

Spotlight

Evaluating the evidence for educational technology: Part 1 – the technologies

November 2023



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The key messages in this Spotlight reveal that:

- ⚡ Educational technology (edtech) has increased in popularity, use and availability since the pandemic.
- ⚡ Notable advancements in technology, for example, the development of artificial intelligence (AI) language models such as ChatGPT and Google's Bard, have occurred within the last few years.
- ⚡ Although edtech is often presented as a panacea for improving a range of teaching and learning outcomes, not all uses of edtech deliver the intended benefits.
- ⚡ Some edtech (including AI language models such as ChatGPT) is intended to better support teachers, reduce their workload and/or promote more effective school management; however, appropriate training and professional learning will better enable teachers and other education professionals to fully capitalise on these benefits.
- ⚡ A repeated pattern has become apparent in edtech

- There is hype and enthusiasm for using new technology in education
- Early adopters achieve promising outcomes in initial trials
- Widespread adoption shows mixed results
- Hype for the latest tech (step 1 repeating) means that interest shifts to the new tech.

- ⚡ The evidence base demonstrates that the quality of pedagogy has a more significant impact on student outcomes than edtech usage.
- ⚡ There is substantial evidence that, even when edtech is student-centred and well-integrated, teacher input (critical thinking, contextualising feedback, etc.) is essential for student learning. As such, edtech does not reduce the need for highly skilled, professional teachers.

Introduction

From the advent of personal computers to more recent progress in artificial intelligence (AI), the past four decades have seen repeated advancements in digital technologies. Personal computers became popular in the 1980s, the internet was made publicly available in 1991, the capabilities of mobile phones have evolved significantly since the mid-1990s, and early social media (e.g., Facebook, YouTube and Twitter) were created during the 2000s. Each new development rapidly became an integral component of daily life for many in developed countries. Digital technologies have significantly altered the ways we communicate, access information, and conduct business. The impact of these technologies on society is expected to increase substantially in coming years (Tuomi, 2018).

Future development of digital technologies, especially AI, is expected to have an ongoing impact on the skills individuals need for daily life, including participation in the workforce (Carretero Gomez et al., 2023; European Centre for the Development of Vocational Training (ECDVT), 2022). Digital literacy is becoming increasingly important in today's rapidly evolving technological landscape.

Digital literacy

Digital literacy refers to competency using digital devices and associated software (UNESCO, 2018). This encompasses:

- being able to effectively search and navigate, communicate and collaborate, and create online; as well as
- the ability to critically assess information and safeguard one's own safety and wellbeing when using a variety of digital technologies. (Department of Employment and Workplace Relations, 2020).

Digital literacy skills are vital for teachers and students alike.

A fundamental aim of education is to prepare learners to fully participate in a rapidly evolving, digital future (UNESCO, 2021). This requires that learners are not only able to use digital technologies but also that they have the critical thinking skills and knowledge needed to identify misinformation, attempted fraud or phishing ^[1](Bocconi et al., 2022). Consequently, during the last decade, many education systems have increasingly focused on developing students' digital literacy.

Recent studies from Europe indicate that insufficient skills using digital technology likely limit workplace performance (Figure 1; Centeno et al., 2022; ECDVT, 2022). An increasingly digital future is also predicted to further alter the attributes required for future employment, likely increasing the demand for skills that aren't easily replicated by AI, such as critical thinking, innovation and creativity, and communication and collaboration skills (Carretero Gomez et al., 2023). Collectively, these attributes and digital competency are often referred to as 21st century skills.

Figure 1. Statistics showing the business need to improve digital skills of the European populace.

¹ECDVT(2022). ²Centeno et al. (2022, p. 27)

52%

of workers would be able to **better perform** their current roles if they had greater digital skills¹



40%

of people aged 25-64 years old* had **below-basic** digital skills²

*as a proxy for the working age population

To help 'future-proof' labour markets, many governments have called on educational institutions to better prepare students for future employment through developing these 21st century skills (Carretero Gomez et al., 2023; OECD, 2023). In a somewhat circular argument, using digital technologies is often regarded as a key method of developing these attributes in learners (Howard & Mozejko, 2015).

"In Australia, the national curriculum has positioned the capability to use information and communication technologies as a general capability, along with literacy and numeracy."

Digital technologies used for educational purposes are frequently referred to as edtech, even if those technologies were not initially developed for educational purposes.

As such, edtech encompasses everything from classroom computers to mobile apps, augmented reality and AI-based learning platforms (Department for Education (England), 2019). Edtech has added another dimension to teaching and learning, offering the potential to enhance traditional educational methods with innovative tools and approaches. During the past two decades, advancements in edtech have enabled more personalised and interactive learning experiences. This is widely viewed as providing better support for students who face additional barriers to learning (whether due to low literacy, language barriers, disability or other characteristics).

Much edtech is intended to improve student outcomes (such as academic performance, engagement or motivation). However, the term also encompasses digital technologies intended to better support teachers and promote effective school management (see sidebar; Department for Education (England), 2019). There is a significant edtech sector in Australia that has a strong focus on schooling (Figure 2).

The main applications of edtech. Source: Australian Trade and Investment Commission, 2016

