



“Over the last decade, our studies and those of others have repeatedly shown that when students solved Science and Maths problems, performance improved significantly when they used a stylus interface rather than a keyboard.”

Sharon Oviatt, *The Design of Future Educational Interfaces*, 2013, page 4

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Executive Summary

Inking Your Thinking was an in-depth study of how Microsoft's 2-in-1 Surface device could be used in schools to make dynamic learning possible. Through three classroom case studies, it explored how Surface and the Surface Pen can promote new learning for students and the use of innovative pedagogies by teachers. The complete findings are detailed in the 2014 Inking Your Thinking report and summarised here.

The study highlighted how naturally students use the Surface multimodal touchscreen, keyboard and pen to develop 21st century skills. Surface Pen, in particular, expanded their learning choices by enabling them to annotate images, maps and graphs and to write symbols, take notes and draw straight onto their devices.

Teachers found that Surface devices opened a wider range of learning experiences, incorporating visual, oral, kinaesthetic and aural approaches. Students thrived on the opportunity to use them to learn independently, express their ideas and present and reflect on their learning.

Research design

The study was conducted in three Victorian government schools in 2014, in partnership with the Victorian

Department of Education and Training (DET), Victoria University and Microsoft. It focused on the following questions:

1. How can Surface devices be integrated into K-12 school settings to maximise learning?
2. How does a 2-in-1 device with a stylus impact on learning scenarios in educational contexts?
3. Do teachers and students think that 2-in-1 devices impact on the quality of learning, and the ways they represent their learning?

These questions were explored through case studies conducted in three Victorian schools in four different year levels (Kindergarten, 4-year-olds; Year 2, 7-year-olds; Years 7/8, 13-14-year-olds).

Each case study involved students developing 21st century skills of creativity, critical thinking, collaboration and communication as they engaged in new learning across different school subjects. Each case study consisted of learning scenarios that exemplify curriculum foci and the 21st century skills of creativity, critical thinking, collaboration and communication in the context of new learning and becoming global citizens. The data was collected on observation days spent in classrooms and in discussion with school personnel.

Background

This report is informed by recent research on using a stylus for interacting with digital content. Professor Gordon Sanson, Director of e-Education Unit at Monash University, claims that a stylus allows thinkers to integrate 'high fidelity' artefacts with the fluency of 'low fidelity' notations (2009, Keynote presentation ATiEC). This process is said to improve thinking and idea synthesis.

Sharon Oviatt (2011) proposes that using a stylus can promote thinking and adaptive learning more than using a keyboard by providing 'a single focused input tool for expressing all representations (e.g. symbols, diagrams, numbers, language and shifting among them) while working on a task' (p3). She contends that pen and multimodal interfaces support human-computer interactions more effectively than graphical interfaces and can stimulate 'high levels of communicative activity, which is compatible with engagement in exploratory learning and constructivist views of learning' (p3).

If learning is about belonging and engagement (Yelland, 2007), 2-in-1 devices like Surface have the potential to be very powerful because they can help provide these multimodal learning experiences.

Key research findings

- Surface Pen was a key point of difference and appeared significant in expanding students' learning choices, enabling them to create more thoughtful work
- Using Surface and the integrating of specific apps, services and programs allowed students to learn independently, express their ideas and thinking, reflect on their learning, make learning visible and present their understandings (Hattie, 2009)
- Students adapted quickly to using Surface, were actively engaged in their learning and valued the device
- Teachers used Surface as a resource to plan and introduce learning activities. They focused on knowledge acquisition activities that were both creative and skill building
- Using OneNote enabled teachers to annotate and collate artefacts that captured evidence of students' learning
- The versatility of Surface supported new learning experiences for students across year levels
- Students demonstrated responsible behaviour using Surface both within and beyond the classroom
- Early years literacy skills were enhanced by maximising the multimodal nature of Surface. Students wrote, drew and discussed their learning (Sheppard, 2011)
- The built-in camera and microphone enabled students to take photographs and make videos to explain their ideas, clarify their thinking and extend their vocabulary
- By producing eBooks, students created content and enhanced a range of skills including writing, spelling, reflection, audience awareness, collaboration and creativity

Dallas Brooks Community Primary School

Kindergarten (4 years of age)

A Microsoft Showcase School, Dallas Brooks is in the northern suburbs of Melbourne, with 470 students from Preparatory to Year 6, and 150 preschool students. The school community represents a diverse range of socio-economic, cultural, religious and language backgrounds. Two kindergarten classes consisting of 60 children participated using seven Surface devices.

