privacy. Also bullying is a key concern in schools. The Alannah and Madeline Foundation in Australia has reported that one in four students is bullied and one in five are victims of cyberbullying.⁶⁷ Therefore, all online activity, including digital learning, must be closely supervised.

Flexible displays have the potential to reshape how classrooms look with screens as thin as a sheet of paper.⁶⁸ Also, multi-touch LCD screens continue to increase in size and reduce in cost making them available for many uses including throughout classrooms. These can be used to make classes more interactive and entertaining. Utilising screens instead of printed material also means that the content can be easily updated, and tailored to the specific needs of each audience.

Augmented reality (AR) has the ability to transform education by overlaying digital information onto a user's environment. AR has the potential to improve student learning by making education more fun and allowing for more detailed information to be experienced. Pokemon Go highlighted the appetite for this type of technology with 15 million downloads in its first week setting a new record for the app store.⁶⁹ One area where this technology is particularly useful is in schools for deaf and hard-of-hearing students where AR can be used to create flashcards that use sign language.

Case study

Chromville, Spain



Chromville is an education tool that combines physical creative practices and digital augmented reality experiences. The Chromville package offers teachers a set of printable colouring sheets as well as a class application that enables students to view and engage with their coloured creations in a whole new way. Students colour in the sheets and then view them through a smart device to play a game or complete an activity. The augmented reality models are customised based on how the students coloured their drawings on the colouring sheet. This education tool aims to improve children's creativity, increase motivation when engaging with education, accelerate early learning processes and encourage social interaction with the use of digital technology.⁷⁰

Case study

Popar, USA



Popar has developed augmented reality education products that change the way students experience play, stories, puzzles and learning. Their smart toys, books, puzzles and charts come to life with animations, games and reading activities. These products are designed to improve the way that students learn and retain information, build listening comprehension and stimulate cognitive development. The founders, Scott Jochim and Robert Siddell, identified that young children learn best through play and doing what they enjoy. Their products have been designed to this philosophy and have engaged students in classrooms around the world.⁷¹

Case study

No.11 High School, Hangzhou

The Hangzhou No.11 High School has installed facial recognition cameras into its classrooms. These cameras feed data to a 'smart classroom behaviour management system' that is able to record students' attendance as well as how they experience a class. A student's experience of a class can be determined by the emotions recognised by the camera. The camera is capable of recognising and differentiating between happy, angry, fearful, confused and upset expressions. Every thirty seconds, the system records student actions such as writing, reading, raising a hand or being asleep at their desk. This data is then collated and can be viewed by teachers to track a student's attendance, engagement and experience of their class.⁷²



Forecasts suggest that the worldwide artificial intelligence market (AI) will be worth US\$9 billion by 2025, an approximately a 30-fold increase in 10 years.⁷³ This technology offers a range of potential applications in education to make learning both richer and more efficient. AI could be used to assist with anything from basic assistance, such as grading exams, to more advanced tasks such as tailoring educational modules, and even acting as support teachers. Although the true skills of teachers are unlikely to ever be fully matched, AI will continue to evolve and increasingly assist in the schools of the future.

Biometric facial recognition can be used in schools for many applications. In St. Louis High School in the USA it is used for security; the system recognises staff and students and will therefore not allow unrecognised people to access the site.⁷⁴ This technology has also been used to track attendance and is now emerging as a way to find out more information about what students are doing and further profiling. However, children are already the most data-mined section of society which raises questions about the ethical use and security of this information.⁷⁵

Case study

Virtual teachers, New Zealand



'Will' is a virtual educator powered by machine learning to teach primary school students. This project was a collaboration between Vector, a New Zealand based energy distributor and Soul Machines, New Zealand's leading AI company. Will can interact with children from a desktop, tablet, or mobile, and helps them to learn about renewable energy such as geothermal, solar and wind. Will uses Soul Machines' Artificial Nervous System, a platform that is modelled on the way the human brain and nervous system work, to bring his digital human face and persona to life. Will is able to learn from the students he interacts with and adapt his presentation and teaching style to their unique needs and preferences.⁷⁶