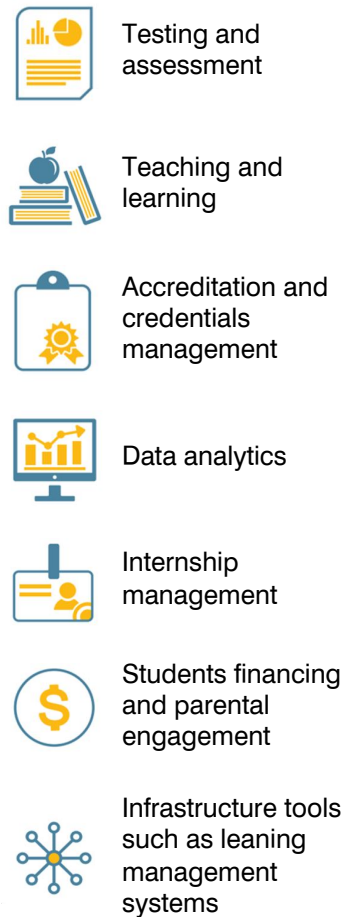


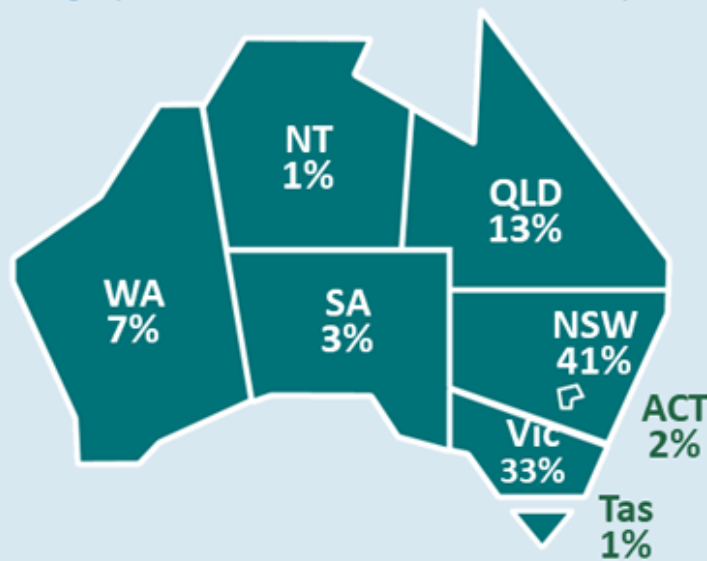
Figure 2. Edtech in Australia. Adapted from the Australian Edtech Directory (n.d).

Edtech in Australia

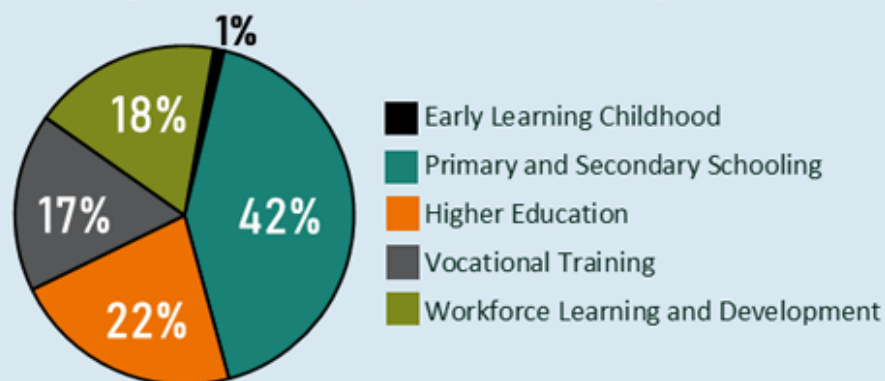
A. Key facts about the labour market and economy



B. Geographical distribution of edtech companies



C. Target audience by educational setting



Summary: (a) key facts about the labour market and economy, (b) the geographical distribution of edtech companies and (c) the target audience by educational setting (Early Learning Childhood = 1%, Primary and Secondary Schooling = 42%, Higher Education = 22%, Vocational Training = 17%, Workforce Learning and Development = 18%).

The COVID-19 pandemic highlighted the importance of edtech, having pushed schooling online in many jurisdictions. The development of edtech and related research has markedly increased since then; the now global reach of advanced AI-based models (such as ChatGPT) testifies to the speed at which edtech can evolve. Consequently, edtech is again being promoted as a catalyst for transforming education and empowering students, despite its mixed success to date (Howard & Mozejko, 2015). As such, it seems timely to provide an evidence-based synthesis of 'What works in edtech' to deliver positive outcomes for students and teachers.

This Spotlight summarises research findings on the impacts of selected edtech to help support teachers to make evidence-based decisions about including edtech in their own practice. To provide the most relevant information for Australian teachers, this Spotlight primarily focuses on research from developed countries (including Australia, the United States, the United Kingdom, and countries in the European Union). Where possible, existing literature reviews and meta-analyses (which allow the relative impact of different interventions to be compared) have been used to provide an overview of existing research.

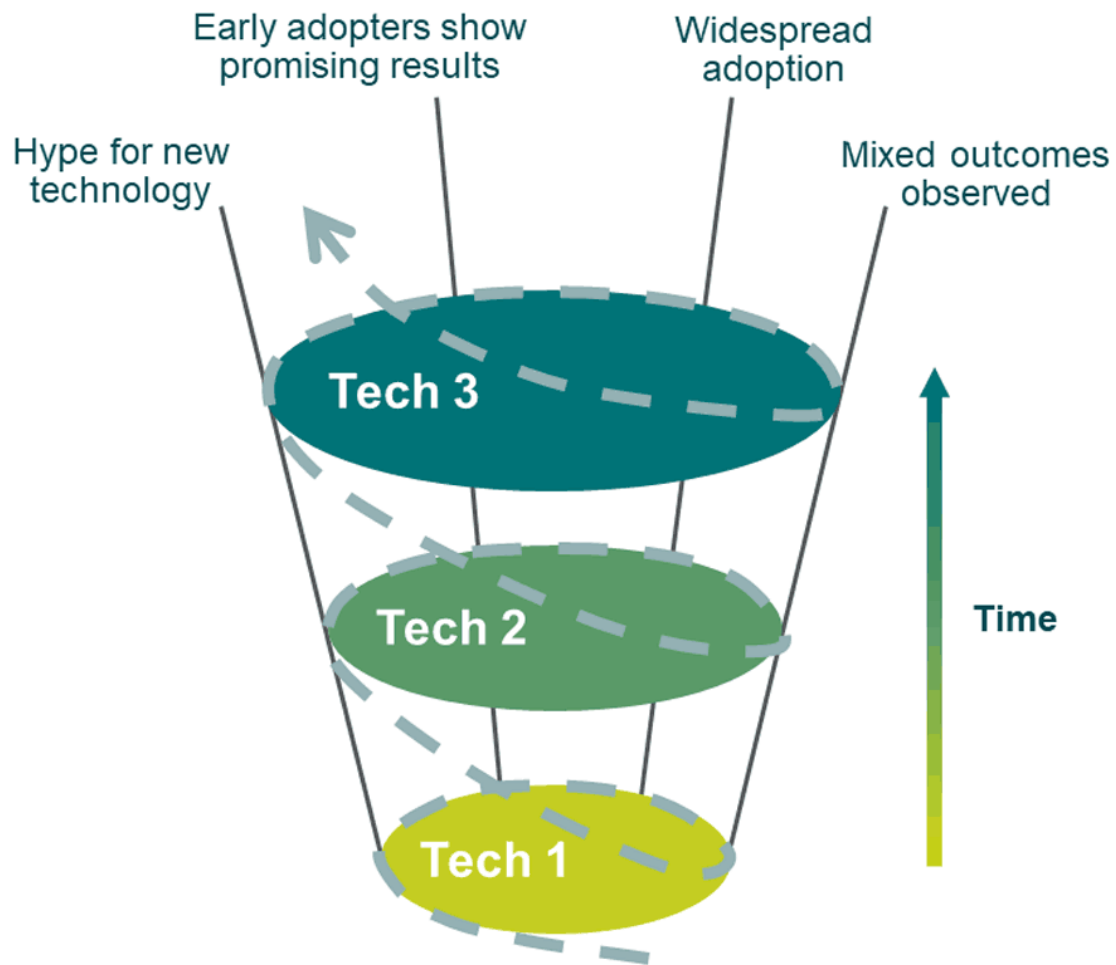
What does the research and evidence base say about different types of edtech?