Students revealed high levels of engagement with ideas, skills and knowledge while using the devices in a play-based curriculum. Teachers said they also used Surface to support questioning and reflections when they were discussing a topic in group time.

"I was watching the kids and it was so interchangeable! They were using their fingers for the big sweeping motions that they needed and then picking up the stylus for the intricate aspects of what they were doing. So they were just interchanging. The seamless interchange between finger and stylus, finger, stylus."

Teacher B



How Surface helped students develop 21st century skills

Creativity	Critical thinking	Collaboration and communication
<p>Students enjoyed taking photos on the device and using Surface Pen and their fingers for creating artwork.</p> <p>Multimodality was used in portrait drawing. Children observed their faces in a mirror and then drew themselves in pencil and in Tux Paint.</p> <p>Using Kids Story Builder, students created digital stories by choosing photos, adding text and audio. They were autonomous in deciding what they recorded, while creating a permanent record that could be shared with parents.</p>	<p>The most popular apps were Animals Memory 2 and School Writing, which students used to practise drawing numerals and letters. The 'smart screen' with palm rejection let them practise their pencil grip with the stylus while resting their hand on the screen.</p> <p>Using the camera helped introduce early Mathematical language, such as positional and relations terms. Areas on the photo could be highlighted with Surface Pen and explained.</p> <p>This class documented seed planting in an eBook to align with the Science curriculum.</p>	<p>Communicating ideas and the shared reading of eBooks were the most popular use of Surface devices.</p> <p>The teacher was also able to show and share the children's work with their parents.</p> <p>The seven devices helped develop social skills like sharing, collaborating and taking turns.</p> <p>Collaborative eBooks and taking photographs are sample activities that required children to collaborate with each other with specific desired learning outcomes.</p>

Horsham West Primary School

Year 2 (7 years of age)

Located in regional Victoria, Horsham West caters to 585 students with purpose-built classrooms for Years 2 and 3 and has participated in the Australian Microsoft Partners in Learning Innovative Schools program. Three Year 2 classes took part in the study, with five Surface devices in each classroom used in small group rotations and collaboration.

The devices afforded opportunities to extend student proficiency in literacy and numeracy skills in applied contexts and supported an investigative approach to learning. The learning experiences incorporated visual, oral, kinaesthetic and aural approaches that went beyond pen and paper and students thrived on these challenges. Teachers said the stylus facilitated a wider range of learning activities, impacting their lesson planning.

"We've been using Explain Everything... where the kids have been able to draw on their screen and articulate their thinking verbally, by recording their voice in the program as well... we share that as a class... so that's been an interesting exercise."

Teacher C



How Surface helped students develop 21st century skills

Creativity	Critical thinking	Collaboration and communication
<p>In small groups, children created eBooks around an investigation of <i>Living Things</i> using stylus- or hand-drawn illustrations and images from the internet. The design process engaged them creatively as they negotiated what information to present.</p> <p>Students reflected on different modalities and selected the ones they thought most appropriate to tell their story.</p> <p>Surface enabled them to create texts that were both linguistic and oral and also to mix the two elements in dynamic ways that would not have been otherwise possible.</p>	<p>Students created and photographed arrays when studying the concept of multiplication, importing the images into Explain Everything and annotating them to discuss later.</p> <p>Natural disasters, in the context of 'building empathy', led to students researching Haiti and its earthquake on their devices. They created annotated maps, saving them to OneNote for group discussion.</p> <p>Students collated their family's recycling habits as graphs. Using Surface Pen, they wrote observations on them to share with the group, using numbers in a relevant context and stimulating effective class discussions.</p>	<p>All three Year 2 teachers valued the acquisition of foundational literacy and numeracy skills and encouraged an investigative approach to concepts and topics.</p> <p>Time was always made to share information and findings with the whole class and also at the lower primary assemblies.</p> <p>The children could do this via the interactive whiteboard and projector, or directly from Surface.</p>

Hawkesdale P-12 College

Years 7 and 8 (11 and 12 years of age)

Hawkesdale P-12 College is a small, rural school of 240 students. Students in Year 7 received 23 Surface devices with Year 8 students receiving another 20 devices, creating a 1-to-1 learning program. Twelve teachers also had access to Surface devices.

