



**Directorate for Education
Centre for Educational Research and Innovation (CERI), OECD**

Innovative Learning Environments (ILE)

INVENTORY CASE STUDY

John Monash Science School

Australia (Victoria)

John Monash Science School is a Year 10-12 government selective entry specialist senior school focused on science, mathematics and associated technologies. The result of a joint partnership between the Victorian Government and Monash University, the school is located in the south-eastern suburbs of Melbourne on Monash's Clayton campus. John Monash Science School showcases new ways of thinking about curriculum and pedagogical practices whilst also reconceptualising physical and virtual spaces for effective student learning. Innovation is visibly evident due to the school's flexible learning spaces, quality of teacher and student interactions and the creative ways in which learning occurs. A culture of collaboration and collegiality is exemplified, as well as the staff's ongoing commitment to professional learning. In the same way, the rigorous intellectual pathways for student engagement and autonomy are enhanced by inquiry based curriculum and the school's daily practices.

This Innovative Learning Environment case study has been prepared specifically for the OECD/ILE project. Research has been undertaken by Professor Jill Blackmore and her team at the Centre for Research in Educational Futures and Innovation, Deakin University in partnership with Dr Elvira Vacirca from the Department of Education and Early Childhood Development of Victoria, Australia, following the research guidelines of the ILE project.

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Innovative Learning Environments (ILE) Project

Case study: John Monash Science School

Aims of the ILE and the nature and history of the innovation

John Monash Science School (JMSS) is an example of a university-government partnership designed to meet the perceived problem of insufficient students in science and maths disciplines in universities and shortages of applicants for science-oriented occupations. Based on a newly developed partnership between the Victorian Department of Education and Early Childhood Development (DEECD) and Monash University, this specialist science school catering for students in Years 10 to 12, brings new ways of thinking about curriculum and pedagogies at the post-compulsory level and reconceptualises physical and virtual spaces for effective student learning. At the time of this report, in December 2010, the school had been operating for 10 months.

Background and context

JMSS is located on the campus of Monash University in the south-eastern suburbs of Melbourne. Whilst situated on the campus, the school is quite distinct from the rest of the campus, with dedicated car parking and facilities. Staff and students access other university facilities including the Monash Science Technology Research and Innovation Precinct (STRIP), home to university and corporate enterprises developing leading-edge technologies and research capacities (Monash University 2005).

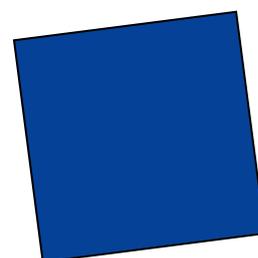
The school is located just metres from the existing science and medicine faculties where the best minds in Australia are creating solutions for the future. It will provide the school's students and staff with unique opportunities to engage with university teaching and research staff (Vice-Chancellor Richard Larkins, Monash Newline 2009).



Figure 1. John Monash Science School design



Figure 2. John Monash Science School building



JMSS was purpose built (see Figures 1 and 2). Architects, in consultation with academics from the Monash University Education and Science Faculties and with input from neighbouring schools and representatives of DEECD (Eastern Region), undertook the design process and made the early decisions about use of space, such as design of laboratories. At the time of the Principal's appointment, he was 'able to make two or three changes to the building design, which changed some aspects internally, but the physical layout was pretty much confirmed'. What was important was that 'we had complete ownership over the development of the vision for learning and the new curriculum, and that's where we got to work with the most energy in the early days' (Principal).

JMSS is unique in a number of ways. First, it is one of only five selective-entry government schools in Victoria. Typically, such schools provide 'an educationally enriched environment for high-achieving, academically gifted students' (DEECD 2006). Second, JMSS differs from other selective-entry schools because it is a specialist school. Finally, selection is based not only on academic ability, as determined in a centralised exam process, but also upon the 'applicant's passion and aptitude for science, capacity for logical and numerical reasoning, and mathematical ability' (JMSS 2010) as determined through an interview.

In its first intake of 191 students, JMSS enrolled students from 90 Victorian metropolitan, regional and rural schools, leading to significant cultural diversity. The recent school event celebrating 'Harmony Day' highlighted student connections to 39 countries. Many students travel considerable distances daily or are located in home-stay or billet programs. Overall, the Principal characterises these as 'particularly able' and 'highly motivated' students who 'get a kick out of learning something new and seeing connections between the science disciplines'. Staff now refute the myth that JMSS catered only for 'clever students', favouring the view that their students boast a range of abilities across a broad spectrum of interests: music, language, golf, equestrian events, swimming, literature and humanities. These changing perceptions of the learners at JMSS have had a significant impact on teacher practices and expectations.

The teaching staff at JMSS are young and enthusiastic, selected because of their outstanding records in their previous roles, and clearly committed to the pursuit of excellence in teaching and learning. They include 20 full-time teachers, including the Principal and two Assistant Principals and 14 non-teaching staff. Fractional staff positions cater for music and chaplaincy, and Year 10 physical education 'which looks more like recreational sport' (Principal). The last is facilitated in partnership with Monash Sport. All the trained teachers, including the Principal and Assistant Principal, teach daily and are considered to be affiliates of Monash University. It is 'not unusual for Monash academics to be taking sessions within the school' (Head of Science). Most teaching staff have a formal leadership role within the school, and the school is advertising for new staff to teach the second intake of students.

As an innovative learning environment, the school was designed on the basis of sound educational and architectural principles but only had three months to implement these principles as students and staff worked initially in temporary spaces at Monash University before moving into the new building (DEECD 2011). Even in the early stages, significant learning developed out of the relationships and partnerships between different stakeholders of this school, as well as the design processes of the physical environment. In particular, considerable benefits emerged from recognising the expertise and autonomy within the school leadership which enabled the teachers to develop rich curriculum and assessment practices within a culture of collaboration and respect between staff and students.

Origins and development of ILE

Partnerships

The JMSS was ten years in the making, from early conceptualisation through to the first enrolments of students in 2010. A key player at Monash University, and a catalyst for this endeavour, was Emeritus Professor Richard Gunstone. The Deputy Vice Chancellor and Vice President (Resources), Ms Allison Crook, encouraged Professor Gunstone to develop the idea of a specialist science school within the newly established prestigious STRIP. A new Dean of Science at Monash

University from New South Wales (NSW) became involved in the early negotiations. His personal and educational history was in NSW, which has over twenty government selective and specialist schools.

I really came from that philosophy of 'this is the sort of school that children from working class backgrounds can really thrive in'. My parents were working class and I just appreciated the opportunity to get into education. I attribute where I am now to the fact that I went to a selective high school. It gave me an opportunity to learn science and appreciate science in a school that had decent labs and good teachers (Dean of Science).

The motivation to develop JMSS was based upon a number of drivers. At the most fundamental level, it was about enthusing learners in the sciences by improving the quality of secondary education, in the belief that this would have flow-on effects into tertiary science.