There is a plethora of research available on edtech, and the number of publications produced each year continues to rise (Gunes et al., 2023). With over 10,000 publications in 2021 (Gunes et al., 2023), this equates to 200 new articles every week.

A cyclical pattern in edtech research has been observed over several decades (e.g. Higgins, 2012; Figure 3), with research publications about new edtech typically representing the following phases:

1. As a new technology is developed, a flurry of theoretical or opinion-based articles will promote its adoption in education, typically extolling significant benefits for students and teachers.
2. Initial findings from early adopters in schools are often very positive and based on anecdotal feedback from students and teachers.
3. As the technology is applied more widely, more extensive research studies that attempt to quantify the impacts often show limited improvements in student learning, if any. Conflicting results are more likely to be published at this stage, although a bias towards publishing positive outcomes has previously been noted (this bias is common to many research fields).
4. The latest innovations draw the interest of researchers and early adopters with their apparent potential to offer better outcomes (as per phase 1). Consequently, research efforts and publications shift focus to the latest technologies. The pace of change can leave the majority of teachers and schools with little time to adopt, or adapt to, any given edtech before the next 'latest' development arrives.

Figure 3. Cyclical pattern observed in edtech research and implementation with movement from one type of edtech to the next, over time.



According to the literature, motivations for integrating edtech differ, with reasons frequently cited by teachers including increased student engagement and motivation, improved conceptual understanding and better learning outcomes, as well as greater access to learning resources and to save time. Some outcomes are repeatedly mentioned across multiple types of edtech; for example, extended reality (XR), educational games and interactive whiteboards have all been reported to improve student engagement, conceptual understanding, and collaboration. In contrast, other outcomes are cited for specific types of edtech; for example, improved spatial awareness is mentioned in some literature about XR.

There is significant support from teachers for the use of edtech in schools. The latest Teaching and Learning International Survey (TALIS), conducted in 2018, shows 78% of teachers in Australia reported that they could support student learning through the use of edtech either “quite a bit” or “a lot”; this was significantly higher than the average across Organisation for Economic Co-operation and Development (OECD) countries of 67% (OECD, 2020). Additionally, 11% of Australian teachers reported a “high level of need for professional development in ICT for teaching”; lower than the OECD average of 18%. These results suggest Australian teachers have greater skills or self-efficacy in this area relative to the average of OECD nations that participated in TALIS 2018. A recent survey of American teachers, principals and school administrators similarly found that the vast majority (>80%) thought edtech was useful for learning, however, only 25-30% thought there was sufficient useful information for them to decide what types of edtech would be best suited to their purposes (Gallup, 2019).

Edtech solutions for teachers and schools

During the last four decades, promotional materials have frequently claimed that the latest edtech will save teachers time, whether that be time spent preparing lessons, creating assessment artefacts or providing feedback to students and their families (e.g. Bryant et al., 2020). Numerous new management 'solutions' have been created to minimise the time teachers need to spend undertaking administrative, preparative or management activities. The potential to save teachers and school leaders time is increasingly important as, although Australian teachers are dedicated to their profession (Australian Institute for Teaching and School Leadership (AITSL), 2023a), they face excessive workloads (Hunter & Sonnemann, 2022). Teachers currently need to spend much of their time on activities that don't involve direct interactions with students (AITSL, 2023b).

“Reducing excessive administrative tasks and finding more efficient ways to manage them can alleviate some burden on teachers, improving work-life balance and reducing work-related stress. Such measures can also enhance time for instruction and student engagement; the aspects of teaching that we know contribute positively to job satisfaction. ”

–AITSL, 2023

Unsurprisingly, the main advantages of edtech **for teachers and school leaders** are stated to be:

- greater access to high-quality resources, reducing the time needed for lesson planning and preparation;
- enhanced communication and collaboration with colleagues; and
- greater time efficiency when undertaking tasks that are not student-facing.

However, applications within real-world settings have shown mixed results in realising these outcomes. This could be argued to reflect the modern day 'productivity paradox'; innovation in digital technologies in the decade immediately prior to the recent pandemic should theoretically have boosted productivity, yet Australia, the US and several other developed countries have instead seen a productivity slump in this time-period (Department of Communications and the Arts, 2017). Digital technologies offer the potential for increased productivity, especially through greater communication and access to information (Schneider & Kokshagina, 2020) but this may be a double-edged sword. The same communication media also brings more interruptions and distractions for workers, especially those in digital work environments (Orhan et al., 2021), which can counteract the potential gain in productivity or time efficiency.