The devices supported 21st century skills in Mathematics, Science, Art, Chinese and the Humanities, as well as setting up inter-school Skype sessions. Surface Pen was particularly valuable for writing, drawing, undoing and redoing Mathematical or Chemical notations. Students used them to connect with ideas and other students at remote locations and set up communities of practice around themes and projects. Teachers reported higher student engagement levels when using Surface over other digital or traditional resources, aided by Surface's quick start-up time, reliability and simple design.

"Surface's pen is an advantage, especially in Mathematics. Explain Everything is a really good app for Mathematics because they can record little videos with them talking... being able to write with Surface's pen is especially good for fractions which are really hard to do on a laptop because you have to type them all in. So Mathematics is definitely more easily achieved on the touch device."

Teacher E



How Surface helped students develop 21st century skills

Creativity	Critical thinking	Collaboration and communication
<p>Surface provoked students to experiment and create art electronically and compare it with more traditional materials.</p> <p>One student was interested in Manga (Japanese comics) and spent a lot of her time drawing using Fresh Paint on her Surface, expressing appreciation for the ability to continually hone drawings.</p> <p>Most students found they could doodle and draw with the same ease as they could with traditional materials, with the added capacity to extend their ideas in the technological modality.</p>	<p>Students used Skitch and Explain Everything to annotate images with Surface Pen to explain their thinking on a concept. They discussed, annotated and shared visual stimuli in new and dynamic ways. They also articulated Mathematical and Scientific ideas and recorded thoughts to discuss later.</p> <p>In Chinese, students used Surface for written work and games. The teacher used Nearpod for assessment, and appreciated student performance statistics and integration with Office 365.</p> <p>In History and Geography, students looked up maps and data and presented findings in charts.</p>	<p>Students used Skype to speak to partner schools in Victoria and Asia. Surface was useful to clarify questions and to take notes for discussions after the sessions.</p> <p>Students paired with students in the other schools to create and share a document online. Each pair of students then wrote their thoughts regarding friendship.</p> <p>Office 365 enabled students to document, annotate and share their thinking in a tangible way. Students continued to improve the design and clarity of their collaborative documents as they progressed and some used audio to create a multimodal document.</p>



Conclusion

The data from the full study provides a wide range of empirical examples to illustrate how 2-in-1 stylus-enabled devices, specifically Surface and Surface Pen, can provide contexts for deep learning and the acquisition and use of 21st century skills in a variety of ways.

The study found that Surface promotes spontaneous learning and innovation. With its choice of keyboard, touch and digital

pen input, it opens a world of opportunities for creating, collaborating, connecting, communicating and researching. Surface Pen, in particular, greatly enhanced 21st century skill development by enabling students to discuss, annotate and share visual stimuli in new and dynamic ways.

For each year level studied, the learning scenarios illustrate how students used Surface to engage

in creative acts, critical thinking, collaboration and communicating their ideas to an audience.

These essential elements of 21st century schooling are enacted in the context of curriculum frameworks, which support knowledge creation and the exploration of existing knowledge that is interesting and useful.

Unique features of Surface that promoted new learning in this project included:

- The mobility, portability and versatility of a tablet with the power of a laptop
- The ability to flex between laptop and device usage styles on a single 2-in-1 device
- Natural note-taking using the digital, pressure-sensitive Surface Pen
- Ability to run universal apps, cloud services and programs, including Microsoft Office and the Adobe suite
- Ease of connecting to the school network enabled traditional file sharing and printing
- Enhanced functionality through the intuitive buttons on Microsoft Surface Pen
- USB ports enable interactions with peripheral hardware, extending the potential of the device
- Long battery life supports usage for extended periods of time