We felt science wasn't understood at the secondary level. It wasn't particularly taught well. And there was a decline in science enrolments at the tertiary level worldwide. So the concern for us was, why? I mean science should be exciting. Science should be a great thing. The answers to that are very complex and there are all sorts of reasons for it. There was a lot to be learned through a specialist science school (Dean of Science).

JMSS was therefore expected to be experimental in terms of its curriculum.

At a policy level, the rationale of the school was to increase student numbers in science and maths, as a way of responding to the ongoing impetus for science, technology and innovation which foster economic growth. This fitted in with Monash University's stated aims (Monash University 2007) and was also a direct response to the challenges identified within the then Victorian Labor Government's strategic document *Growing Victoria Together* (State Government of Victoria 2001).

The concept for JMSS was presented to the Monash University Council after extensive research into similar settings around the world which had concentrated on other recent innovations in science education, such as the Australian Science and Maths School founded in Adelaide, South Australia in 2002. The Dean of Science proposed the school at Monash University to DEECD, as a rich partnership opportunity for his new portfolio, which would lead to more science graduates and also develop new programs in science teaching.

It means training science teachers in a new way. And also it's not all altruism, as it is a way of recruiting students to Monash particularly in the Faculty of Science. And my proposal was that we allocate a plot of land on Monash ground and get the Department to build a school and that Monash put some money to help the Faculty of Science members relate to the teachers and help them design the programs (Dean of Science).

Selective-entry schools have been a contested political issue in Victoria within the Department of Education and Early Childhood Development and among parent groups (Dunn 2005). Moreover, some schools were closing or amalgamating in the Monash area, and there was a perception that this school would potentially remove high-achieving students from their local community schools (Monash University academic). Teacher unions highlighted in the media the inequitable allocations of resources already evident in the state education system, warning that elite selective schools would attract both resources and academically talented students away from other government schools already endangered from falling enrolments. Unions argued that 'we wouldn't want to see one school being resourced better than another' and that 'all schools should be properly resourced, whether they are a specialist school or a standard secondary or primary school' (Smith 2007). During the period 2001-06, interest in the school waxed and waned. The concept of the 'Science School' attracted much attention from other community stakeholders, including potential private school partners and corporate groups. 'It was as if everyone else could see the value in what was being proposed except for the two big players' (Monash University academic). The provocation was the desire of the Labor Government to establish specialist and even selective schools to attract students back to the government sector.

Early in 2009, the first Principal, Peter Corkill was appointed. He encouraged students to excel but also wanted JMSS to be ‘a place where they will be challenged by contemporary thinking and engaged in helping find solutions to current pressing problems’ (Monash Newline 2009). Initially situated at the DEECD’s eastern regional office, and working closely with the regional network leader and the regional director, he was assisted by a retired Principal, Phil Gardener, as project officer. They recruited the school’s leadership team, including two Assistant Principals and a business manager. The JMSS staff were located in an office in the STRIP at Monash University, from whence they appointed the curriculum leaders and advertised for staff, who were selected on the basis of what they could offer. Leadership was critical at this point, with the Principal outlining clear guidelines as well as being able to ‘think really big and really differently’ (Assistant Principal).

Teachers arrived excited about the possibilities of an ‘open slate’ in a new school with few blockers and a supportive administration.

We’ve really just been let free to run with all of our ... even fanciful ideas. Another school might look at that and think ‘oh, you can’t do that’ or ‘that’ll never work’, but that’s certainly not the attitude here (teacher).

Although the new building was unfinished, student applications were sought in the middle of 2009 after an open night was attended by 600 people. In total, 191 students were selected from 330 applications. Given the lack of a school building and of anything more than a curriculum framework, albeit one linked to the Victorian Certificate of Education (VCE) outcomes, it meant that a different group of parents and students were engaging with the idea of the school.

I characterise those parents as risk takers and the students as risk takers as well. Most were probably really happy in their schools but they saw a different opportunity here. In many cases it was the students who drove this. ‘I know about this school, I want to go there’. From what we know of the students, because we interviewed most of them, the students that are here are genuinely interested in and passionate about science (Principal).

Structured patterns and characteristics of the learning environment

Given the novelty of the flexible learning spaces, attention was paid to the multiple ways in which teacher and student interactions were facilitated with what was an emerging ‘culture of collaboration and collegiality’ (Principal).



Figure 3. JMSS - central ground floor

Flexible learning spaces

As often occurs with new schools, staff and students occupied temporary spaces in traditional tutorial rooms and laboratories in the university for Term 1, and then moved into the specially-designed space (DEECD 2011). This move provided the opportunity to reflect on the potential offered by different physical learning environments.

We watched our school being built. We were so excited about everything that was happening, and the unfinished buildings were just another thing to look forward to. Being at the University was exciting and we felt very special (student).

JMSS is physically striking because of its overwhelming sense of openness and natural light over three floors. Each floor has a range of spaces that can be variously utilised. The ground floor is designed to be a multidisciplinary and communal space, whilst the first and second floors are duplicate dedicated learning spaces. The ground floor houses the reception desk, administrative offices and formal meeting rooms that adjoin the Principal’s and Assistant Principal’s offices as well as a small cafeteria (see Figure 3 and 4). A staff room doubles as a staff meeting room and a lunch room.



Figure 4. JMSS Student spaces



Figure 5. JMSS Flexible Learning Spaces



Figure 6. JMSS Science laboratories



Figure 7. JMSS Breakout spaces

The first and second floors are divided by the learning bridges, each half dedicated to two pastoral houses where students usually begin each day. These have a mix of open spaces, formal science laboratories and small break-out rooms used for student meetings or small teaching groups. Modular furniture is used to generate the boundary of each specific learning area resourced by interactive whiteboards, data projectors and other resources, and used as instructional and recreational spaces.



Figure 8. JMSS teacher's working spaces



Figure 9. JMSS learning bridges

The house-group teachers' planning areas are incorporated into their specific learning commons in open spaces bounded by modular furniture to head height, facilitating sightlines (see Figure 8). This was a new way of working for teachers, traditionally used to closed-off private areas and personal desks.

On day one, when we came in and the staff tables were set out, there were gasps of 'Where's my desk? Where am I sitting? Where are my folders? My pigeon hole?' That settled very quickly after two or three days and that was ... I mean any sort of change of space or whatever is a big shock and that ... in the end that's been a real benefit and I think everybody sees the benefit in that. It has almost forced us to work with each other in the same ways we expect the students to (teacher).

As with the pedagogy, the space models behaviours and encourages teachers to rethink their relationships with each other and their students.

I think that working in an open space can be seen as intimidating and lots of people when they tour through here can't believe that we don't even have separate office areas, but I think that's part of the beauty of it. But, before I came here, I'd never really thought about it (teacher B).