Case study

Robotics in learning, New York



The Bina48 robot was developed by Hanson Robotics as a learning AI that can present information, respond to human conversation and learn from these conversations. This robot co-presented an ethics philosophy lecture at the U.S. Military Academy at West Point in August 2018. When students asked questions during the presentation, Bina48 would respond to their question before continuing with the lecture. It was concluded that the robot might not be best suited for West Point since it didn't keep pace with the class. It may provide greater benefits in countries with lower literacy rates or in facilitating other forms of education such as primary schooling.⁷⁷



Case study

High Tech High School, California

High Tech High School in San Diego sees the importance of collaborating with the wider community. The school strengthens its ties with the community by finishing every project with a public exhibition. The external audience encourages the students to put greater effort into the display and invites people into the school, strengthening the relationship and spiking community interest.⁷⁸



Schools in the community

Some communities are built around the school as they start children on their learning journey, connect parents and families, initiate lifelong friendships and become places for people to return for further study.

Schools can be in a range of physical forms; including high rise schools in city centres or smaller buildings in residential areas. Learning can occur in many places, ranging from classrooms to community gardens. Teaching environments can be highly digitised or low tech. This complex range of educational elements weaves together to create the fabric of a community.

When a school is well integrated with a community, children can familiarise themselves with the school setting through pre-school activities. Throughout school life, students are more likely to attend consistently and take on an active role in the wider community. Families become more engaged with their child's education, through the shared use of facilities which results in a supportive, desirable and stable environment. Children are more social, achieve academically and have good physical and mental health.

Schools form part of the building blocks of our cities and towns. It is impossible to consider schools as isolated buildings where students spend their days. Learning is done in multiple forms across the city, throughout the day. The following infographic highlights multiple elements that come together to form a complex matrix of initiatives present when we consider the future of schools.

Schools of the Future

Creating adaptable, collaborative and sustainable learning environments

- 1 Flexible, adaptable spaces
- 2 Vertical schools
- 3 Portable classrooms
- 4 Innovation labs
- 5 Access to industry
- 6 Active lifestyles
- 7 Outdoor spaces
- 8 Community gardens
- 9 Green initiatives
- 10 Environmental sensors
- 11 Enhanced wellbeing
- 12 Intelligent acoustics
- 13 Maker spaces
- 14 Online connectivity
- 15 Artificial intelligence
- 16 Augmented reality



1



Flexible, adaptable spaces

It is vital for schools to be both adaptable and flexible. They should be flexible to cater to varied teaching styles, a range of activities and the differing numbers and needs of students. They should also be able to adapt over time to different functions and long-term changes. Schools can do this by incorporating features such as moveable walls or lightweight movable furniture. Spaces should also be designed to allow for evolving technology.

3



Portable classrooms

Learning will become a more decentralised activity along the lines of teleworking. Students are able to take their learning sources on the go with modern laptops and smart devices. They are always connected to the web that contains a vast number of resources which can continue their learning outside of the classroom. Public places of study such as libraries and desk spaces only enhance a student's ability to be able to work and learn from anywhere.

2



Vertical schools

As our urban centres densify to accommodate more people, land becomes scarce and the need to build upwards becomes necessary, even for schools. High rise schools in cities have many advantages, as more students can be accommodated, and more facilities can be provided in one place. Rooftops can be potential areas for outdoor spaces such as sports fields. Being embedded in cities also provides opportunities such as connections with surrounding businesses. Grouping so many students in one building can bring logistical issues as younger children are harder to organise than adults.

4



Innovation labs

Innovation can be nurtured and expressed from a young age, if provided with the tools and space to do so. Spaces in schools where students are free to express their creativity and problem-solving skills can be valuable for identifying where a student's strengths lie. These are spaces where students have opportunities to make, hack, program, design, produce and build. An innovation lab will serve as a place to express passions and even discover new ones through self-directed exploration. Ideally, these labs are tied into the student's curriculum rather than being just an isolated programme.