Learning management systems

Learning management systems (LMS) are web-based applications that support the design, dissemination, evaluation and administration of educational courses, whether online, blended or in-person (Stockless, 2018). LMS are sometimes also referred to as virtual learning environments or digital learning platforms. LMS were originally intended to (a) provide a repository for learning materials and (b) simplify administrative tasks such as tracking student progress and completions. LMS support the management of learning content and learning activities. They can support teachers to better manage differentiated instruction to increase student achievement (Burgstrom, 2017). As

differentiated learning should better engage students (by allowing them to work within their individual zone of proximal development), LMS are also expected to reduce in-class behavioural issues (Burgstrom, 2017).

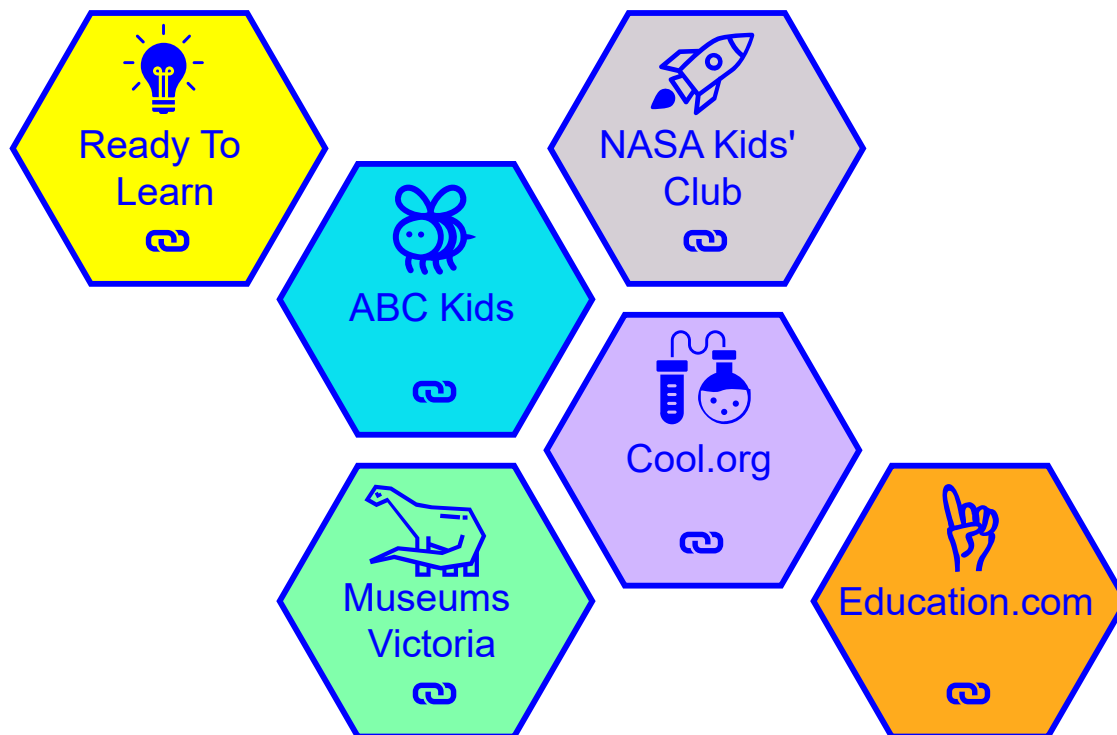
Today, an LMS will typically include a combination of the following core components:

- course management tools (syllabus, calendar, drop boxes, announcements),
- content tools (content pages, lessons, links to resources, quizzes, assessments), and
- communication tools (email, discussion forums, chat) (Yildirim et al., 2014).

Although originally anticipated to catalyse change to learner-centric education, LMS are frequently still used in a traditional manner where students are seen as passive receivers of information. This is demonstrated globally by two-thirds of national LMS lacking any interactive content for students (Rui et al., 2022) even though interactivity is viewed as a key driver of student engagement, motivation and learning. This is consistent with teachers reporting the main benefit of LMS for student learning is providing additional learning scenarios (Badia et al., 2019).

Teachers have reported that a key benefit of using LMS is creating and sharing multiple digital resources, including learning content and activities with students or colleagues (Jewitt et al., 2011). Sharing lesson plans and resources could significantly reduce teacher workloads (Jewitt et al., 2010). For example, all Year 9 science teachers within a school or region could use the same course outline, lesson plans, online resources and other materials, yet still have their own class page within an LMS. Additionally, numerous websites enable teachers to share digital resources, including lesson plans and supporting materials, many of which feature high-quality learning products. Finally, numerous organisations (see Figure 4 for examples) provide free online learning resources for educational purposes, including lesson plans for specific ages and subjects, activities, videos and podcasts.

Figure 4. Examples of organisations that offer free digital learning resources for early childhood and school-aged children. Note: click on the text boxes to access each hyperlink.

