Microsoft Surface

Moving Classrooms to Third Space Learning

What happens when a Surface is put into a teacher's hands? An investigation into mobile-intensive pedagogies in schools

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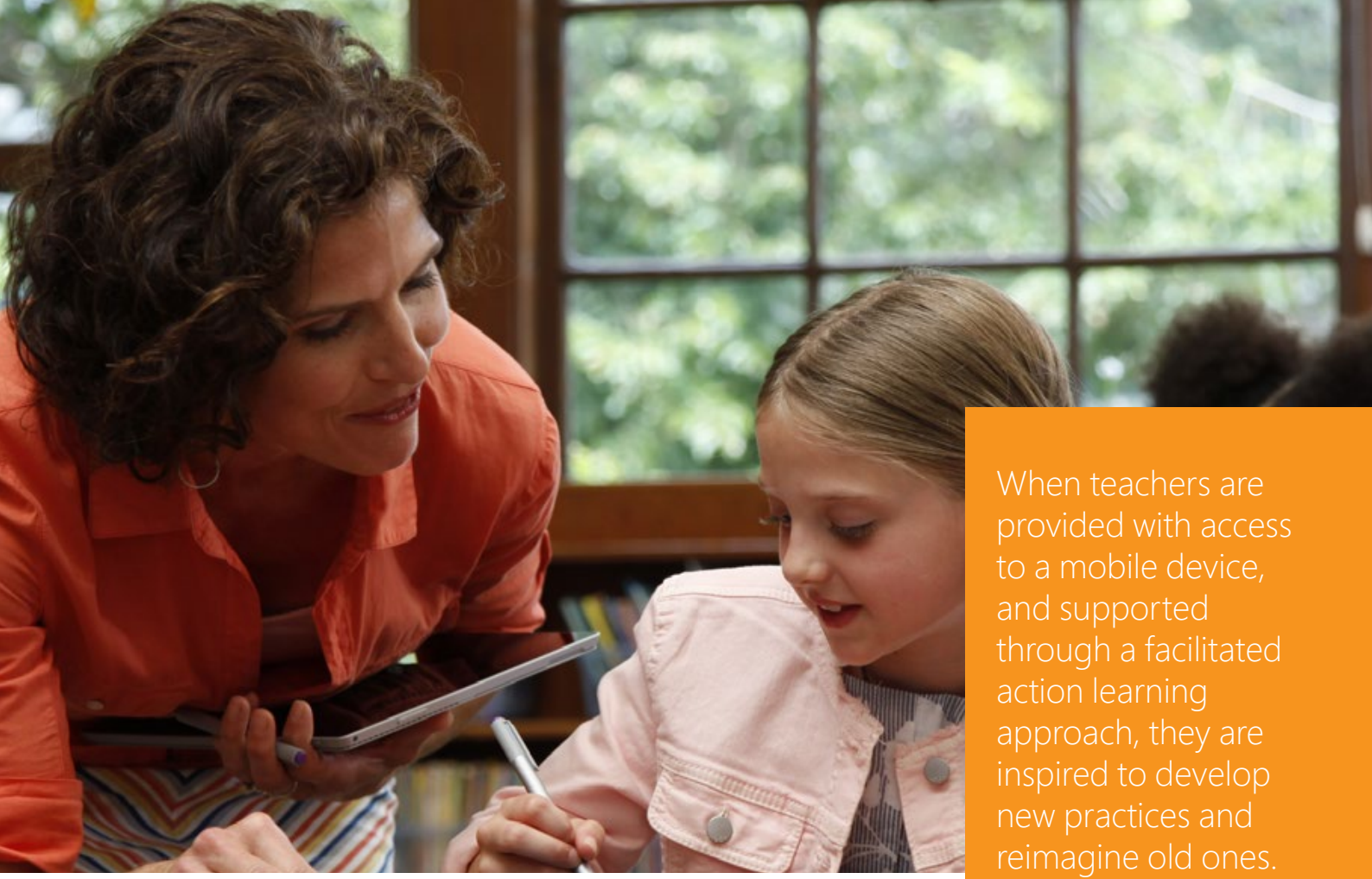

When teachers are provided with access to a mobile device, and supported through a facilitated action learning approach, they are inspired to develop new practices and reimagine old ones.

What happens when teachers use mobile technology in their classrooms?

A pilot, facilitated by the University of Technology (UTS) Sydney and Microsoft, sought to investigate two questions:

1) How do mobile-intensive pedagogies contribute to the quality of teaching and learning?
2) How do teacher practices and understandings develop when mobile-intensive pedagogies are used to promote effective teaching and quality learning?

We provided ten teachers in two Sydney schools with a 2-in-1 device and asked them to develop mobile-intensive pedagogies in science and maths. We supported them with two professional development sessions and a series of facilitated action learning sessions.

The project revealed that when teachers are provided with access to a mobile device, and supported through a facilitated action learning approach, they are inspired to develop new practices and reimagine old ones.

Key findings of the study

Roles change

When pedagogy becomes mobile-intensive student and teacher roles change.

The third space is unleashed

During lessons, teachers embraced what we call the 'third space' – that is, being able to teach anywhere, anytime and seamlessly transition from one place to another, untethered from the classroom.

Learning happens everywhere

Students worked in corridors and playgrounds and were not restricted to classroom spaces.

Action Learning helps

The Action Learning Model provided accountability, support and structure for the teachers developing mobile-intensive pedagogies.

Device capabilities matter

The device contributed to the development of mobile-intensive pedagogies. Its 2-in-1 form, inking capabilities and the use of Miracast increased mobility and opportunities for learning in STEM subjects.

Partnerships are important

The university and industry partnerships were found to be extremely valuable in providing support, stimulus for change, expert advice and devices. They also facilitated the action learning process, and off-campus professional development.

A framework scaffolds learning

The Mobile Pedagogical Framework (Kearney, et al., 2012) was used by many teachers to both scaffold the teaching and learning in terms of collaboration, personalisation and authenticity, and support reflection on teaching experiences in STEM.

Recommendations for future practice and research

The Surface was very suited to teaching subjects like maths and science, which use a lot of formulae and diagrams, so teachers were eager to expand and scale the project. It would be worthwhile exploring its use in these two subject areas more deeply.

Both UTS and Microsoft played an important part in encouraging mobile-intensive pedagogies and stimulating a process of trialling, investigating and reflecting about teaching and learning with mobile devices. We recommend research and development of a scalable model of mobile-intensive pedagogy, in partnership between schools, UTS and Microsoft. Research could explore how best to make mobile learning in schools sustainable through increased access to devices and cloud solutions.

Other recommendations are:

- Reduce existing barriers such as connectivity and resourcing.
- Use conceptual devices like the third space and Mobile Pedagogical Framework to support practice and design learning experiences that contribute to school reform.
- Provide expert advice on pedagogical affordances and technical assistance on site and as needed.
- Further investigate the value of the Action Learning Model to provide accountability, collaboration and support for sustainable change.
- Explore student experiences and learning outcomes more deeply in a mobile learning environment.