Students also identified the advantages of teachers being in the same open spaces. It means 'teachers don't have separate offices. They're out here with us as well, and we think it's really good because we know where they are and we can talk to them when we need to'. In response, a teacher considered that it made both teachers and students more accountable 'because we're always there'. The interviews indicated how the physical learning environment had impacted upon the teaching and learning experience. Teachers and students alike commented that the environment 'forces you to work with others, even in areas you don't usually work with others' (student).

Pedagogically, the large, open spaces afforded teachers choice in the ways of enabling group work, and working with different class sizes. Advantages were also seen in large class groups and how they can be organised:

We actually don't have walls in our classroom. We block classes together so there's ... for example, in Issues Studies we have 75 students with three staff members which means we can then break those groups up into a whole range of different environments. We can divide them based on ability, interest, or just randomly. And so that also gets students to meet and work with other students (teacher).

Indeed, the open spaces attracted one teacher who felt that his previous science teaching had occurred 'in a small lab behind closed doors' whereas at JMSS he 'had not yet taught a class on his own, and found it professionally satisfying'.

Open spaces in VCE, and in science in the labs is something quite unique. To have double labs with so many clever people all firing off each other. Every class brings 'aha' moments which are different 'aha' moments from other experiences I've had. It's very energising ... what happens between students and students, and students and teachers, and teachers and teachers in these spaces (teacher).

The other advantage teachers identified was the possibility of 'knowing what others are doing' and therefore learning from one another, as well as 'having a stronger sense of what the students are learning' and the ways in which richer connections could be made between different areas of learning. This led to significant behavioural changes and adjustments.

Everything is open and we're learning from each other and there's constantly people walking through and the students don't bat an eyelid now, they barely even look up. You know I'll often be sitting in my workspace and I'll hear another class going on and I'll think ... I'll see

someone doing something, and I think oh that's a great idea. I also struggle with some of the things the students are learning, and it makes me want to know more (teacher).

There was also a heightened awareness of the ways in which 'strong, supportive and professional relationships between staff and students' are nurtured (Principal).

Staff and student relationships

Framing practice

Staff and student relationships are considered central to the school's culture, as evident in the Staff Code of Professional Practice and the Learner's Developmental Framework. A vertical house system, induction programs and homework clubs also support students' learning experiences.

The Staff Code of Professional Practice and the Learner's Developmental Framework are both organised around the United Nations Educational, Scientific and Cultural Organisation's (UNESCO) *4 Pillars of Education* (Delors et al. 1996). The 4 Pillars: 'Learning to Live Together, Learning to Know, Learning to Do and Learning to Be' over the lifespan are about relating 'a way that all people can get the most out of their own specific educational environment all through their lives' (UNESCO Institute for Lifelong Learning 2010, p. 3). The school leadership team, with staff input, generated a vision for the culture of the school and how the 4 Pillars have been used to think deeply about the emergent population of JMSS.

| | Staff Code of Professional Practice | JMSS Learner's Developmental Framework |
|---------------------------|--|---|
| Learning to live together | <p>Focused on building sound relationships</p> <ul style="list-style-type: none"> • We create a sustainable, safe, encouraging and supportive environment conducive to effective learning and aimed at developing core skills, values and attributes in our learners. • We build effective collaboration by working constructively together, considering and valuing the input and viewpoints of all. • We build positive, respectful, and caring relationships with all community members. • We value and celebrate diversity and are inclusive of others. • We work effectively in teams to ensure student outcomes are maximised in open, sharing learning practices. | <p>Focused on building sound relationships</p> <ul style="list-style-type: none"> • Our learners build effective collaboration and teamwork by working constructively together, considering and valuing all input and viewpoints fairly. • Our learners build positive, respectful and caring relationships with all community members, and celebrate diversity. • Our learners contribute to the creation of a safe, welcoming, encouraging and supportive learning environment and community. • Our learners have a global perspective, know and care about the world and its communities, and seek to live sustainably and impact positively now and in the future. |

| | Staff Code of Professional Practice | JMSS Learner's Developmental Framework |
|------------------|---|--|
| Learning to know | <p>Focused on our professional learning</p> <ul style="list-style-type: none"> • We know our students and place them at the centre of teaching, learning, decision making and action. • We undertake professional learning that reflects current research, DEECD policies and initiatives. • We share our expertise, knowledge and developed resources with colleagues, and actively develop professional networks and partnerships in the wider educational community. • We regularly and critically reflect on our teaching practice through multiple sources of feedback to improve the quality of teaching and learning at our school. | <p>Focused on thinking and understanding</p> <ul style="list-style-type: none"> • Our learners are effective inquirers, able to ask meaningful questions which probe understanding, and take risks in their learning. • Our learners are critical thinkers, able to analyse information, evaluate evidence and produce informed conclusions. • Our learners are creative thinkers, open to new ideas, imaginative and resourceful in their use of different strategies and approaches. • Our learners are reflective, aware of their own skills and abilities, and open to feedback to improve their own ideas or performance. |
| Learning to do | <p>Focused on professional practice</p> <ul style="list-style-type: none"> • We provide high quality teaching, learning experiences and assessment strategies informed by best practice to promote effective learning in our students. • We work collaboratively toward a shared view of effective learning and teaching so that consistent approaches to pedagogy are practiced. • We set and maintain high expectations of ourselves and our students. • We develop and implement a personal professional learning improvement plan that contributes to school improvement and our individual professional growth. | <p>Focused on knowledge and skill acquisition</p> <ul style="list-style-type: none"> • Our learners are adaptable, being able to listen effectively with change, skilled in the use of modern technologies, and prepared to meet any challenge with optimism. • Our learners are effective communicators, being attentive listeners and also articulate in both written and spoken media. • Our learners are persistent, being able to work effectively through difficulties, and resilient in the face of setbacks. • Our learners develop the competencies necessary to advance their learning in specific disciplines, and are responsible for their own learning. |
| Learning to be | <p>Focused on developing good people</p> <ul style="list-style-type: none"> • We act ethically, responsibly and with integrity. • We encourage everyone to achieve their personal best, and positively reinforce their efforts with a sense of optimism and a can-do perspective. • We advance the teaching profession through high standards of professional behaviour, punctuality and dress. • We welcome people new to our community and help them transition quickly into their environment. • We recognise and celebrate the achievements of all members of our community. | <p>Focused on developing good people</p> <ul style="list-style-type: none"> • Our learners are well-rounded with a broad range of skills, perspectives and interests. • Our learners strive to achieve their personal best in everything they do. • Our learners are optimistic, confident, enthusiastic and passionate about learning. • Our learners are able to examine issues from a wide range of perspectives, and understand the need to act honestly and ethically when making decisions. • Our learners value and develop the dimensions of leadership. |

Table 1. John Monash Science School 'Staff Code of Professional Practice' & 'Learner's Developmental Framework'

According to the student engagement and wellbeing policy, the mandate of the school is a 'responsibility to provide an educational environment that ensures that all students are valued and cared for, and feel a sense of belonging which enables them to engage effectively in their learning' (p. 12). This is enabled through the Staff Code of Professional Practice. Similarly, the Learner's Developmental Framework articulates a vision for an educational environment and the qualities and aspirations for teacher pedagogy and student learning 'to develop core skills, values and attributes' in all learners through 'learning, teaching and daily interactions to best prepare all members' for lifelong learning (p. 14). Teachers refer to the Framework consistently in their teaching, and in their planning.