Case study

Modular school, Colombia

The Timayui School by Giancarlo Mazzanti, in Colombia, was built for children belonging to displaced communities by the civil conflict in Colombia. The design employs a modular system, allowing elements to be added, depending on the number of students and space requirements and aims to reflect the connection between families, students and teachers. This modular school design demonstrates the potential to mass-produce purposeful and successful learning spaces.⁷⁹



Case study

Rosa Parks School Garden, California

Students at Rosa Parks Elementary School in San Diego, California, where 54.5% of families earn incomes below the poverty level, enjoy the benefits of a community garden at their school. The students were involved in the design, creating a garden containing flowerbeds and compost, planting beds for vegetables and herbs, a bird bath and feeder for natural insect control. The students maintain the garden and organised a farmers market, where the crops are distributed to students and families. The children chose to grow crops desired by their local community. In addition, the garden is used for interactive lessons on “health and nutrition, science, mathematics, ecology and agriculture.”⁸⁰



5



Access to industry

Students can reinforce their learning by applying real case studies to their theoretical knowledge. Having access to real industry partners can greatly assist with this. Industry representatives may be able to provide guest talks and share experience with students that will be relevant for an industry they may be interested in exploring. In future employment and working environments, it will become more important to have an established network of people that you can gain knowledge from. Establishing some of these networks in early education can be very valuable later on in a student’s career.

6



Active lifestyles

Schools have an important role in supporting active lifestyles in students. Regular exercise for students can greatly enhance their ability to learn as well as support their health and wellbeing. Achieving a balance of learning and recreational/active time is needed for a student’s development both cognitively and physically. Structured physical activities can be a great way to reduce stress in students as well as promote a healthy lifestyle from a young age. Teamwork skills can be developed through organised sport and will translate into effective collaboration in the classroom.

7



Outdoor spaces

Outdoor spaces are useful for both recreation and learning in school environments. Some of the results that come from outdoor learning are enhanced social/personal development, growth in the ability to overcome adversity and the development of a deeper relationship with nature. These spaces are primarily used for recreation by students and provide many physical and cognitive benefits. Achieving a balance of physical and learning time is important for maintaining physiological wellbeing. By providing green spaces, schools often see improvement in students’ mental health.

8



Community gardens

Community gardens offer significant benefits and can be aligned to improve learning outcomes. Students can learn practical skills and knowledge required to grow food. The value of sharing and preparing food together is experienced while mutual respect is developed as students work alongside their peers and teachers. Encouraging healthy eating habits in students is important for managing obesity rates as the consumption of fast food products becomes more prominent in younger demographics. Gardening has also been shown to contribute to student’s mental health and overall wellbeing.

9



Green initiatives

Sustainable initiatives are important for schools as they can reduce operational costs, save greenhouse gas emissions and improve environmental conditions. By including green initiatives, the school can teach students about sustainable practices and become a living lab for students to study. Embedding sustainable thinking at a young age will assist in creating ongoing sustainable practices, as children will grow up developing further sustainable initiatives. For schools that are owner operated, sustainable initiatives can have favourable payback periods that are realised in operation.

11



Enhanced wellbeing

The importance of improving the wellbeing of students in their environment is becoming well understood. There are a number of aspects of schools that need to be addressed in order to achieve this. For example, several elements of the physical environment including daylighting, fresh air and reduction of indoor pollution which can assist in improving wellbeing. Additionally, healthy practices such as learning about stress management, exercise and healthy eating can all be part of a modern education.

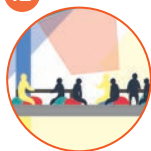
10



Environmental sensors

Environmental sensors are increasingly available and affordable. These can be used to measure and monitor attributes that can affect occupant comfort and health. These factors include daylight, temperature and air quality. Which have been proven to have significant effects on the ability of students to concentrate and learn. Embedding sensors in classrooms and other occupied areas would allow for improved control of environments and improved learning outcomes. Sensors can also reduce energy consumption through daylight dimming and occupancy control.