Contents

Acknowledgements

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- The staff and students of the participating schools.

Learning can take place at home, in a library or on a train, and then neatly transition into the classroom.

What is mobile-intensive pedagogy?

A modern approach to learning

This project focuses on mobile-intensive pedagogy in maths and science. Learning is primarily facilitated through mobile devices that act as resources and tools, and influence approaches to learning. They can be a tablet, smartphone, laptop or 2-in-1 device, such as Microsoft Surface, that functions as both a tablet and laptop. The ability to learn anywhere, anytime, and at any pace, is encouraged by using such devices. They also help learning take on a form that is quite different to learning with other technologies.

Learning is primarily facilitated through mobile devices that act as resources and tools, and influence approaches to learning.

Some pedagogies are more suitable for mobile learning than others (Kearney, Schuck, Burden & Aubusson, 2012). The most suitable ones exploit the unique characteristics of mobile devices, enabling 'untethered' learning (Traxler, 2009).

The third space: taking learning beyond the classroom walls

Schuck, Kearney and Burden (2016, in press) use the metaphor of the 'third space' for discussing mobile learning. The term has been used in a variety of contexts, including first and second language users (Gutiérrez, 2008), theory and practice in schools (Zeichner, 2010) and other contexts where there is a need to look at the space acting as a bridge between two constructs.

When we talk about the third space in mobile learning, we use it as a way to describe the new learning possibilities offered by untethered, mobile learning. Zeichner argues that the third space is where we discard binaries (Zeichner, 2010) and instead look for bridges between spaces that encourage seamless learning. So instead of only talking about formal or informal learning for example, the third space calls for seamless movement between the two. In this way, learning can be completely transformed. Using mobile devices, learning can take place at home, in a library or on a train, and then neatly transition into the classroom – or vice versa.

Why is STEM important?

The ability to analyse data, create new products and bring a critical numerate understanding to tasks are all underpinned by strong STEM literacy.

Science and maths are two subjects that come under the umbrella term STEM (science, technology, engineering and maths). Education in these subjects is considered essential for the production of critical and creative thinkers. In fact, strong and ongoing societal engagement with STEM is needed to produce a society which is competitive, economically strong and creative (Office of the Chief Scientist, 2014).

Many OECD countries, including Australia, are currently failing to support learning in STEM subjects effectively.

According to a recent report by Australia's Chief Scientist, (Office of the Chief Scientist, 2014), student performance in science and maths is 'now lower than important international peers' (p.21). There is also a shortage of suitably qualified teachers in science, maths and information and communication technologies (ICT).

Many STEM researchers believe that subjects can be taught more effectively in technology-rich classrooms (Capraro & Han, 2014). However, for it to be a success teachers need support integrating new technologies into their classrooms. And while we know primary school education in STEM subjects is influential in enhancing students' understanding of, and engagement in, STEM subjects in secondary and tertiary education (Nadelson, et al., 2013), many primary school teachers have a lack of confidence teaching STEM. Add to this the fact that many secondary school teachers of STEM subjects are out-of-area teachers, due to the current shortage of suitably qualified teachers (Office of the Chief Scientist, 2014), and it's clear we need to do much more to support effective STEM learning in Australian schools.

The mobile pedagogical framework

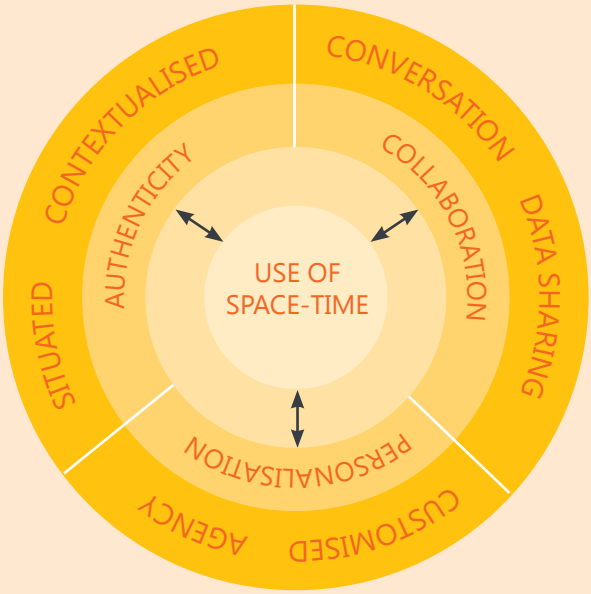
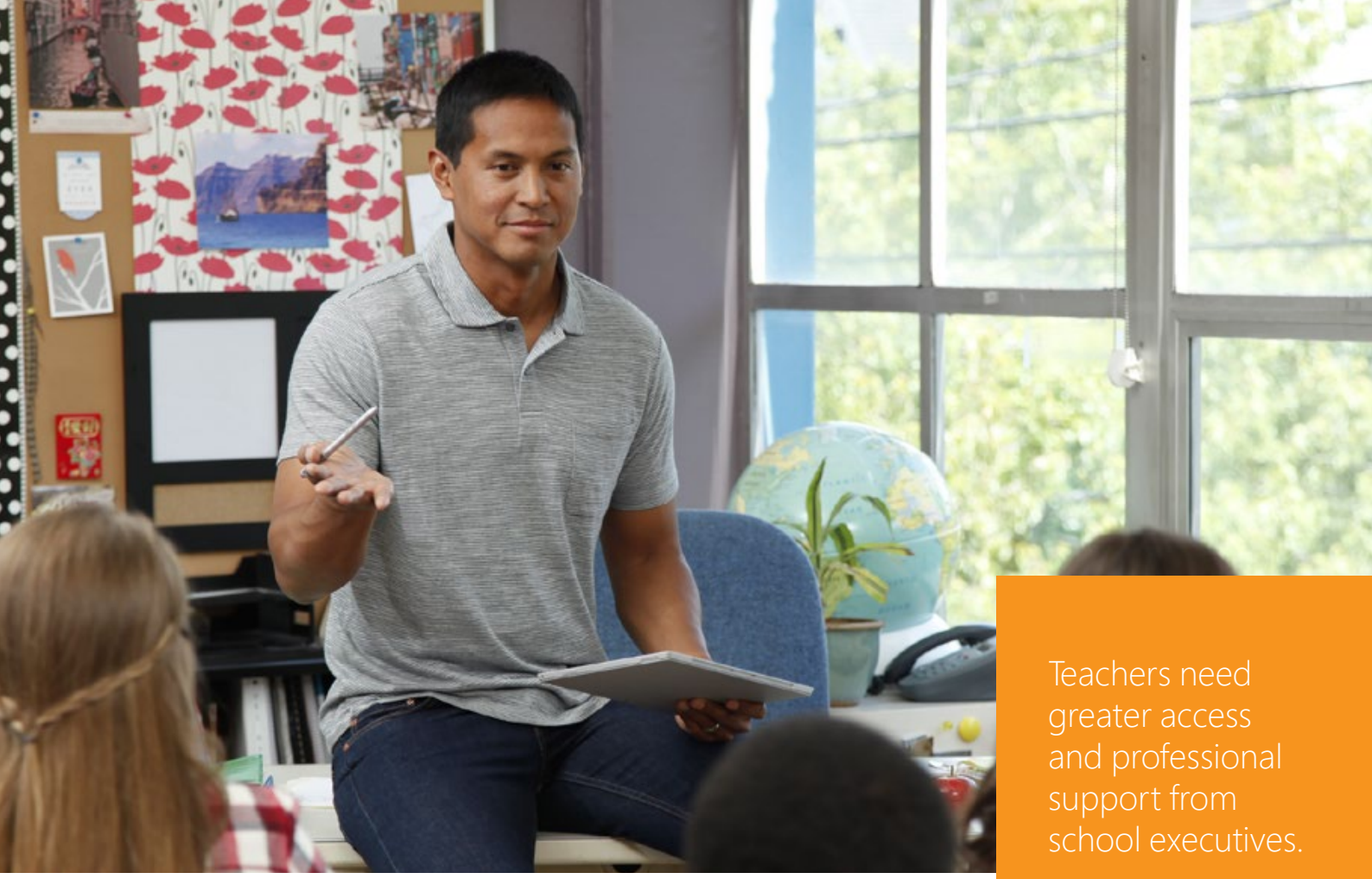