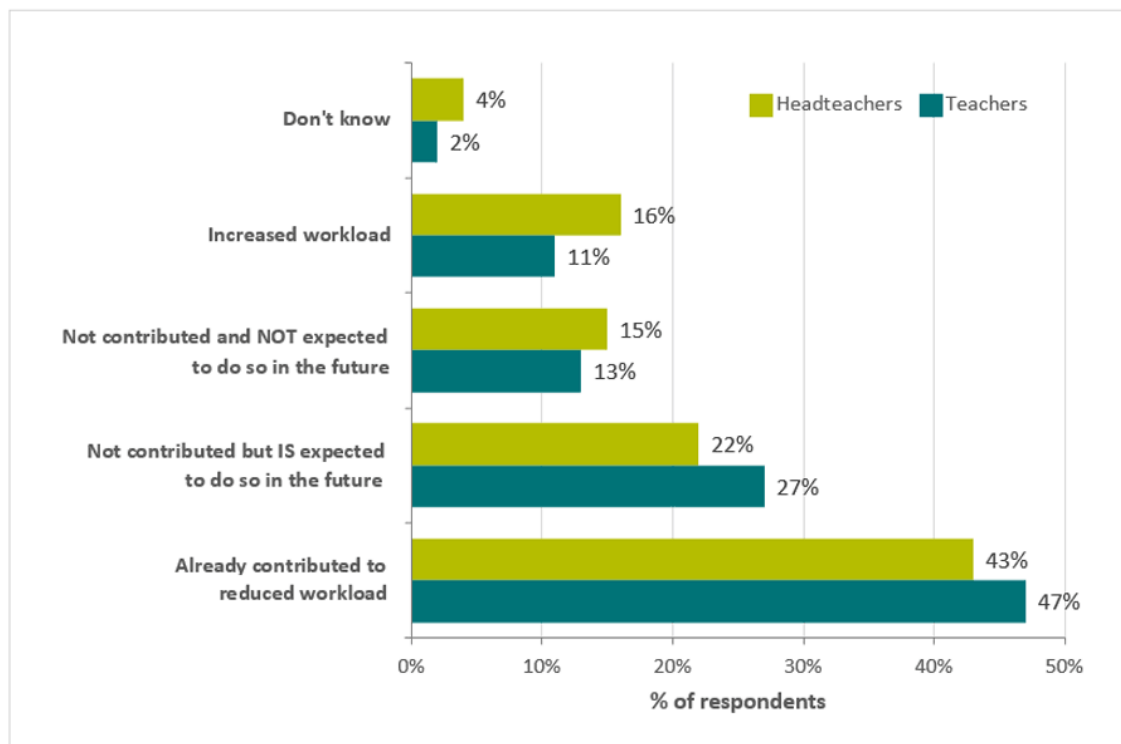


Note: Cool.com is free but registration required.

LMS also enable increased engagement and communication with the wider school community, as teachers, students, and parents and carers can interact with posted content and, potentially, each other. For example, parents and students can typically access multiple features through the LMS including student grades and feedback, parent/carers and teacher communication, and classroom content. Although communication frequently consists of school staff providing information to the community (for example, class notes and photos, school newsletters, and permission slips), there are usually features that enable students, parents and carers, and other community members to contact school staff. Compass, which many schools in Victoria use, is an example of an LMS that simplifies parental communication in this way. Secondary teachers who used communication and collaboration tools in LMS were more positive about the impact of LMS on student learning than those who used this edtech predominantly for the traditional provision of learning materials (Badia et al., 2019).

However, there is limited information available on whether LMS and the sharing of digital resources correspond to reductions in the amount of time teachers need to spend on such tasks. Time savings associated with mid to long-term planning of courses using LMS have been reported (Underwood 2006). Of approximately 1,750 teachers and headteachers (who are akin to principals) from the UK, who completed an extensive survey in 2020-2021, 43% of teachers and 47% of headteachers reported that using edtech had already saved them time, whilst roughly 25% expect it to do so in the future (Figure 5; CooperGibson Research, 2021). In contrast, 16% and 11% of teachers and headteachers reported that using edtech increased their workload (CooperGibson Research, 2021). Collectively, this evidence suggests that LMS and the sharing of digital resources may save teachers time when used collaboratively.

Figure 5. Perspectives of UK teachers and headteachers as to the actual or anticipated impact that the implementation of an LMS had on reducing their workload. Figure adapted from CooperGibson Research (2021).



Learning analytics

Vast amounts of data on student performance, engagement, and behaviour are collected by various edtech including LMS, digital games and other online learning platforms. This can be combined with digital student records and additional information about the student then analysed using machine learning or AI models to provide actionable insights for teachers; this technology is often referred to as learning analytics. This information is often provided graphically via dashboards highlighting the more important aspects of the data (such as progress through a course or what topics most students are struggling with).

“Learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs.”

–Long & Siemens, 2011

Proponents argue these data-driven approaches enhance pedagogical practices and result in better decision making, thus leading to better student outcomes. There has, however, been limited research regarding how these tools can best be implemented in school settings, resulting in limited guidance available for teachers. A review of learning analytical interventions published from 2012–2021 found most were from university contexts, with only 9% set in primary schools and 15% in secondary schools (Zheng et al., 2023).

A systematic review of learning analytics use in high schools worldwide found that the main reasons for adopting learning analytics were to predict and enhance student learning outcomes, better understand student learning processes, and support teachers (de Sousa et al., 2021). School systems typically focused on small-scale initiatives rather than institutional adoption; consequently, there was no evidence that learning analytics improved learning outcomes, learning support and teaching at a whole-school level (de Sousa et al., 2021). Despite this, positive impacts were observed at a classroom level; for example, the use of learning analytics by teachers within small class

environments improved the quality of written work and student learning in languages (de Sousa et al., 2021). Similarly, 7 studies based in UK primary schools all showed positive impacts when learning analytics were used to determine student literacy instruction (Connor, 2019). Teachers have noted several issues with learning analytics, however, reporting that the amount of data can be overwhelming and that the feedback isn't provided quickly enough for them to respond to it within the same class ("Teachers Know Best," 2015). Dashboards which highlight key metrics on student progress may help teachers improve their feedback and achieve better student outcomes (OECD, 2021, cited in Loble, 2022).

A second key focus in learning analytics has been the earlier identification of students at risk of not completing their studies. A number of exploratory models have been developed for secondary schools (e.g. Márquez-Vera et al., 2016; Queiroga et al., 2022). For example, the school zone and the individual student's performance in Grades 1 and 6 were the most significant factors for identifying students who were less likely to complete secondary schooling in Uruguay (Queiroga et al., 2022). Other studies have focused on student engagement and affect as key variables for identifying students at risk of not completing high school (OECD, 2021), although there has been limited uptake of more advanced methods such as emotion-aware intelligent tutoring systems (ITS) which use cameras and sensors with eye-tracking and emotion recognition software (Southgate et al., 2019).