12



Intelligent acoustics

Schools are becoming more like university campuses or business parks. They provide access to multiple amenities, embrace an open plan, and utilise collaborative spaces. It is important to note that children have different acoustic needs than adults, including quiet spaces for concentration and learning. It is important that acoustics in schools are carefully planned to provide quiet spaces with low reverberations that allow children to hear and understand. This is of particular importance where students are learning in a second language.

Case study

Nature Bridge, California

Nature Bridge operates as a non-profit organisation that supports students across a diverse range of communities, enabling them to learn and experience environmental science. Educators bring the science to life by hosting lessons in national parks. Students are taken on hikes, explorations and overnight expeditions throughout the parks. Students learn about stewardship in taking responsibility for the land, by knowing their sense of place within nature and by understanding the interconnections between different aspects of the ecological systems. The organisation has been operating since 1971 and has provided life-changing experiences for over 1 million participants.⁸¹



Case study

Sevenoaks School Expeditions, UK

Sevenoaks brings school excursions to life from the comfort of the classroom. With the help of the Google Expedition Headsets, students can explore the world and imaginary environments through virtual reality technology. Great teaching is often considered the best way to open the eyes and minds of students, however with these new technologies teaching can be taken to the next level of student engagement and interactivity. Students can be transported on virtual trips to museums, under the sea and outer space. These trips are collections of 360 degree panorama images, annotated with details, points of interest and questions that make them easy to integrate into curriculums already used in schools.⁸²



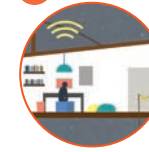
13



Maker spaces

Many students learn better through working with their hands rather than traditional classroom learning. The incorporation of maker spaces into learning environments can have substantial benefits for a range of students. Successful maker spaces provide a variety of activities ranging from carpentry to robotics to art. Although some maker spaces are incorporated into classrooms, dedicated spaces with a range of activities can provide a creative outlet for students. These dedicated spaces require good curation and supervision in order to maximise their usefulness.

14



Online connectivity

Many excellent learning resources are now available online. A curriculum that incorporates this material can have many advantages. Firstly, some of this material is very high quality,⁸⁸ from some of the best teachers in the world. Secondly, students can access this material in the comfort of their own homes with potentially fewer distractions than at school. Thirdly, students can learn at their own pace, with some online learning packages testing concepts which allow students to repeat material until they have mastered it.

15



Artificial intelligence

Elements of AI are already present in schools today. Adaptive learning software that can identify a student's current level of knowledge and ask an appropriate question is just one example of this. These kinds of technologies have led to more personalised learning that is tailored to each individual student. Further developments in AI could lead to adaptive learning that can respond to a student's emotional reactions or demonstrated learning biases rather than just keystrokes and answers given.

16



Augmented reality

AR has many potential uses in schools through the teaching of content and assisted learning. This technology adds a layer of tangibility to what traditionally has been taught through text and images. The physical nature of AR allows for a deeper interaction between students and their learning content. This technology allows the student to be at the centre of the learning and create opportunities for collaboration that will foster a deeper understanding.