Figure 1. Mobile Pedagogical Framework by Kearney et al. (2012)

Kearney et al. (2012) developed the Mobile Pedagogical Framework (Figure 1) to encapsulate the nature of mobile learning from a socio-cultural perspective. It identifies three key dimensions.

- **1. Personalisation:** The student chooses the task, desired outcomes and approach to completing the task. Customisation enables the student to choose when and where learning takes place.
- **2. Authenticity:** High levels of contextualised learning are seen when the learner works in a way that is relevant to them. Situated learning is also high when the learner is part of a community of practice.
- **3. Collaboration:** High levels of conversation and the sharing of data, such as screenshots, images and video, promote collaboration on the task.

This framework helped teachers develop and refine their approach to mobile learning practices to improve outcomes. It also provided them with a checklist for developing new approaches and tasks. This framework is likely to become even more valuable as schools continue to adopt a 'bring your own device' policy – where students are encouraged to bring personal mobile devices to school to support their learning.



Teachers need greater access and professional support from school executives.

What's important for technology integration to occur?

Teachers have to be completely on board for technology to be successfully integrated into the classroom.

Blackwell et al. (2014) found that teachers' attitudes have the strongest effect in supporting integration of learning technologies into practice. It's also imperative they get the support and technical training relevant to their level of competency. As early as 1999, Ertmer identified two types of barriers to the integration of technology by teachers.

The first type focuses on external factors such as:

- Access
- School support
- Training

The second type of barrier depends on the individual teacher and their:

- Attitude
- Beliefs
- Pedagogical approach
- Technical proficiency

Both types of barriers still exist today. To overcome the first order barriers and ensure learning technologies are used in pedagogically sound ways, teachers need greater access and professional support from school executives. To address the second order, teachers need to believe pedagogical goals can be achieved by adopting technology-enhanced learning practices. We made sure to address these barriers in our pilot to give teachers the best chance of success when integrating mobile devices into their classrooms.

The (facilitator's) role is not to instruct or teach, but to act as a guide through the cycles of plan-act-reflect.

Supporting mobile pedagogies with action learning

Action learning as a tool for teacher professional development has been growing in popularity with well-documented evidence of its benefits in supporting sustainable and contextualised change (Aubusson, Brady, & Dinham, 2005; Aubusson, Ewing, & Hoban, 2009; McDonagh, Roche, Sullivan, & Glenn, 2012; McNiff & Whitehead, 2005; Perry, 2012).

Action learning involves participants working in teams, referred to as 'sets'. These sets explore a key issue within their practice and move through cycles of planning, acting and reflecting with an ultimate goal of sustainable change. The formation of community (Aubusson, Ewing & Hoban, 2009) that builds through the action learning process supports the situated and individualised nature of teacher practice, while also respecting the broader collaborative requirements of a school context.

The role of the facilitator, as seen within this project, connects with traditions of community-based action research (Stringer, 1999) as well as action learning theory (McGill & Brockband, 2004). In both cases, the facilitator is viewed as a resource or consultant to help participants define problems clearly and work to solutions. The role is not to instruct or teach, but to act as a guide through the cycles of plan-act-reflect.

The study

We developed a small scale study to answer two questions around the use of mobile devices in classrooms:

1) How do mobile-intensive pedagogies contribute to the quality of teaching and learning?

2) How do teacher practices and understandings develop when mobile-intensive pedagogies are used to promote effective teaching and quality learning?

To answer these questions, we put devices into the hands of teachers and students, focusing on the subject areas of science and maths. As Microsoft was partnering with us on this pilot, we equipped participants with a Surface Pro device. One primary school and one secondary school, both from the north shore of Sydney, New South Wales, participated in the project. Participating teachers came to the project with varied backgrounds and experience, but with a common belief in the need for mobile-intensive pedagogies in classrooms.

The primary school

- Approximately 750 students and 25 classroom teachers.
- Five teachers were included in the project: three teaching year three, one teaching kindergarten and one teaching year six.
- Two deputy principals participated, one also being an English as a Second Language support teacher.

The secondary school

- Approximately 1600 students and 77 classroom teachers.
- Four teachers were included in the project: three from the maths faculty and one history teacher who is also on the school leadership team.

The scope

Starting in the middle of term one, 2015, the project ran for just under two terms, finishing at the beginning of the third term the same year. UTS coordinated the project and two members of the research team ran the action learning sessions.

Facilitating action learning

We held regular meetings at each of the schools throughout the project to facilitate the action learning process, and on three occasions the two groups met together. For two of the joint meetings, we ran professional development sessions at Microsoft's head office in North Ryde. Facilitated by an educator and expert in Microsoft educational technologies, the sessions guided the teachers through the use of the Surface device and its various educational applications.

Enabling collaboration

In addition to face-to-face meetings, teachers could collaborate and share ideas using the online platform OneNote. They could also post links and personal reflections regarding the implementation of the devices into their practice.

The process

To get the project underway, a UTS professor led a workshop at each institution outlining key features of action learning, guidelines for participation and a broader outline of what the process involves. A series of UTS-facilitated team meetings then took place in each school, highlighting context-specific issues that recognised and responded to the individual needs and journeys of the participating teachers.

Both schools followed a similar action learning process, but the pilot saw individual nuances emerge at each school. School leadership in the primary school drove the broader context in which the team members could plan to implement mobile-intensive pedagogies. In the secondary school, teachers had greater control over what they hoped to achieve.

At the mid-way point, the two school teams came together to share their experiences of using Surface in primary and secondary school contexts.

Expert input from Microsoft was provided twice during the project. Taking the teachers out of the workplace for these sessions gave them an opportunity to focus on their technology integration and skill development. As with the team meetings, the second of these external sessions was tailored in response to self-identified needs of the teachers for supporting their future work. To bound the journey for teachers, a sharing with colleagues, or 'making the knowledge public' (Altrichter, Posch, & Somekh, 1993), feature was implemented in early term three.