Several large-scale studies have assessed the effectiveness of predictive models in US secondary schools in alerting staff and enabling individual interventions to provide additional support to specific students at risk of not completing school. Unfortunately, the subsequent interventions reduced chronic absenteeism but did not affect course completion rates (OECD, 2021). These studies demonstrate the potential for learning analytics to identify students at risk; however, subsequent interventions are not yet achieving the desired results of retaining these students until graduation.

Automated marking

Edtech offers multiple opportunities to reduce manual marking including via personalised learning platforms and automated marking software. Automated marking software can provide detailed and consistent feedback to students, inform teachers of student progress, and potentially provide personalised learning plans (Beheshti & Adamsas, 2023; Faber et al., 2017) including guiding students to relevant online resources to improve their knowledge or skills (Wilson & Roscoe, 2020). Proponents for automated marking claim it:

- saves time and resources, allowing teachers to focus on other student-orientated tasks;
- reduces human bias, ensuring all students are graded fairly and accurately; and
- provides immediate feedback to students, allowing them to learn from their mistakes and improve their performance.

Traditionally, automated marking focused on multiple choice and short-answer questions, frequently within mathematics and science. Positive outcomes for student learning and time efficiencies for teachers have been reported from multiple school-based trials, even short interventions (Escueta et al., 2017; Roschelle et al., 2010, 2016). A study of 43 schools in the state of Maine in the US showed positive outcomes for student learning in mathematics (Murphy et al., 2020) with low-achieving students showing the largest improvements. Furthermore, a large-scale experimental intervention involving 79 primary schools in the Netherlands found that automated, formative assessment in mathematics improved student learning and motivation, although this was more effective for male

students and higher performing students, with the effects greatest with longer interventions (Faber et al., 2017). The relatively widespread adoption in both these studies suggests that this particular edtech can be effectively implemented by teachers of varying experience and pedagogical beliefs.

Automated writing evaluation

Automated writing evaluation (AWE) software enables marking of longer written texts by models (now frequently AI-based) trained on massive datasets of diverse material (Warschauer & Grimes, 2008). Within a school environment, AWE software such as MI Write, Criterion, Intellimetric and E-rater typically provide feedback to both the student and teacher (Zhang, 2021). Some AWE also simplifies reporting of student effort and learning to parents and guardians. Deployment in 4 US secondary schools demonstrated that AWE saved teachers time (Warschauer & Grimes, 2008). Conversely, a study of 8 schools reported that AWE didn't save teachers time as they spent an equivalent amount of time contextualising AWE feedback or providing greater individualised assistance to students (Nunes et al., 2021).

AWE feedback can help students develop better writing skills by mastering cognitive writing processes such as planning, translating and revising their writing (Graham & Perin, 2006; Limpo & Alves, 2013; Nunes et al., 2021). The vast majority of studies in secondary schools showed the use of AWE resulted in improved learning outcomes (Nunes et al., 2021), although one study indicated this had less effect on essay quality than teacher, peer or self-feedback (Graham et al., 2015). The way students engage with the feedback, rather than the feedback itself, has a greater impact on learning outcomes. For example, a study of 4 US schools found that students who received feedback from AWE software either did not engage with feedback or made minor changes to spelling or word choice, rather than focusing on content, organisation or structure (Warschauer & Grimes, 2008). The authors argued this was consistent with student response to teacher and peer feedback as well, as students within these schools rarely engaged meaningfully with feedback. In comparison, a study of implementation in 8 US schools found that use of AWE improved essays; with the level of improvement linked to the number of revisions undertaken (Nunes et al., 2021).

AWE use may help “narrow the gap” between disadvantaged students and students who are not faced with such disadvantages. For example, in a study with over 1,000 students, students with disability initially scored lower than students without disability, but were able to close the gap by repeatedly revising their essays following automated feedback (Wilson, 2017). Additionally, meta-analyses showed that the impact of AWE on writing quality and quantity varied with socio-economic status (SES), whether students had disabilities, or were from diverse backgrounds (Wen & Walters, 2022).

AWE produces the most benefit for students when employed as a supplementary assessment device; to augment other types of feedback (e.g., teacher, peers) and not as a replacement of human scoring (Attali, 2013). Teachers play a pivotal role in contextualising automated feedback for students (Nunes et al., 2021) although a moderate effect on writing quality was observed when AWE was used in isolation of other feedback. When used as a classroom tool, AWE allows teachers to devote more time to high-level feedback and student development rather than on correcting errors (Nunes et al., 2021; Palermo & Thomson, 2018; Rich & Tang, 2017). Consequently, automated marking may help reduce the amount of time teachers spend on student assessment and feedback but won't eliminate it.

AI-powered chatbots

A chatbot is a software program or online interface that attempts to mimic human conversation with a user, via written or verbal input. Many websites now use these functions to provide a question and answer facility. AI-powered chatbots typically draw on enormous datasets (often publicly available, online information up to a set date) when they answer a question. Recent advances in AI-powered chatbots have resulted in mass publicity, especially for ChatGPT. This chatbot is capable of producing long text responses, including essays, computer code, or other types of responses specified by the user.

As such, there is notable potential for such tools to save teachers and other school staff considerable time. Recent papers suggest that AI chatbots could be used in teaching preparation (e.g., developing course outlines and materials), performing language translations and assessment support (such as evaluating student performance and developing assessment tasks) (Lo, 2023; UNESCO, 2022). For example, a teacher could refer ChatGPT to a specific curriculum or course outline and then ask ChatGPT to develop a sequence of 10 lesson plans (of a nominated lesson length) which combine to fully address the curriculum, including links to relevant interactive activities for students. The teacher could then ask ChatGPT to create the assessment artefacts including components such as the marking criteria and/or assessment rubric plus examples of student work at different levels of proficiency.