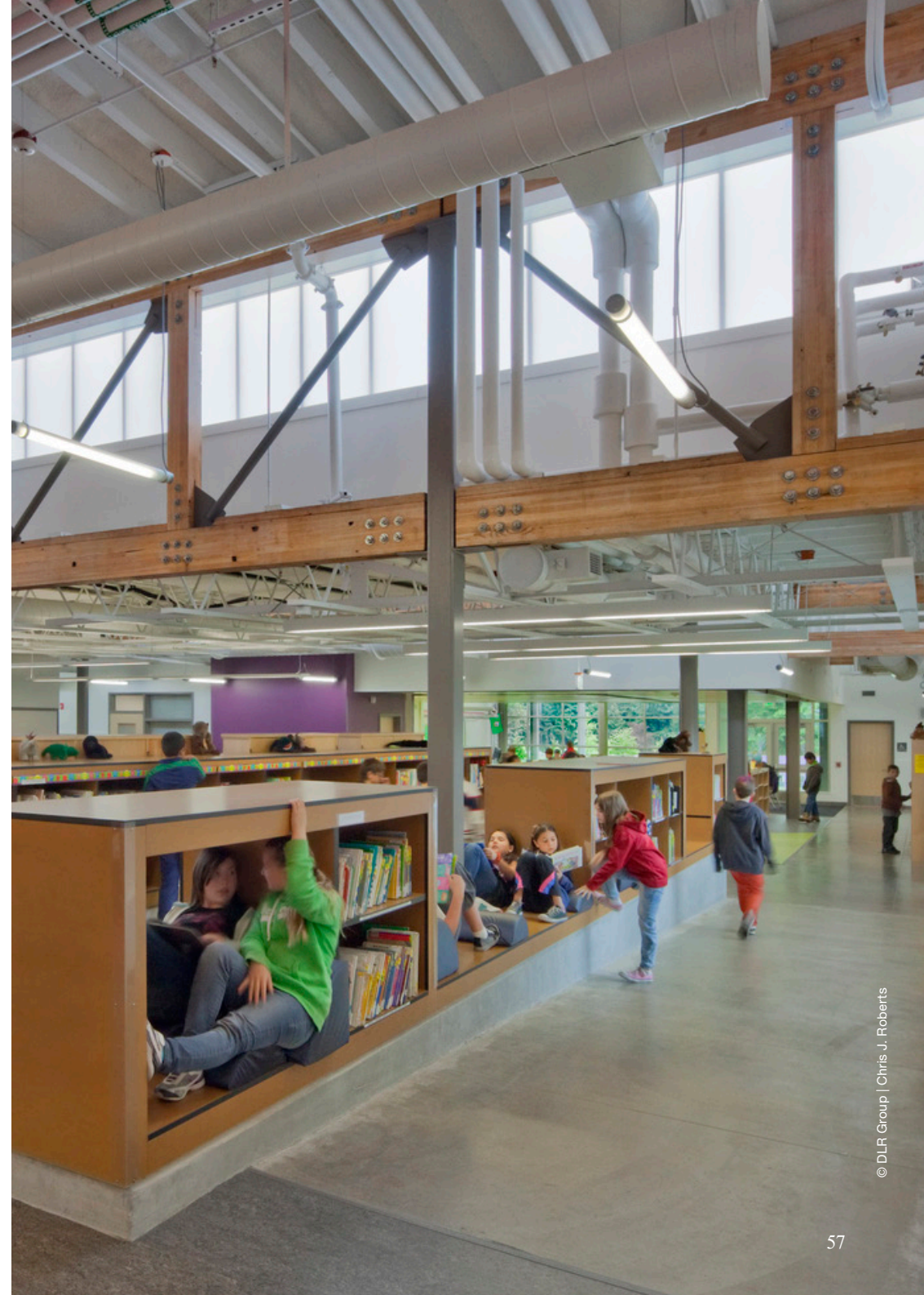
Conclusions

The school of the future is an adaptive learning environment, where students will build a strong foundation to support their endeavours in an increasingly complex world. Characterised by student-directed curriculums and the development of both practical and conceptual problem-solving skills, future schools will offer diverse, flexible and tailored spaces to meet student needs. The physical school environment must reflect these changes, housing collaborative open spaces and enabling intimate workshops. The way students and teachers inhabit spaces will become more adaptive, providing both a broader education and the capacity to pursue fields of interest in great depth.

Beyond academia, schools are a platform for social development. Future schools will uphold strong community ties to develop support networks around students that foster the exploration of personal interests. This will result in more engaged workers with lifelong learning habits. There is a growing responsibility for schools to develop

socially responsible citizens who understand sustainable practices. These virtues should be promoted in the design of accessible and sustainable schools that respond to the unique environmental and cultural values of their locations.

As information becomes more accessible through the internet, learning becomes more flexible and mobile while the traditional role of a school and teacher is evolving. The integration of technology and online learning tools will see a shift in the structure of learning methods and objectives; from exam results and content-based learning to an increased focus on real-world projects and high-order thinking. To enable success in the unknown industries of the future, we need to teach students not simply *what to think*, but *how to think*.