Investigating Mobile-Intensive Pedagogies in Schools

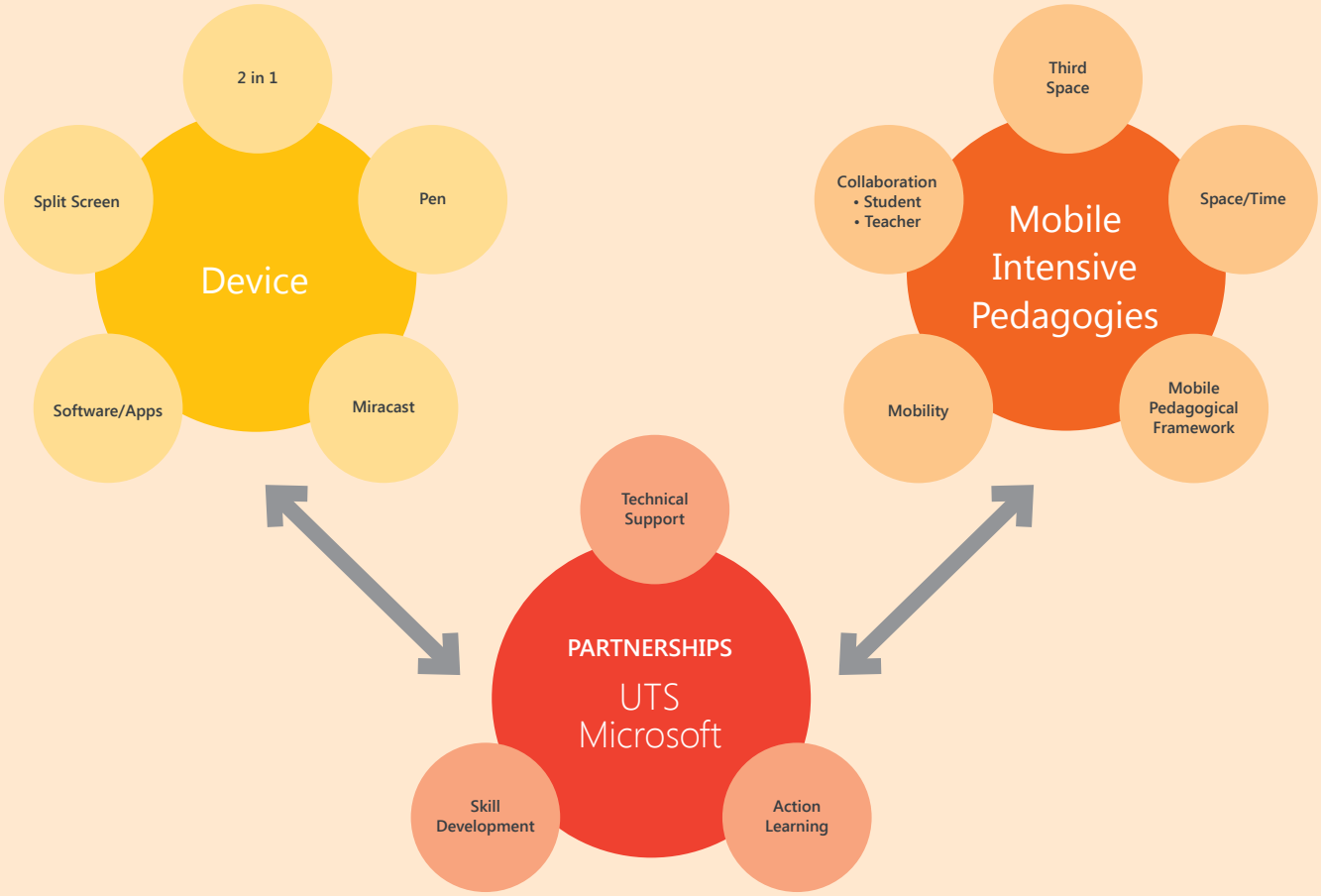


Figure 2. Investigating mobile-intensive pedagogies in schools: key elements

The technology

Microsoft Surface

Microsoft Surface is a 2-in-1 device designed to function as both a laptop and a tablet. It has full functionality of traditional desktop applications such as Microsoft Office, but has the added feature of letting users take advanced notes and annotate with the Surface Pen – addressing a wide variety of classroom needs.

Office 365

Microsoft Office 365 for Education empowers teachers with a suite of services, on the web and through the Office applications such as OneNote and Excel, to enable real-time collaboration, document sharing, note-taking, file management and storage. OneNote is particularly useful in education allowing users to take notes by hand, collate multiple different types of resources and collaborate across a whole class on the web and on any mobile device.

"A critical mass of teachers have now become more actively engaged with mobile devices."

Primary Leader: Interview

Did Surface change the game?

Teacher feedback suggests project participation reawakened or reinforced existing beliefs, as well as expanding their concept of the 'classroom'. They speak highly of the benefits of real-time access to data and the way in which changed understanding is shifting their teaching practice. They also made connections to existing broader pedagogical approaches with one teacher stating, "My thinking has just been reawakened because I did a lot of enquiry-based learning overseas." (Stage 2 Teacher: Interview)

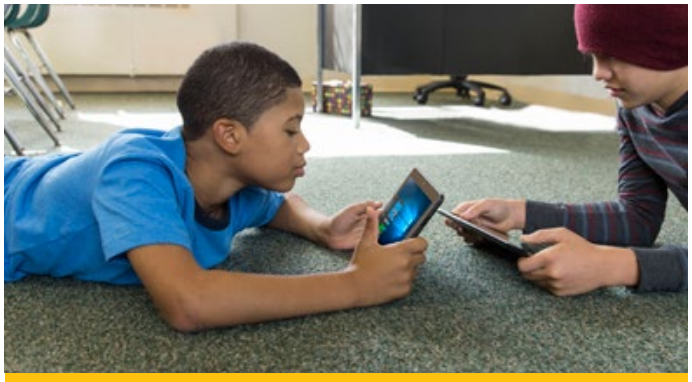
"It helps me help students better. There's just nothing else to be said and that's why it's good."

Secondary Teacher: Interview

Mobile devices were recognised by one of the school leaders as supporting pedagogical change in classrooms more effectively than the use of more static technology such as interactive whiteboards.

The Surface device helped increase the adoption of mobile-intensive pedagogies, and significantly increased students' use of the internet. Teachers recognised that this helped build student skills through the ability to easily research information, participate in flipped learning experiences and see what is happening locally and in other areas of the world. They also recognised that students enjoyed "recording their own findings using technology rather than writing it down on a piece of paper – and having the ability to modify it later." (Stage 2 Teacher: Interview)

Teachers also identified administrative benefits through the 2-in-1 capabilities of Surface, which they used for discrete note taking in meetings, recording student work through images or video, collaboratively developing exam papers and annotating for record keeping.