They own the document. They created the document. It is continually refined. It must be up to its third, fourth or fifth go, now. It was one of the very first things we did. Peter [Peter Corkill, Principal] did the first draft because it was the start of a vision. You know, a consistent set of expectations for staff and for students. As more people come on board, we visit it again, because the vision changes, even a little bit. If we sign on something like this, it means we have to follow it, like a contract of sorts. You have to have expectations right (Assistant Principal).

The Learner's Developmental Framework is the subject of constant staff review relative to the students, a process that requires teachers to consider how to make the pillars explicit in their daily practice. One teacher commented:

I'm sure when students enrolled here, they thought that they were just in for the science and maths ... well, more than that, but I'm sure they and their parents thought it would be all academic. I've thought about this since our last meeting, and this could almost be a specialist school just in being and living together, especially for teenagers (teacher).

Through discussion, the staff critically analyse their practice and identify gaps in the student experience, as part of the ongoing planning cycle.

This is year one. We know that next year's student intake will be different, and that this year's group now have expectations. It is crucial as we begin planning for next year to think about what it is we are doing here, and how we are progressing. I know we are doing some great things, but we need to know if there are areas that are just not being addressed (Principal).

Staff are confident that the 4 Pillars are being addressed, but suggest that they 'hadn't really thought about how rich some of the opportunities were in mapping across a number of aspects of learning' and how different areas could be best articulated within a pillar such as Learning to Know, 'without looking just like any other curriculum document, which would never do it justice' (teacher).

I firmly believe that we don't just teach at a school to teach content. We are also modelling behaviour to them and I think it's important. The Code of Practice and the Framework work together so that the students see that we're working as well and that we have relationships with other staff members and that we're learning. And we have to work to the same expectations that they do. At the end of the day, here, it doesn't matter whether you are a teacher or a student, you're working to be the very best. Working under the same kind of pressure means that we all understand each other. It's funny to think about it like that (teacher).

Vertical house system

Likewise, the vertical house system nurtures more intimate relationships between smaller groups of students and key staff members. There are four house groups named after distinguished Australian scientists (Wood¹, Flannery², Doherty³ and Blackburn⁴). Each house group has an appointed Head

¹ Dr Fiona Wood AO, is the Head of Royal Perth Hospital's Burns Unit, co-founder of Clinical Cell Culture, known for its world-leading breakthroughs in the treatment of burns, Clinical Professor with the School of Paediatrics and Child Health at the University of Western

of House, and three other teachers associated with it. The Head of House is the first point of contact for each student or parent in regards to their wellbeing or academic achievement. The teaching staff members within the house are referred to as ‘tutors’, who oversee some of the practical things like attendance and coordinating students, or teachers, to make sure everything is going as it should be as well as participating in the negotiation of Individualised Learning Plans (ILPs).

I am in Wood House. As a girl, it is wonderful to be in a woman scientist’s house. But the houses, you know, they help you to know other people. I didn’t know anyone here. My Head of House is very nice, and she knows me more than teachers at my last school ever did (student).

The house structure of the school enables students to develop the leadership dimension of their learning, referred to in the Learner’s Developmental Framework. Each house has a student leadership team, including house captains and student parliament committee leaders. The student leaders within the houses are formally recognised within the school’s student engagement and wellbeing policy as operating within the school’s responsibility to ensure the personal and academic wellbeing of all students.

I am the Head of a House, here. There are some parts of the job that are very administrative. Most of the job though is building relationships with students and helping them to know each other and support each other. We celebrate our triumphs and watch out for each other in times of stress. These students are very good to each other. Here they have the chance to lead in ways they never have before. Often, these students were the silent population in their schools (teacher).

The students compete in sporting and academic pursuits as members of their house and provide support for the induction of new students into JMSS.

Induction programs

Dominant discourses amongst leaders and teachers are the notions of transition and induction. Teachers were mindful that ‘as young adolescents at a challenging time of their lives’ (teacher), students would need to gain an understanding of the vision of the school.

In my last school, we ran some amazing programs for our Year 9s because quite frankly we knew that the industrial model of education was just not working for them. It is a time in the students’ lives of transition, and they don’t necessarily see that what they are doing in school is useful. We made it useful. And, making things useful changed a lot of behaviours and increased student engagement. Here, everything is ‘useful’. It’s what the students want to do, but because everything is different, we had to help them to learn about a more mature way of coming into this school and into the university. We needed to orient them to make what we wanted to do work (Assistant Principal).

The orientation and transition process for JMSS commenced in October 2009 for the students of 2010. Information evenings provided staff with the opportunities to present their curriculum plans to students and their families, and for families to seek any clarifications. At this time, possible learning

Australia and Director of the McComb Research Foundation. She is world-renowned for her patented invention of spray on skin for burns victims and winner of the Australian of the Year Awards (2005).

² Tim Flannery is one of Australia’s leading thinkers and writers and internationally acclaimed scientist, explorer and conservationist. As a field zoologist he has discovered and named more than thirty new species of mammals and at 34 he was awarded the Edgeworth David Medal for Outstanding Research.

³ Peter Doherty is a Nobel Laureate for his contribution to science research. With Rolf Zinkernagel, he won the Nobel Prize in Physiology or Medicine for discoveries concerning the specificity of the cell mediated immune defence (Nobel Prize.Org, 1996).

⁴ Elizabeth Blackburn studied at universities of Melbourne, Cambridge and Yale and is currently Professor of Biology and Physiology at the University of California. In 1998 she was the winner of The Australia Prize for her work in molecular genetics and won the Nobel Prize in 2009 for the discovery of how chromosomes are protected by telomeres and the enzyme telomerase.

pathways and opportunities were presented to students to stimulate their thinking 'about what could be' (Principal). Each student, with his/her family, then met with staff in a 'course counselling interview' to 'plot the student's course'. By the end of 2009, each student had a plan and timetable for their course outlined. This facilitated teacher preparation.

We had a lot of data about these students before they actually came. Meeting with them to talk about their aspirations, and even think about what subjects they were doing helped me to understand them even better . . . before I actually knew them. So I was planning for a group I knew much more about than any other group I had ever planned for. The student's orientation was as much for us as them (teacher).