Another key advantage of ChatGPT is that users can upload documents and ask the chatbot to incorporate their content in the response. These materials could potentially be used to customise lesson plans to individual students according to personalised learning plans, or to cater for other variables, such as literacy skills. Consequently, teachers could simply quality assure the output and adapt where desired. As yet, there is limited evidence as to the amount of time that using ChatGPT (or similar AI-powered chatbots) can save teachers, however, it is predicted this could exceed 50% of the time they currently spend on some tasks (Bryant et al., 2020).

A cautionary note is that ethics and student privacy need particular consideration in this context, especially when uploading personal learning plans. Any such documents need to be carefully de-identified and ideally separated from class material to prevent re-identification of students. There is potential for programs similar to ChatGPT to be restricted to school systems to address such concerns, as demonstrated [via a current trial of such a program in 8 South Australian schools](#). Advisory material detailing such considerations has previously been produced for Australian teachers (Southgate, 2020; Southgate et al., 2019).

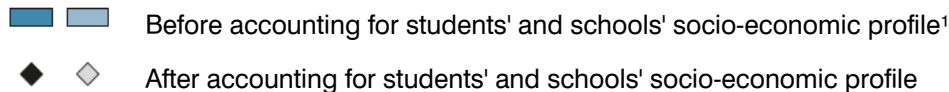
Edtech solutions to improve student outcomes

The disparity in edtech accessibility worldwide has enabled the impact of information and communication technology (ICT) use on academic performance to be assessed on large scales, albeit with mixed results. For example:

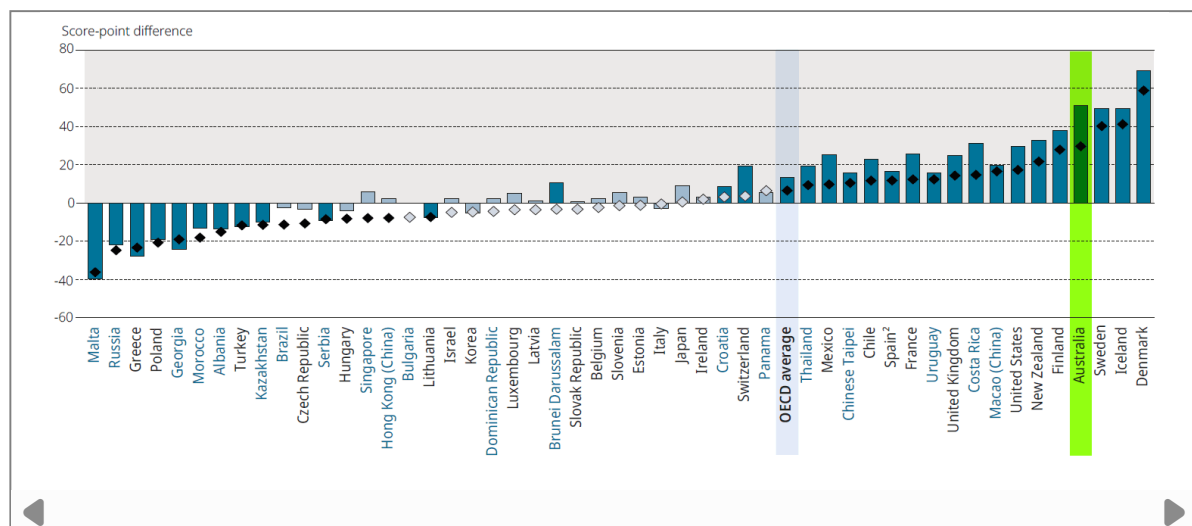
- a study of 76 countries indicated that schools with better ICT infrastructure performed better in reading, mathematics and science (Bozkuş, 2021), yet the OECD (2021) reported a persistent negative relationship between the time spent using ICT in class and student performance in these three areas. However, if students used the internet to research topics in class, they had higher reading scores than students who didn't (Figure 6; OECD, 2021).

- a comparison of 44 countries revealed that student performance was higher in countries where students had more access to ICT at school, but student performance was lower if students had more access to ICT at home (Hu et al., 2018).
- the Progress in International Reading Literacy Study (PIRLS), an international study of reading, found a positive association between digital devices at home and student reading attainment (Mullis et al., 2017).

Figure 6. Score point difference in reading of students who reported using digital devices for browsing the internet for schoolwork compared to those who reported they never did that. Source: OECD (2021).



Students who reported using digital devices for browsing the Internet for schoolwork scored higher on reading performance than those who reported that never did it.



1. The socio-economic profile is measured by the PISA index of economic, social and cultural status (ESCS).

2. For the comparability of Spain's data see Readers' guide of this report or PISA 2018 Results (Volume I): What Students Know and Can Do, Annex A9.

Note: Statistically significant differences are shown in a darker tone. Countries and economies are ranked in ascending order of the score-point differences in reading, after accounting for students' and schools' socio-economic profile.

These results indicate it is not just access to edtech that influences student outcomes, but also which technology is being used and how it is used. As such, the next section looks at several key types of edtech that are popular for use with school students.

Experimental and quasi-experimental approaches can provide more definitive information as to whether edtech (or specific types of edtech) caused or contributed to the observed changes in performance. Many such studies have shown various edtech can improve student outcomes relative to 'standard' teaching and learning practices (Higgins et al., 2012; Underwood, 2009). Evidence that edtech improves student performance relative to other learning interventions (such as active learning,

peer collaboration, and non-digital game-based learning) is weaker with some inconsistency between studies. Various studies have also demonstrated differing impacts on student learning depending on learning stage and the subjects studied (Underwood, 2009) which would contribute to the inconsistencies observed in their overall impact. To provide more clarity on the topic, the reported impacts of several key types of edtech are summarised below.