Mobile-Intensive Pedagogies

"I've always liked mobile pedagogy and encourage students to work anywhere. No student owns a desk in my classroom, they constantly move around and work with different people. For example, at the moment I've left them up there with an open-ended task and they're all running round. Year three students really like that sort of thing – being able to lie on the floor, work outside or move to a quiet area if they want to."

Stage 2 Teacher: Interview

How helpful was the framework?

"I really like the model with the authenticity, personalisation and collaboration sections. I think it would be really nice to use as a tool for reflection."

Primary School Leader: Interview

The Mobile Pedagogical Framework (MPF) developed by Kearney et al (2012) was shared with participating teachers to support teaching and reflect on the new classroom experience. The three key elements to the framework are:

- Personalisation
- Authenticity
- Collaboration

Personalisation

Teachers were able to see the effectiveness of using mobile devices for personalising learning at both primary and secondary levels.

As stated by one teacher, the use of mobile devices was seen as allowing "students to be more individualised, take advantage of those individualised pathways and for us as teachers to assist the students along those pathways. So kids are actually learning what they need to learn, when they need to learn it." (Secondary Teacher: Interview)

Authenticity

Almost all teachers could see that mobile devices were effective in supporting real time engagement and expanding the four walls of the classroom. What's more, they could see that the ability for students and teachers to connect meaningfully with other schools positively enhanced the learning experience.

The Surface device encouraged teachers to let students be directors of their own and each other's learning. The inking capabilities support advanced level annotation and further encourage teachers to think creatively about classroom engagement.

As one secondary school maths teacher said, "We should be giving kids the technology to be able to solve real world problems without getting bogged down in the fact that they can't necessarily do the basic maths to do that. Maths as a set of skills is what we tend to spend an awful lot of time teaching and then every now and then we will apply it to something. But we don't apply it to anything that's real world, because often the numbers and the base content behind that is actually quite hard. In reality we should be looking at the problem itself and then how to use a tool to come up with a mathematical solution to that problem." (Secondary Teacher: Interview)

Student Collaboration

Of the three MPF components (Kearney et al, 2012), collaboration for students was the most commonly discussed element. Collaboration was viewed in a variety of ways, from students filming and giving feedback to each other, to file management and cloud-based collaboration skill development. Mobile devices provide for collaborative forms of learning (Burden & Maher, 2014), and teachers commented on the ease with which the device facilitated these activities. Teachers viewed students largely as the drivers of collaborative digital engagement at both the primary and secondary level recognising that students "want to have that shared decision making about a resource they're developing and they want to get good marks... So I think the students are going to push that." (Secondary Leader: Interview)

Teachers saw a significant increase in student collaboration, with one teacher confirming mobile devices as "the children's 'go to' form of recording their information." (Stage 2 Teacher: Interview) Students were seen creating collaboratively on the devices as well as accessing documents and working on them together outside of school hours for homework. Teachers noted that the change in skill level for these students was significant.

The impact of enhanced collaboration for both teachers and students was articulated clearly by one stage 2 primary teacher: "using mobile devices has enabled greater collaboration and increased the creativity of students and teachers. With mobile devices they can plan/design, collaborate, make, present and reflect – not only on their learning but also on the process. What worked... what didn't.... what skills were developed... how else could we... who do I work well with... what type of learner am I? And so forth." (Stage 2 Teacher: Reflection)

Authenticity

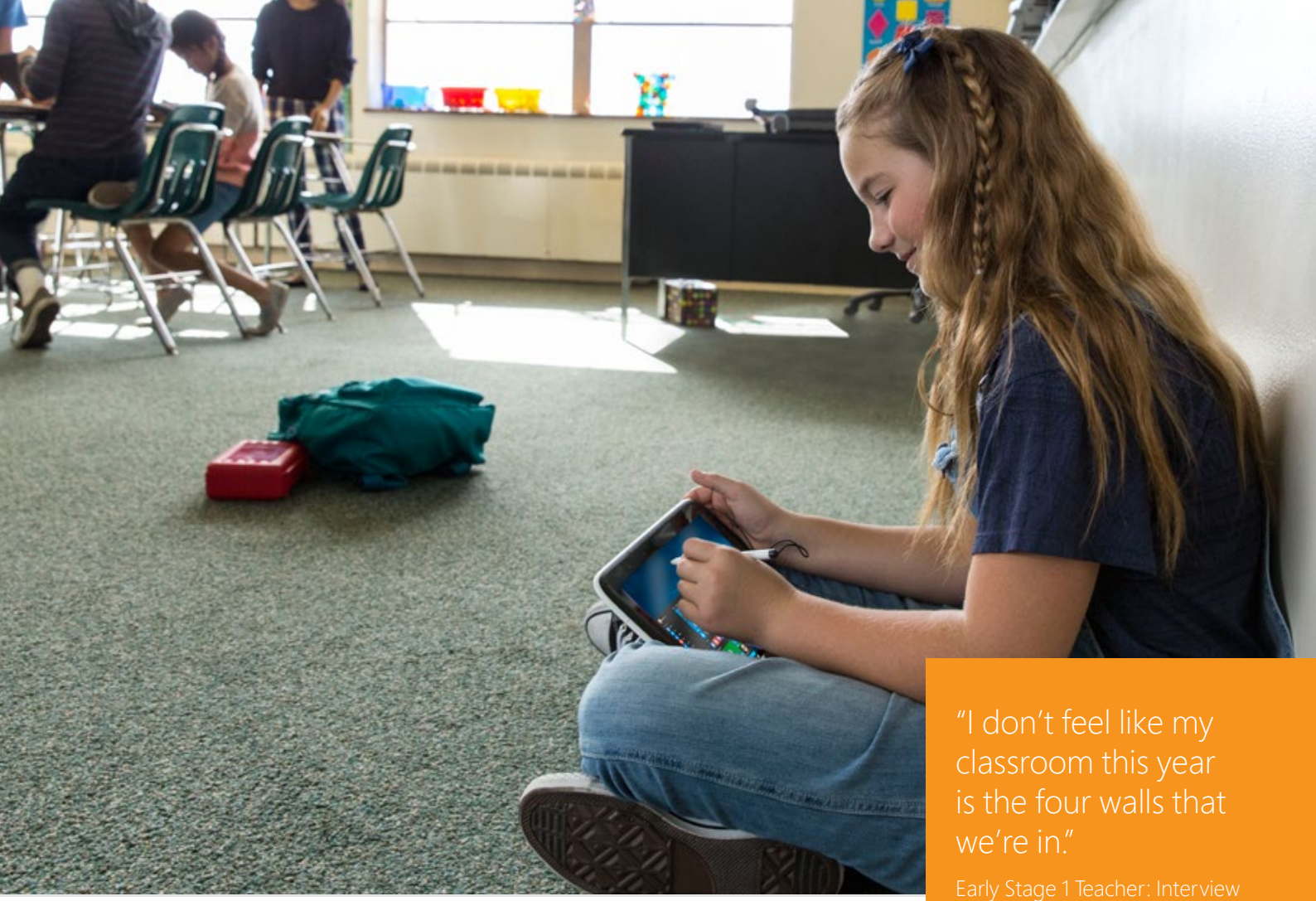
"I set up the class Twitter account and we shared [weather photographs] on a Twitter account. Showing them the audience was real and that we could interact with other schools in other places around the world gave the students a real motivation, but it also gave them more language I think. If you asked them to write what they were talking about on a piece of paper? There's no way we could have done what we did using Twitter, the Blog, photos that we were taking and that sort of thing because they don't have the writing or reading skills in term one."