The first three days at JMSS are residential, hosted in Farrer Hall, at Monash University, and include all staff and students. The orientation camp comprised formal sessions that 'introduced the students to the academic stuff that they could be learning' (Assistant Principal), 'more pastoral activities' such as learning about the house structure and knowing their tutor group, and navigating the Monash University facilities including the protocols in the 'more specialist areas along the STRIP' (teacher). Most importantly, the students and staff were given the opportunity to get to know each other.

The very first night we had a bush dance. Some students from Asian cultures had not really had that experience and they loved it. The quieter students got into it because everyone was involved. The teachers danced too! There was a warm and happy feeling. The second night, we had a talent quest. It constantly amazes me how talented some of these students are (Principal).

And:

I did not know anyone. I felt quite scared before I came. I have friends at my old school, but when we stayed together here, I think everyone talked to me. I like the people here because we belong together. It felt this way the first day, even when I was scared. Even the teachers belong with us (student).

With regards to the temporary facility, 'we weren't bothered though, because we were all in it together' (student). The camp was seen in evaluations as 'a pivotal moment' (Principal) in the beginning of the school as it enabled students to address a number of anxieties in changing schools and in committing to a narrower educational pathway in comparison with their previous schools. Teachers who were involved in the establishment of JMSS are mindful of how to inform the next influx of teachers about how they have 'lived the transition and the beginning of the school' by 'getting everything out of my head and available for others to use and learn from' (teacher). Mentors will be allocated to new staff within the house structure.

We're just starting to talk about it at leading teachers' meetings. I've had some thoughts that I need to put together a handbook, where we share key information, like where our entire curriculum is stored, how our unit plans work and how we construct assessment tasks. And, they'll belong to a number of teams, and there will be lots of support through those teams (teacher).

Ownership of reform is critical to its success. A similar orientation process was undertaken in 2011, with the 2010 cohort acting as mentors, to nurture a sense of place and address intergenerational change.

Student support and learning clubs

Students have structured ways in which they can enhance their learning and social life through the house system, with additional classes and clubs that draw upon students' passions and interests.

We think that we as staff encourage students to seek help and get feedback and we provide a lot of structured support for them in terms of maths club and revision classes that they ran

in science. Leading into major assessment tasks, teachers provide a lot of personal support for students (teacher).

These extra-curricular activities lead to the 'longer than usual day' at JMSS, with the homework club commencing after school. Occasional special interest groups, or clubs, have a 'guest speaker who would not have ordinarily been available during the day or the topic would not have been relevant to everyone' (teacher).

A culture of collaboration and collegiality

When asked to elaborate on what the culture of the school is, first and foremost, staff refer to the collegiate environment in which they work and the opportunities for innovation that occur as a result of the 'safe environment where risk is acceptable'.

I think that part of what makes this school so special—the personalities on the teaching staff in terms of their willingness to try new things and to be open to learning and innovating (teacher).

Acknowledging and rewarding collaboration and collegiality amongst staff is made explicit and public within the community of the school, and at team and general staff meetings. The environment is warm, professional and inclusive of everyone present—including pre-service teachers completing their teaching practicums and researchers.

Collaboration and collegiality are necessary aspects of everyday life as all classes are team planned and taught, which differed from teachers' earlier experiences as it recognised how 'more personal dimensions affect how you teach' (teacher). Several teachers referred to values such as trust and respect being essential within such professional relationships.

In other schools, you can go to a planning meeting, and nod your head like you are going to do what has been planned... because you go back to your own little space and just do it. Here, we work together. We see everything everyone else does—for good and for bad. You have to have a good working relationship with people. You have to know you can depend on them, and that they can depend on you (teacher).

Commitment to ongoing professional learning

The strong commitment to the professional learning of teachers was evident in the collaboration engendered by the learning spaces, as informed by the Staff Code of Professional Practice, as well as in the time dedicated to professional learning and curriculum development every week on Wednesday afternoons when students are undertaking extra-curricular activities with 'non-core teaching staff'. During this time, teachers are involved in 'strategic professional learning' (Assistant Principal). These sessions include a range of professional learning activities for the teachers, facilitated by a member of the leadership team, different faculties or discipline groups; for example, the Learner's Developmental Framework discussion was run by the leadership team.

During our sessions, we focus on a whole school issue, or on making sure we are working towards our agreed vision. At the moment a lot of these meetings are used to talk about moving forward to the next two years when new students and staff come on board, and we need to develop strategies to really plan properly for this (Principal).

In faculty-led sessions, staff share hands-on learning activities and experiences which enhance the practices of other staff members, often involving multiple activities. The Head of Science commented:

We were struck by how differently everyone was using the spaces at the school. We started the session by sharing the ways that we are using the space for teaching together, and for working students in different ways. It seems to be really paying off. And we know that there are some very talented staff members here, so we wanted to drill down into that a bit more. People were probably taking their practices a little for granted (teacher).

Some professional learning sessions were dedicated to ‘up-skilling teachers who are not necessarily au fait with what can be done’ through reflecting, for example, on a use of technology and how it can translate into another classroom context.

Each of our learning areas take turns in sharing how they use the spaces, how they use technology. So for example on Wednesday this week we had rotating sessions. We had half of our staff undertake Click View⁵ for an hour and the other half heard from our English faculty about how to make instructional movies using the software that we can put on the site and I’m really proud to say that the maths teachers made one. And it’s me explaining to the students how symmetry relationships in trigonometry work, something they always find hard. There is now a permanent record of this explanation students can refer to again and again (Principal).

Similarly, the school promotes the appropriate and purposeful use of social networking media, as well as search engines, and their potential uses (and abuses) within the learning environment.

... we did a Twitter PD (Professional Development) and now we have the majority of the staff on Twitter and engaged in teacher learning networks. So I think that willingness to work hard and build something and push yourself to keep improving is really important especially in an environment like this where we’re beginning everything from scratch. But that’s part of the challenge (Head of English).

The Principal is extremely supportive, recognising the diverse range of backgrounds that ‘offer a tremendous richness in professional learning’.

Rich partnerships with external stakeholders

The reciprocal relationship that has emerged through the development of the JMSS between the school, Monash University and DEECD has become a model for similar projects. Each partner has differing responsibilities. DEECD is involved from a policy perspective, with a more dynamic relationship between the school and the University. All the teaching staff have been appointed as affiliate members of the University, to enable their full access to the Monash facilities. Likewise, the students have some access to the university library, sports facilities and the Wi-Fi network that enables them to work anywhere in the university on their school computing tablets, with age and copyright limits. In terms of governance, the Monash University academic staff became members of steering committees of the school, and some remain on the School Council. Monash University also provided infrastructure within their own workload system to enable ongoing support and partnerships between teaching and academic staff.