Actions and recommendations

Future skills

In a future that will be heavily automated it is important for students to learn skills that cannot be easily performed by robots such as empathy, critical thinking and emotional intelligence. A deep understanding of ethics is also important when programming robots or handling precious data. Students must also learn to be entrepreneurial. They may have skills that they excel in but apply to multiple jobs over their lifetime. Furthermore, in a connected world, students must be global citizens understanding how to maintain everything from planetary health to their personal wellbeing.

- Equip students with skills that will help them work in harmony with robots
- Embed ethical values in students so that they are responsible with technology and data
- Teach students how to learn so that they can continue to change and adapt to the ever changing world in which they live
- Develop skills that allow students to propose innovative solutions to problems that arise
- Ensure students are good global citizens and treat all people with respect and empathy
- Encourage students that implement solutions that have a positive impact on the planet

School models

School models have moved away from rote learning and standardised testing. Not only is there a better understanding about the need to personalise learning in order to make students thrive, but both design and technology are continually evolving in order to better enable this. Families and the wider community need to support students' learning throughout their daily lives in order to get the most out of their learning journeys.

- Personalise learning journeys so that students understand concepts before moving on
- Consider online learning opportunities for some content to maximise the use of teaching and collaboration during the day
- Embrace a range of teaching models from Sudbury to the mastery approach to see how students learn best
- Engage with families and the wider community to share facilities and support learning and connections
- Ensure that your teaching model is accessible and inclusive of all students regardless of abilities and social standings
- Include students in educational planning and school decisions to prepare them for further learning and the workforce

Evolution of the classroom

The classroom goes well beyond the four walls that school rooms often consist of. Spaces need to be adaptable to suit changing needs and uses. Indoor spaces need to connect both viably and physically to other spaces, the outdoors and even the wider urban realm. Digital technology is rapidly changing and allowing new learning opportunities and experiences. This also allows for further permeability between schools and the wider community.

- Include schools as a central element of community masterplans in order to connect with the community and promote lifelong learning
- Design adaptable spaces that can transform as required
- Connect spaces to the outdoors including daylight and views in order to aid in concentration and wellbeing
- Test new digital technologies to maximise interest and excitement in learning
- Supervise students physically and online to protect them from bullying and other threats



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Publications



Perth 2050 presents four perspectives from rising engineers and designers at Arup to establish a vision for Perth in 2050. The themes look at a future city of Perth that is data-driven, has seamless and integrated mobility, utilizes sustainable urban water management and has resilient urban systems.



Future of Labs explores the major drivers shaping the design and operation of science research facilities across the world. It provides recommendations for the design of labs of the future, including wellbeing and place, adaptable spaces, digitalisation and networked spaces.



Campus of the Future examines the trends affecting the design, operation and experience of higher education campuses, highlighting global best practice from the education sector and beyond. It aims to help higher education designers, developers and facilities managers better understand the forces shaping these evolving spaces.



Future of Libraries examines the key trends that are influencing the transformation of libraries in terms of the social infrastructure they provide and the services they offer. Libraries are evolving into hubs for education, health, entertainment and work. They are becoming strategic city assets, designed to stimulate cultural exchange, economic prosperity, and support stronger communities.

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About Arup


Arup is the creative force at the heart of many of the world's most prominent projects in the built environment and across industry. We offer a broad range of professional services that combine to make a real difference to our clients and the communities in which we work.

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The findings of this report identify drivers shaping the future of schools and how our understanding of learning is evolving. Equipping students with the skills needed to thrive in a rapidly changing, unpredictable work landscape will be an ongoing challenge. We have a duty to ensure that we are not simply teaching children what to think, but how to think, in order for them to deal with growing complexity.

To foster concepts of self-directed learning, we can look at how school environments are becoming increasingly adaptive and modular, adopting new technologies and sustainability practices. Open learning, a shift from exam-centric objectives, will see more diverse curriculums emerging that focus on the development of real-world skills and involve whole community participation. Further, as access to online learning platforms continues to grow, we can reconsider how class time is most effectively spent and the types of environments where learning is best undertaken.

Insights into the challenges faced by students and educators alike, demonstrate the need to proactively shape school environments that offer future skills and nurture self-reliance.

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