Early Stage 1 Teacher: Interview

Student Collaboration

"I gave my students a homework challenge to make up a cool order of operations – telling them the best one I would share on the Facebook group. I hadn't been in there for a couple of days and didn't realise that they'd been posting their order of operations and were all answering each other's questions and giving each other challenges. That shows me that they're starting to see that space as an opportunity for them to engage with each other, share their own knowledge and challenge one another. Creating that environment within your classroom has got to be an offshoot of enabling that flexibility through mobile devices with those kids."

Secondary Teacher: Interview



"I don't feel like my classroom this year is the four walls that we're in."

Early Stage 1 Teacher: Interview

Making the most of the third space

A sense of the possibilities offered through enhanced mobility for both primary and secondary classrooms was increasingly evident to teachers across the project. All commented on the freedom of movement around the classroom enabled by the device, for themselves and students. This will ultimately assist them in reimagining their pedagogical approach to teaching.

A sense of movement in learning across physical and virtual spaces, as well as time, was witnessed through flipped classroom approaches and online collaboration tools. Teachers encouraged students to "start a homework task in class time and then continue the work at home – so it's more like a seamless relationship between home and school." (Stage 2 Teacher: Interview)

The way teachers positioned themselves in the learning space was also reimagined. Teachers became more mobile in their engagement with students, shifting their perceptions of their role and ability to interact in the classroom. As one secondary teacher stated, "Because I can go and sit next to a student, I've really noticed that while I'm still the driver of the learning, I'm actually more of a passenger than ever before in terms of the discussion that has taken place. It's helped conversations become more free-flowing which is good." (Secondary Teacher: Interview)

Benefits of partnering with external institutions

Professional learning for schools is usually provided in two key ways: internally managed and facilitated learning, or through externally provided courses. There are significant benefits to internally run professional learning exercises, including the ability to adapt the course to suit the individual nuances of classrooms, teacher experiences and student diversity.

Despite this, the ability to push for significant or disruptive change can be limited. Microsoft and the University of Technology Sydney harmoniously provided external expertise and school-based support, underpinned by a facilitated action learning approach, to help drive this disruptive project.

Microsoft

Getting expert help on the functionality and educational applications of the mobile device was extremely beneficial to teachers. As one teacher stated in regard to the first full-day session at Microsoft: "...The timing was really good because we were all thinking, "Well, how do we actually use this device they've given us? Before that I didn't even know how to download apps." (Stage 2 Teacher: Interview)

Working with the same expert across both external training days allowed for a rapport to develop, and the provision of space in the second day for personalised support was recognised as significant and beneficial.

Teachers also appreciate the ability to engage with colleagues and peers outside the school context. They were inspired by each other and felt armed by a sense of authority provided by participation in the project, to share information with non-participating colleagues.

University of Technology Sydney

An action learning approach encourages participants to embrace any feelings of discomfort or disruption, and the University of Technology Sydney academics supported and nurtured the school teams throughout this process. Leaders in both schools recognised the importance of outside influences in creating disruption and stimulating change, with one leader stating, "An outside authority helps leverage this kind of work and action learning is something I've been working with for a long time. It helps teachers engage and focus, and to have that outside support is fantastic." (Primary Leader: Interview)

The power of teacher collaboration

An increase in collaboration between teachers was evident through the data, in addition to the enhanced student collaboration previously reported. Teachers were particularly grateful for structured time to reflect with peers as a way to improve practice. As one teacher stated, "Sometimes you don't get enough chance to reflect… it's so nice having someone else in the room to talk through your process and identify areas for improvement." (Stage 3 Teacher: Interview)

Others saw the time and opportunity to reflect as a way to create meaning, step out of silos and remove themselves from the bustling classroom environment to "consider what you've already achieved, what you need to do to moving forward and what you can work on collaboratively with colleagues." (Secondary Teacher: Interview)

Action Learning

You're accountable because you know you're going to meet every so often, and it's top of mind because you're seeing it in action all around you. That's what's good about action learning.

(Primary School Leader: Interview)

The planned meeting times, provided through the facilitated action research process, were considered extremely beneficial as a way to brainstorm ideas, reinforce positive changes and progress, and allow for future planning. The regular sessions also gave participants a sense of accountability. The opportunity to collaborate across a primary and secondary school was also considered a benefit of the project by participants. It was recognised as a way for them to share innovative ideas from different perspectives as well as providing an opportunity to learn more about the challenges and successes of mobile device integration in each schooling context.

A number of teachers commented on the levels of enthusiasm the regular meetings helped build, as well as the benefit of keeping people on track with the project. They also helped showcase the ease and effectiveness of the implementation, and encourage less confident teachers to get involved. Some teachers recognised that change for them personally was only small, however they appreciated the regular reinforcement and reminders to keep trying small things along the way.

In all cases, we found ways to overcome these barriers and use them as facilitators for creative practice and pedagogical change.

Overcoming barriers and embracing drivers

Internet connectivity

Internet connectivity was the key first order barrier faced by teachers at both schools. The lack of control by teachers and school leaders to ensure regular and consistent connections frustrated the participants and, at times, impacted student engagement. During such times, we saw teachers using their creativity to maintain student interest to try to ensure learning experiences were not compromised where possible. The connectivity issues are a result of a broader set of systemic challenges faced by the teachers and schools in Australia that are beyond the scope of this report.

Resources, access and maintenance

The number of, and access to, mobile devices was reported as an issue in both primary and secondary contexts. Charging, replacing lost or broken devices, associated costs and effective booking systems were all identified as barriers. While not a concern for all staff, issues of students with disabilities was also raised as impacting on the choice of devices to be used in a classroom. The cost of mobile technologies was a significant barrier in realising teachers' mobile-learning plans. As with issues of connectivity, teachers once again stepped up in exploring creative ways of ensuring all staff had equitable and adequate opportunities to use devices when they were required.

Attitudes

With significant barriers such as resources, access, and intermittent connectivity, it follows that a number of staff outside the project mentioned these barriers as a reason for not implementing change in their classrooms. The negative attitudes of some staff external to the project expressing differences of ideas and opinions was identified as a significant barrier for two teachers in the project.

The broader project context and authority provided through participation assisted in countering this barrier to some degree.

Skills

Skill level was a barrier for both teachers and students across the project. A number of teachers were concerned about the time required to build student skills in areas such as file management, application-specific knowledge, connecting external devices and simply logging in. As with the majority of barriers identified through the project, the teachers persisted, went back to basics and saw significant improvement. In some classes, particularly in older years, students were able to support each other through this learning curve as well. Teachers reported increased technical skills and greater personal confidence in problem solving and trouble-shooting through participation in the project.