Before the school staff were appointed, academic staff from the Faculties of Education and Science would sit around the table imagining what was possible. That was very exciting. Then the Principal and other teachers were appointed, and the structures of the Department and school life became more apparent, and we all had to think about how we could make this work by all working together. So, we often come in with the big ideas, and the staff ground us. But none of us give in, because we all want this to be great. So, we work very hard to make everything happen (Monash University academic).

The university staff works closely with the school staff to develop curriculum, and often take a hands-on role on teaching content. The school staff see reciprocal benefits for their own professional learning and students’ disciplinary understanding in working so closely with experts across specialist fields. For the academic staff, there is often a renewed sense of interest in their field in response to the enthusiasm that is evident amongst the younger generation of learners. ‘So much of science is just getting the enjoyment and the enthusiasm across to the students. That’s the

⁵ ClickView is a software package designed to assist learning in the classroom by providing a simple and complete solution for watching digital video and other digital media within a school.

key issue' (Dean of Science). As a consequence, the discipline areas have expanded beyond what has been typically taught within schools.

Even at the best school, the VCE curriculum locks you down to biology, chemistry and physics ... By the time our students will be formally in Year 12, they will have already been studying things which are only available in universities. In some ways, we act as translators or mediators between the theory base and the students ... although the students love working with the university experts (teacher).

Learning technologies

JMSS has revisited notions of a paperless school (Hardy, Jones & Turner 2003). All students and staff have purchased portable computer tablets that are the responsibility of their owners and required for all lessons in the school.

We wanted to make sure that we were being very environmentally sustainable. We didn't want paper going everywhere. We wanted to come up with a solution for students that was portable everywhere, exciting, something that maybe they haven't used before but also could interlink with the university, and that's where the tablets have come in. The university have also been trialling them (Assistant Principal).

This policy was thought to have been a possible cost burden for some parents, and as a result they have been offered the options of an upfront payment, or a monthly payment. The tablet was chosen on the basis of its reliability and robustness, as well as its appropriateness for the level of computing (Bateman & Oakley 2009). This initiative is supported by a full-time e-learning technician.

A distinctive feature of the school is the use of web 2.0 technologies to host resources and facilitate online forums. It means that 'everything is online and it's accessible. We're using Google Apps (applications), even bulletins, course content, interactions, emails, blogs, and Google Videos. Now some subjects are using video pre and post to extend students' (Assistant Principal). The technician programs the web 2.0 spaces to enable different levels of access for individuals. Staff have secure Google Docs to upload planning and other administrative documents. In the same way, students also have secure spaces to work. Both staff and students invite others to look at various pieces of work or feedback on work. There are also shared, public spaces, for people to work virtually and collaboratively. Similar to a more structured learning management system, there are a variety of folders and spaces associated with different units of work, faculties and house structures. The use of information communications technologies (ICTs) in this way has left a more visible trace, or documentation of student learning, and therefore of increased pedagogical value.



Figure 10. JMSS students on tablets



Figure 11. JMSS Google Apps

With the online collaboration things that are created are not discarded, they do always have the ability to go back. And we mark their essays, even though they hand write them, the rubrics are all electronic so they can have their rubric emailed to them and save it or upload it onto their personal learning page (teacher).

Nature and quality of the learning

In addition to the use of the flexible physical and virtual spaces and the ways in which learning is structured and enacted through the Learner's Developmental Framework, other mechanisms such as timetables, curriculum practices and individualised learning plans also influence the quality and nature of learning.

Structuring the daily pattern of learning

Every day except Wednesday begins with a fifteen-minute tutorial group meeting. On occasion, the Head of House will draw all of the tutor groups together into a larger space for a specific purpose. The timetable of the school operates on a four-period day, and a ten-day cycle. Each period is 75 minutes in duration to provide opportunities for 'deep learning' (Principal).

The 75 minutes enables lots of activity. It enables you to explore concepts in depth, to take time over things. You can construct different activities and then evaluate and debrief. And so you see all sorts of different ways that the teachers use that time (Principal).

Teaching staff and students monitor lesson start and finishing times as there are no bells or announcements throughout the school day. The timetable is coordinated in a way that particular discipline-based classes operate at the same time. This avails all students of shared resources and guest speakers and enables teaching teams to work in creative ways with students. Sometimes, these blocks will involve extended research in large groups, whereas at other times, having all discipline teachers available within a particular year level enables smaller group rotations to take place. On Wednesday, students go straight to their first class, enjoy recess, have two more lessons and then, after lunch, attend 'co-curricular learning'.

In the co-curricular afternoon all of our students do something different. Probably about half of them do a Language Other Than English (LOTE). We have about 15 languages running. About 40 students do these by distance education and we have a teacher who coordinates all of that. The students use either the phones or video conferencing to talk with their tutors in at the VSL (Victorian School of Languages) or Distance Education Victoria. We have tutors from the university coming in to assist our students. We cover Mandarin, Indonesian, German, Latin and Italian among others. This year we had two face-to-face French classes and one face-to-face Japanese class taken by teachers from the Victorian School of Languages. This works like a Saturday morning language school ... The rest of the students do music, drama or sport. And we have quite a vibrant concert band which practises at this time—they have participated in several school and external events. Other groups of students are involved in guitar tuition and singing. Finally we have a large group of students undertaking sport and another group of students doing drama. We hire tutors to provide instruction at these times (Principal).

Curriculum practices

Prior to enrolling, students and their families are advised of the curriculum offerings at JMSS. All of the curriculum practices reflect the domains and dimensions of the Victorian Essential Learning Standards (VCAA 2005) and VCE study designs. At the same time, many of the studies at JMSS far exceed the requirements of these frameworks, including dimensions of the International Baccalaureate around interdisciplinary learning. All students study English, Maths, Science, Physical, Personal and Social Learning, Sport and Physical Education as well as Creative Studies and Issues Studies. Where possible, inquiry and student-directed pedagogies are utilised, 'even in subjects you wouldn't have thought of trying it' (teacher).

English

The English curriculum is taught as a separate discipline, although where possible makes inter-textual references between students' other subjects. At the same time, English genres and the teaching of explicit literacy skills are taught across all studies, but there are also opportunities for acceleration into the next year level. English is taught in a dynamic and multimodal way (Cope & Kalantzis 1999). The Head of English describes herself as having a love of 'all things technology', and where possible technology infuses pedagogies and learning experiences. The use of the Google Apps and shared documents has made the 'drafting and writing process much more collaborative'. In developing the curriculum at JMSS, the teachers have used a backward design model, thinking about where their 'students need to be, and where they start from' (teacher). The curriculum is often planned through big concepts, such as identity and change.

In some respects, and in some schools, vision can be a little limited by the ways that science learners and humanities learners are separated in schools. Spending so much time in open spaces where you are so much part of everyone else's lessons has helped us to see many more possibilities for crossovers (Head of English).

Science

It is within the Science curricula that there are the strongest partnerships between the school and external partners. The Year 10 Science curriculum is broken into Core Science studies and Enrichment Science studies. Core Science studies includes Science in Action (Science in the real world), Physics & Chemistry (the enabling Sciences), Themes in Biology and Investigative Projects (student inquiries). Each of the core science studies lasts one term. Students choose semester-long studies from the Enrichment Sciences. As part of accelerated studies, students are able to enrol in higher levels of VCE Biology and Physics, but a number of other Enrichment Sciences are unique to JMSS, including Nanotechnology, Marine Biology, Astronomy (from Quarks to Quasars), Geoscience (from Ice to Fire) and Biomedical Sciences. In planning for future cohorts, further university enrichment subjects are being investigated.

We don't want to teach Science in the traditional ways. We've got to grab these students in year 10 and take them on a journey and teach them that science is not all about silos called Physics, Chemistry and Biology, it's not the way real scientists work or construct knowledge. And that's why we're doing a lot of work with the real scientists at Monash and the Education Faculty so that we can start to break down those barriers (Head of Science).

The design of the Science curriculum attempts to develop 'big picture understandings of science in the world' (teacher). This year, across the core science studies, as well as covering fundamental concepts in the traditional science disciplines, the teaching staff have attempted to develop skills and knowledge in students integrating core ideas in topics such as light, across the major science disciplines.

It is often easier to think about Biology, Chemistry and Physics through the different natural occurrences in the world, so it makes sense to students to link these ideas together under a core theme. This has been a different way of conceptualising learning for our learners, and has been challenging for teachers also (Head of Science).

Maths

There is an expectation that all students will study Mathematics up to Year 12, the final year of formal schooling. In Victoria, there is a range of Maths subjects taught. JMSS offers a range of permutations and combinations incorporating studies in Maths Methods at Years 10 or 11, and Maths Methods at Years 11 or 12, with options also of Advanced General Maths in order to prepare for Specialist Maths in Years 11 or 12 and opportunities for enrichment Maths studies. As opposed to developing maths directly from textbook exercises, the staff try to make maths learning inquiry-based, and 'more than just regurgitating a formula' (teacher). When staff began teaching maths with an open-ended inquiry approach, there was some resistance from students and their families because it looked and felt different to their previous experiences.

We started with a unit that was purely exploratory which really threw them right out because a lot of these students just love to do their text book work. That's all they've really done before and now we had them drawing pictures of billiard ball paths on billiard tables and trying to find patterns and make predictions, a very different sort of mathematical thinking—we need to do more of it. The parents were wondering what we were teaching them and wondering where the maths was. And you've just got to ride that wave. And hold your ground and keep explaining to the students why this is good—it helps to develop their ability to think (Head of Maths).

This 'holding your ground' and explaining why 'working differently' is significant has been important in this area, and there has clearly been a rethinking from the students' point of view. In one observed maths lesson, students were keenly engaged in discussions and theory work around transformations of lines and quadratic functions. Two teachers working together around the room engaged with students as they attempted to solve quadratic equations. While one teacher explained one method of solving the equation, the other teacher presented an alternative method. As more challenging equations were posed for students to solve, one of the teachers then presented yet a third way of solving the equations. The students, as well as being able to apply a theory or formula, were also able to distinguish between the alternative approaches and identify when the use of each would be most appropriate. With the passion and mathematical knowledge of these teachers, what 'would usually take a whole week to cover, now only takes a session or a couple of sessions at most' (teacher).

Creative Studies

Two subjects at JMSS are 'unlike any other units in any other secondary school'. The first of these units is Creative Studies, which explores the nexus of problem solving, creativity, technology and nature. This collaboration with academics aimed to generate showcase units of study which 'would demonstrate the potential of very powerful curriculum choices' (Monash University academic). During the first semester, students completed a number of short self-contained projects that allowed them to explore how the notions of computing and information processing are highly relevant to all of these areas and how they can allow us to investigate nature from a different point of view. The year began with a study of Virtual Worlds, computer simulations of natural phenomena. The students built computer simulations and visualisations to perform open-ended explorations of complex natural phenomena, such as bushfires and bacteria colonies, and learned how a computer can be used as an instrument of scientific enquiry.

In experiments with the true slime mould, *Physarum Polycephalum*, the students studied the idea of Natural Computing or computing in natural systems. They explored how this simple amoeboid organism can solve surprisingly complex problems to optimise its survival chances. They discovered that computing is not limited to technological artefacts, but is an integral part of nature. The final module of the first semester introduced Acting Machines, robots that can physically interact with their environment. In a variety of projects, the students tackled enjoyable and challenging constructions, from sumo wrestling robots to robots that perform search-and-rescue missions.

The major focus of the second semester was Algorithmic Thinking. Students were introduced to the idea of algorithmic problem solving and constructed a computer program to beat a human player at Tic-Tac-Toe. Through this project, the students explored what it means to solve a complex problem systematically by means of computation and how a (comparatively simple) program can appear to behave intelligently. This naturally led to lively class discussions exploring the ideas of what computers can and cannot do. On the background of computational theory, these discussions examined questions such as 'What does it mean to be intelligent and creative?', 'Can computers be intelligent?', 'Does mathematics require creativity or is it just computation?', 'Can everything be computed?' and 'How does human thinking relate to computation?'

Though the second semester was certainly challenging, it helped a significant number of students to reach a level of understanding of computation and programming that is normally only expected at introductory university entry level (Monash University academic).

Issues Studies

The second curriculum area unique to JMSS is Issues Studies, developed in collaboration with Monash University Humanities Faculty, an integrated studies unit which invites student inquiries about 'issues of world significance'. Learning in this area typically highlights knowledge and skills within the humanities domain of learning.

Issues Studies teaches students to examine issues through a range of lenses—scientific, social, ethical, political, philosophical, historic, economic and through notions of place. It is complementary to all of the learning that happens here. We are quite committed to developing ethical scientists as well as knowledgeable ones (Principal).

This year's studies have focused on Climate Change and Sustainability, during which students considered the social effects such as demographic distributions, and the ethical dimensions of this world-wide problem. They have also looked at human actions through time that could have contributed to current thinking in this area. In the same way, thinking about sustainability has challenged students to think about key events that have generated change in the world, such as the Industrial and Scientific Revolutions.

This thinking is very important for these students. Often they have come from schools where they have learned the science or the maths or 'the whatever' very thoroughly, but a subject like this helps students to ask the big questions about why things happen, or why things should happen. It's like a deeply philosophical study which helps them to also think more critically about the value of scientific and other knowledge themselves (Monash University academic).

As a result of their collaborative studies of a specific issue, students are encouraged to pursue an in-depth and extended independent study. Through these studies, students identify the complexity of issues around them, and in turn recognise the complexity of applying solutions. This notion of deeply reflective learners who are able to make connections within their learning is also valued within the cultivation and negotiation of individualised learning approaches.