"Students get that it's a learning curve and teachers don't necessarily need to be 100% proficient with the technology."

Stage 2 Teacher: Interview

Time

Time is one of the most significant barriers facing teachers in all aspects of their practice. Participating teachers wanted to take the time to learn more about the device and its capabilities but were often caught up with other commitments like school reports, curriculum and planning needs and leadership responsibilities. School leaders in both schools acted as facilitators to mitigate this barrier, where possible, by releasing teachers from classes and/or playground duties.

A number of other minor barriers in this first category were also identified including:

- Management of other agenda in the school context.
- Working with outdated or incompatible software.
- Working alone in their stage level.
- Needing specific technical capabilities.

The existence of these barriers did impact the popularity of this project. "Teachers don't have enough time to have Plan B, Plan C and Plan D up their sleeves every time they walk into a classroom, but at the moment that's what they're having to do. It has been very disruptive for our projects this year. Having said that, I'm still overwhelmed by the success and engagement that teachers and kids have had in this." (Primary Leader: Interview)

Second order barriers

As all of the teachers in this project volunteered to take part, the number of second order barriers was quite low. Where second order barriers did exist, it was more to do with trying to convince other teachers of the value of the project. Resistance to change was a fairly common theme, but fortunately the authority of the project helped to mitigate this negativity – as did teacher persistence and attitude.

Importantly, school leaders saw the need for teachers to recognise that they were on the same technology learning journey as their students, and that perfection was not the aim. Personal limitations were to be expected and expressed in order to be managed effectively. For instance, one teacher recognised that the regular team meetings were essential for his practice as they prompted him to continue pushing his pedagogical change.

Suitability of the Surface device – Overview

The teachers valued the unique features of Surface Pro. They commented on the overall simplicity in relation to connectivity, the interactivity and ease of annotation, and enjoyed the benefits of the split screen.

Pen	✔ Inking capabilities and advanced quality were useful for precision and accuracy. ✔ Good freehand annotation capabilities. ✔ Useful to link and support note taking through OneNote. ✔ A significant strength for secondary maths. ✔ The ability to highlight key passages and annotate past HSC papers, slides or whatever to enhance student understanding.
Split screen	✔ Allows students to support each other in understanding and recording answers to problems. ✔ Provides an electronic record for future reference. ✔ Being able to make notes on the screen from across the class was a significant change for participating teachers.
2-in-1 functionality	✔ Saw the benefits of the full laptop functionality for ease of connection with servers and the benefit of having full versions of word processing software and internet browsers. ✔ The ease of mobility through the detachable keyboard was viewed as a significant benefit.
Apps and software	✔ Teachers saw the benefit of Office 365, especially OneDrive for Business, for filing their own work and for student collaboration. ✔ Teachers particularly liked the ability to create flipped learning artefacts with Office Mix. ✔ Teachers appreciated being able to use apps regularly, such as Kids Story Builder and Random Student. ✔ One school gradually adopted Office 365 tools to generate collaborative class markbooks. ✔ OneNote was also being explored by a number of teachers, especially at secondary level, for future classes and collaborative exam writing.
Miracast	✔ Untethered, real time connection between Surface and a screen in the classroom inspired teachers to push boundaries. ✔ Teachers could share their work more easily and immediately, and support each other with responses from wherever they were located. ✔ Taking the teacher away from the front of the classroom has changed the way teachers perceive the use of 'space', decentralising the role of the teacher and encouraging a rethink in classroom layout.

"It's better than the standalone tablet, it's better than the stand alone computer. It's probably the ideal device for the classroom."

Stage 2 Teacher: Interview

Suitability of the Surface device in detail

The primary school teachers were concerned that the size, weight and expense of the device would make it less useful for younger students. Similarly the complexity of the platform on the device was regarded as a barrier for students with disabilities.

In particular, the teachers applauded particular features of the device such as the pen, the 2-in-1 functionality, the use of specific applications and software and the pedagogical implications of screen sharing through Miracast.

Pen

The inking capabilities and advanced quality of the pen was identified as a significant strength of the device for use in education, particularly for secondary maths. Teachers commented on the precision and accuracy of the pen and its freehand annotation capabilities. The ability for the pen to link and support note taking through OneNote was identified, although a number of teachers commented on their wish to do more with that connection in the future.

For one secondary maths teacher, the "annotation and the ability to be able to write on anything is a huge advantage for us. The ability to highlight key passages and annotate past HSC papers, slides or whatever to try and enhance student understanding has probably been the biggest benefit of it." (Secondary Teacher: Interview)

Split screen

Teachers recognised the ability to change their pedagogical approach through using the split screen, allowing students to become more active in supporting each other in understanding and recording answers to problems as well as providing an electronic record for future reference. The ability to do this kind of annotation while untethered was a significant change for participating teachers.

2-in-1 functionality

As the project progressed, teachers began to explore the 2-in-1 functionality of the device. They saw the benefits of the full laptop functionality for ease of connection with servers and the benefit of having full versions of word processing software and internet browsers. As opposed to alternative devices that required external keyboards and a mouse, the ease of mobility through the detachable keyboard was also viewed as a significant benefit.

Teachers reported different preferences in regard to tablet or laptop mode, but irrespective of preference recognised the possibilities through the 2-in-1 functionality.

Maths in Action

"I'm really excited about the way in which, in terms of teaching and understanding maths, the use of the mobile technologies is making students work more collaboratively to get away from the whole idea of "let's just do a formulaic lesson in maths where the teacher teaches the example and you go off and do the exercise". It's a different way of structuring your maths lesson where students are using their own work samples as teaching aids for other students. I think that's really exciting."

Secondary Teacher: Interview

Apps and software

The need for effective online collaboration and cloud file management systems were identified by teachers as crucial for ensuring the integration of effective mobile-intensive pedagogies in their classrooms. Teachers saw the possibilities of Office 365, especially OneDrive for Business for filing their own work and for student collaboration.

"I am a big supporter of that kind of file management software, a space where kids can collaborate online, and extending it for homework."

Stage 3 Teacher: Interview

Teachers particularly liked the Office Mix capabilities, but were faced with incompatible versions of software in their schools which limited its pedagogical integration in this project. Teachers commented on the usefulness of being able to use apps regularly, such as Kids Story Builder and Random Student that they had been introduced to during their Microsoft training days, and credited Surface as the reason they could regularly implement these with students.

The project has resulted in change at a teacher planning level, with one school gradually adopting Office 365 tools to generate collaborative class markbooks. OneNote was also being explored by a number of teachers, especially at secondary level, for future classes and collaborative exam writing.

Miracast

"You can't do it without Miracast. If you actually have to plug yourself in then you're still tethered to the front and the whole point is lost."

Secondary Teacher: Interview

The opportunity to explore untethered, real time connection between Surface and a screen in the classroom opened up opportunities for pedagogical change and inspired teachers to push boundaries in their practice.

The real time projection capability saw teachers reimagining the role of students. They could share their work more easily and immediately, and support each other with responses from wherever they were located.