Individualised learning approaches

A central feature of the school is the individual learning plan (ILP) which facilitates students' negotiation of their pathway through the range of curriculum offerings. The ILP is negotiated between the House Tutor, the Head of House and the student at enrolment, drawing on prior experiences, in order to plan their curriculum and manage their wellbeing. School online databases enable teachers to access students' performance data, including attendance and academic achievement, to which staff add online feedback and collected artefacts of student learning.

We are learning to work with the amount of data we generate here. We already have a great deal before the students start, but given the way we work, we are continually amassing more and more. And, we are developing a very big picture of each student, so that we can counsel them in how to work more effectively, like whether they should try to get a bit more balance between study and leisure (teacher).

Teachers get to know their students and are therefore able to advise them on their next stage of studies. During orientation, students record their personal short and long term learning goals using Google Docs and then plot the ways they can achieve their goals. They share the document or give permission for someone to read what they have said. After specific feedback, the plan can be implemented.

We attempt to individualise the program for every student. They will always have the chance to adapt their plan as things change, but it is important to meet regularly to ensure that we are all working towards the same outcome. That is to give our students the very best chance of being the best person each of them can be (teacher).

Impact and effectiveness of the ILE

This school is moving into a new built environment, creating new relationships and partnerships, and seeking to develop a culture of inquiry and collaboration amongst its teachers and students. Issues of sustainability of innovation will arise as cohorts of students enrolled in their first year at JMSS (Year 10), move into Years 11 and 12.

At this point, through the Staff Code of Professional Practice and the Learner's Developmental Framework, there is a clear, yet negotiated vision of the school which permeates every aspect of planning for teaching and learning. The 4 Pillars have been a useful mechanism for organising thinking about the work of, and inter-relationships between, the staff and students within this school.

The physical learning spaces have created new opportunities for collaboration between students and staff, staff and staff, and students and students, although some redesign or re-configuration for different purposes is often required. Teacher practices have been challenged, with serious attempts not to default to 'talk and chalk' approaches. Reflection on the professional learning has been ongoing as teachers are 'being immersed and living within the open spaces'. Higher levels of staff and student visibility encourage teachers to listen to what and how peers are teaching, and enhance teacher availability to students in ways that make students and teachers more accountable.

Open common spaces have enabled students to interact both formally and informally, promoting engagement with each other, their studies, and a sense of belonging as indicated in their 'keenness to be here well beyond the end of the day'. Preliminary student survey data indicates that students are extremely satisfied with their school environment, and the programs they are being offered at this school. Furthermore, there is overwhelming evidence of commitment to individual successes. Only two students have withdrawn their enrolment, primarily to pursue curriculum options not available at JMSS. Prior to their departure, the students were provided with considerable counselling, ensuring that they understood the magnitude of the transition. Staff have shared their concerns about those at risk emotionally, or their concern that individual families were facing financial hardship, and looked for viable resolutions. Teachers are involved in the negotiation of individualised learning approaches.

Staff interaction, collaboration and support are evident among all staff members, arising out of their shared enthusiasm and sense of mutual trust. A number of teachers felt more autonomous and professional due to the leadership team encouraging risk taking. This produced feelings of safety and confidence in their capacities as professionals to make bold choices and take chances. The staff worked interdependently in purposeful ways to provide provocative and engaging curriculum opportunities for students.

The Monash University environment is rich for students who are passionate about science and maths. The location of the school in the vicinity of the STRIP provides students with access to real-life science applications that are considered cutting-edge internationally. There have been some challenges experienced by JMSS: a lack of change-rooms for sport and physical education and performing arts spaces, especially for music, as well as a lack of storage space. The challenges of limited access to the library and other facilities have meant that the school now has to develop a library.

Concluding comments

The ILE at JMSS has, in a short time, made tremendous gains in innovating in predominantly traditional discipline areas across a whole school. As demonstrated through its more interdisciplinary approaches to the core sciences, the school offers students opportunities to extend their learning and to undertake sustained inquiries. Similarly, access to expertise beyond the school environment, through the university partnership and resources on the STRIP, provides students with authentic contexts in which knowledge can be generated and applied. The innovative uses of technology and flexible learning spaces have generated rich and interactive learning for students and enhanced effective team-teaching, student and teacher learning and action-based inquiry. Through the use of tablets and Google Docs, the school has revisited notions of the paperless school, and integrates a range of technologies throughout its curriculum. The flexible spaces serve both pastoral groupings and pedagogies as well as enable those personal relationships so critical to teaching and learning.

As a greenfield site, issues of sustainability are premature, although the coherent policy statements, structure and student and staff recruitment strategies would indicate that the school is on a sound base that will be consolidated over time through their ongoing review process. As a senior school, JMSS provides an exemplar that could be replicated with effective partnerships between University and DEECD negotiated and resourced. This requires significant investment of time and money by the university and the government, as well as commitment and expertise within the school.

Glossary

Backward Design Model: When designing curriculum based on Backward Design a teacher team begins with the end in mind, considering those skills, knowledge and understandings that students are to learn by the end of the unit. Planning works backward beginning with defining a clear goal (referred to as a 'big idea') and a range of essential questions. Focus throughout is on student understanding of the big ideas, which is accomplished through the essential questions, activities and continuous feedback.

DEECD: The Department of Education and Early Childhood Development, Victoria, Australia.

STRIP: The Science Technology Research and Innovation Precinct is a Monash University facility where university and corporate enterprises develop leading-edge technologies and research capacities.

Tic-tac-toe: also known as Noughts and Crosses in the UK, Australia and New Zealand, is a pencil-and-paper game for two players, 'X' and 'O', who take turns marking the spaces in a 3×3 grid. The player who succeeds in placing three respective marks in a horizontal, vertical, or diagonal row wins the game.

VCAA: the Victorian Curriculum and Assessment Authority. The Victorian government system has 1555 schools over a geographic region equivalent to the UK. Currently, school curriculum and assessment is undertaken through the State authority, the VCAA. The VCAA offers curriculum for Prep to Year 12 for all schools based on the Victorian Essential Learning Standards (VELS) for P-10 and three certificates for post-compulsory Years 10-12.

VCE: The *Victorian Certificate of Education* is the exit certificate at Year 12 that can comprise of individual or block of units from VCAL and VET as well as the full range of academic subjects to gain the score necessary to enter university.

VELS: The Victorian Essential Learning Standards outlines what is essential for all Victorian students to learn during their time at school from Prep to Year 10. They provide a set of common state-wide standards which schools use to plan student learning programs, assess student progress and report to parents. VELs is based on best practice in Victorian schools and draws on national and international research about how students learn. The VELs differ from traditional curricula by including knowledge and skills in the areas of physical, social and personal learning, thinking and communication to encourage flexible and creative approaches to learning.

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