As previously discussed, taking the teacher away from the front of the classroom has also resulted in a change in the way that teachers perceived the use of 'space', decentralising the role of the teacher and encouraging them to explore changes in the way that furniture was arranged and used in their learning environments.

It is clear from the teacher feedback that more access to devices is needed, as well as increased and relevant professional development for teachers.

Looking to the future

Overwhelmingly teachers were excited and enthused by the project. It invigorated them and reinforced their desire to teach using mobile devices. In the interviews, they discussed their eagerness to continue working using mobile-intensive pedagogies and identified a wish list that would support their future practice.

One area that teachers were particularly interested in was the use of the third space. They are keen to develop their ideas of changing classroom furniture, wanting to emulate the activity-based workplaces seen on the professional development days at Microsoft's offices. They saw the value of teaching and learning anywhere and anytime and were eager to pursue this.

As a result of the project they identified a number of pedagogical changes that were necessary: "My ideas definitely shifted towards working with a device in small groups or pairs. If I'd had four devices and could've worked in small groups, I think I would have easily doubled or tripled the amount of times that I would have been able to use it with the kids." (Stage 2 Teacher: Interview)

Significant outcomes of the project

- The transformation to mobile-intensive pedagogy, leading to changes in student and teacher roles.
- An increase in teachers using the third space for their lessons – being able to teach anywhere, anytime and seamlessly transition from one place to another, untethered from the classroom.
- A shift away from physical learning spaces – students working in corridors and playgrounds, rather than confined to classroom spaces.
- Strengthened university and industry partnerships that were extremely valuable in providing support, stimulus for change, expert advice, devices and the facilitation of the action learning process, as well as off-campus professional development.
- The development of mobile-intensive pedagogies thanks to Surface and its 2-in-1 capabilities, pen and the use of Miracast to allow increased mobility and functioning in STEM subjects.
- The increased use of the Mobile Pedagogical Framework by many teachers to scaffold teaching and learning in terms of collaboration, personalisation and authenticity – and to support reflection on teaching experiences in STEM.
- The increased accountability, support and structure as a result of the action learning model was found to be useful for the teachers developing mobile intensive pedagogies.

Science in Action

"We were trying to make sure kids developed a deeper knowledge rather than simply repeating what the teacher had set up at the front. So we devoted quite a lot of time to research and classroom set-up, as well as giving them more time to delve deeper into the investigation. We set up tables and gave them small groups in the corridor. It was very mobile."

Stage 2 Teacher: Interview

Recommendations for future practice and research

- Further research to develop a scalable model of mobile-intensive pedagogy, in partnership between schools, university and industry partners.
- Exploration of ways to make mobile learning sustainable in schools through increased access to mobile devices such as Surface.
- Investigation into the nature of learning in the third space to help teachers design learning experiences.
- Focused research around student experiences and learning outcomes in a mobile learning intervention.
- Implementing similar projects in other subject areas to understand the nuances of subject-specific applications.
- Reduction of first order barriers such as connectivity and resourcing.
- Use of the Mobile Pedagogical Framework to scaffold practices in school reform more widely.
- Use of the action learning model to provide accountability, collaboration and support for sustainable change.
- Build strong partnerships between schools, universities and industry.
- More visibility of the specific features of the device that enhance learning in specific areas, such as the inking feature and 2-in-1 functionality.
- Provision of expert support on pedagogical affordances and technical assistance on site and as needed.

"A lot of my faculty have said they really want to upskill themselves in technological skills to better engage students. I want our teachers to teach differently. I'm not sure how that will work, but certainly trying to use technology as a vehicle to enhance and change the practices we use. Realistically, a maths classroom, albeit with an interactive whiteboard or something like that, isn't really that different to what it was 50 or 100 years ago."

Secondary Teacher: Interview

References

Altrichter, H., Posch, P., & Somekh, B. (1993). Teachers investigate their work: an introduction to the methods of action research. London: Routledge.

Aubusson, P., Brady, L., & Dinham, S. (2005). Action Learning: What Works? New South Wales: New South Wales Department of Education and Training.

Aubusson, P., Ewing, R., & Hoban, G.F. (2009). Action Learning in Schools: Reframing teachers' professional learning and development. Oxon: Routledge.

Blackwell, C.K., Lauricella, A.R., & Wartella, E. (2014). Factors influencing digital technology use in early childhood education. Computers & Education, 77, 82¤90. doi: 10.1016/j.compedu.2014.04.013

Burden, K. & Maher, D. (2015). Mobile technologies and authentic learning in the primary school classroom. In S. Younie, M. Leask and K. Burden (Eds), Teaching and Learning with ICT in the Primary School (2nd ed). Oxon, UK: Routledge.

Capraro, R. M., & Han, S. (2014). STEM: The education frontier to meet 21st century challenges. Middle Grades Research Journal, 9(3), xv-xvii.

Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: Strategies for technology integration. Educational Technology Research and Development, 47(4), 47-61. doi: 10.1007/BF02299597

Ertmer, P.A., Ottenbreit-Leftwich, A.T., Sadik, O., Sendurur, E., & Sendurur, P. (2012). Teacher beliefs and technology integration practices: A critical relationship. Computers & Education 59(2), 423-435. doi:10.1016/j.compedu.2012.02.001

Gutiérrez, K. D. (2008). Developing a sociocritical literacy in the third space. Reading Research Quarterly, 43(2), 148-164.

Kearney, M., Schuck, S., Burden, P., & Aubusson, P. (2012). Viewing mobile learning from a pedagogical perspective. Journal for Research in Learning Technology, 20(3), 1-17.

McDonagh, C., Roche, M., Sullivan, B., & Glenn, M. (2012). Enhancing practice through classroom research: A teacher's guide to professional development. New York: Routledge.

McGill, I., & Brockband, A. (2004). The action learning handbook. New York: Routledge Farmer.

McNiff, J., & Whitehead, J. (2005). Action research for teachers: A practical guide. London: David Fulton Publishers Ltd.

Nadelson, L. S., Callahan, J., Pyke, P., Hay, A., Dance, M., & Pfiester, J. (2013). Teacher STEM perception and preparation: Inquiry-based STEM professional development for elementary teachers. Journal Of Educational Research, 106(2), 157-168. doi:10.1080/00220671.2012.667014

Office of the Chief Scientist (2014). Science, Technology, Engineering and Maths: Australia's Future. Australian Government, Canberra.

Perry, R. (2012). Facilitated action research: enhancing the teaching of classroom drama. ALARj 18 (1), 5-34.

Revans, R. (1982). The origins and growth of action learning. Kent: Chartwell-Bratt.

Schuck, S., Kearney, M., & Burden, K. (2016, in press). Exploring mobile learning in the Third Space.

Stringer, E. T. (1999). Action research (2nd ed.). California: Sage Publications Inc.

Traxler, J. (2009). Learning in a mobile age. International Journal of Mobile and Blended Learning, 1(1), 1-12

Zeichner, K. (2010). Rethinking the connections between campus courses and field experiences in college-and university-based teacher education. Journal of Teacher Education, 61(1-2), 89-99.

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