Interactive whiteboards

Interactive whiteboards (IWBs), also called smartboards, consist of a control and a display (i.e., a screen or a projector) that digitally represents a physical whiteboard or the old-fashioned flipchart. Users can interact with the display (either directly or via other devices), for example to highlight text, use virtual tools such as graphing programs, or access software. The primary intent of IWBs is to enable teachers to share materials in multiple formats or media. Multimedia-enhanced classrooms can facilitate increased student engagement and motivation, whilst also enhancing learning and student achievement (Schrader et al., 2018; Underwood, 2009). Multimedia approaches facilitated by IWBs have also shown improved engagement from students with attention-deficit/hyperactivity disorder (ADHD) and at least one report of an autistic student interacting significantly more with his classmates during these lessons, relative to other activities (Underwood, 2009).

IWBs gained popularity in the early to mid-2000s, for example, in the UK all primary schools had IWBs in classrooms by 2007 (Kitchen et al., 2007). An earlier trial in 12 UK schools reported positive responses from students, with increased student engagement also noted by teachers. Teachers needed time to adjust to the new teaching format, thus student achievement improved one year after IWBs were introduced (Underwood, 2009). Interestingly, the introduction of IWBs to these 12 schools catalysed a shift in teaching style, with teachers typically adopting more effective questioning styles and favouring more discussion in lessons (Balanskat, 2006). No increase in student achievement was observed in the second year (Balanskat et al., 2006), suggesting that this pedagogical change may have been short-lived. A larger, pan-European study subsequently only found weak evidence that IWB use led to 'transformational' pedagogies (Wastiau et al., 2013). When IWBs were introduced more widely across England, review studies found that student engagement and motivation both increased (Underwood, 2009). Additionally, student learning improved in each subject examined, namely English, science and mathematics (Underwood, 2009). This improvement was more pronounced in primary than secondary schools; additionally, the greatest benefits were observed for under-achieving or disadvantaged students (Underwood, 2009).

Within Australia, NSW proactively integrated IWBs into schools from 2007-2011 (Beveridge, 2008; Costa, 2007; Hunter, 2011), especially in regional and remote areas. Initial studies undertaken across several primary schools found that IWBs had little effect on the type of pedagogy that teachers used (Bennett & Lockyer, 2008). Learning activities based on IWB use were predominantly teacher-led (Bennett & Lockyer, 2008; Schuck & Kearney, 2007), with teachers primarily using whiteboards as presentation tools (Kearney & Schuck, 2008).

An Australian case study

In 2007, the NSW government introduced 'connected classrooms', across numerous schools (Beveridge, 2008; Costa, 2007; Hunter, 2011). One application of the connected classrooms was an undertaking between five schools for shared teaching where a teacher could teach classes in two different locations, at the same time, via the use of an interactive whiteboard (mirrored in both classrooms) and videoconferencing technology. Partnerships

between schools resulted in a broader curriculum being offered to students, but to maintain engagement with the classroom that didn't have a teacher, each lesson would contain at least 3 activities that were heavily teacher-directed (Mitchell et al., 2010). Furthermore, technical constraints limited the amount of interactivity that could be undertaken for example, the IWB would freeze if students wrote on both screens simultaneously. Thus, whilst the project capitalised on the technology to better support remote students, not all affordances of the IWBs could be realised.

Despite mostly being used to replicate traditional teaching styles, these early Australian studies noted that IWB use improved student learning and engagement due to their greater visual appeal (Schuck & Kearney, 2007). This is consistent with the early findings from the UK. By 2012, a survey of over 100 Australian primary school teachers found that IWBs had increased the diversity of digital resources being used in primary classrooms, with "an increased emphasis on online interactive and multimedia resources (such as learning objects, puzzles and games, images and movies)" (Maher et al., 2012, p152). The more interactive aspects would likely have further promoted student engagement and learning at this time.

Digital personalised learning

Personalised learning refers to tailoring the content and activities to best suit the individual, essentially extending the concept of differentiation to apply to each student within a class, rather than groups of students. Personalised learning became increasingly popular at the turn of the century, with the UK Government making this an official government policy in 2004 as they sought to better meet the needs of increasingly diverse learners (Campbell, Robinson, Neelands, Hewston, & Mazzoli, 2007). Digital personalised learning (DPL) software, powered by AI, extends this concept by automatically adapting the media type, content, activities and difficulty levels to best suit an individual learner based on their responses, interests, and prior interactions with the system. This approach is currently being trialled in 10 state schools in Queensland.

Personalising learning in this context involves the tailoring of pedagogy, curriculum and learning support to meet the needs and aspirations of individual learners irrespective of ability, culture or social status in order to nurture the unique talents of every pupil.

–J. UNDERWOOD ET AL., 2008, P4

Building on drill and practice (a behaviourist-aligned educational approach where students perform repetitive tasks until they demonstrate mastery; Lim et al., 2012), a key advantage of DPL is that any mistakes are immediately corrected and feedback provided. DPL can identify the learning preferences of individual students, personalise learning materials, and make predictions, recommendations, and decisions about the learning process based on data from individual students. Unlike drill and practice software, DPL can scaffold new material to what the student already knows (Hillmayr et al., 2020), allowing students to master the subject at their own pace, and provide teachers with suggestions on how to help them. This fosters more inclusive and accessible education, regardless of individuals' disabilities or vulnerabilities.

Nearly all meta-analyses show positive impacts of DPL for students, whether that be related to learning outcomes, engagement and attitude towards learning or meta-cognitive skills (Major & Francis, 2020; Zhang et al., 2020). For example, moderate increases in reading comprehension were observed with 'Intelligent Tutoring for the Structure Strategy' (Escueta et al., 2017). In low and middle-income countries, a meta-analysis of 16 studies found a relatively small increase in student learning overall, with larger increases observed in studies that had higher levels of personalisation and adapted to the learner's level of knowledge (Major et al., 2021; Major & Francis, 2020).

Demonstrating the versatility of DPL, an experimental study of fifteen Year 12 classes from Danish schools found that DPL increased mathematical knowledge, with underperforming students experiencing the greatest improvement (Bokhove & Drijvers, 2012). Additionally, a meta-analysis calculated that students who had access to such programs would perform better than 62% of students without such access (Valverde-Berrocoso et al., 2022). Multiple reviews and meta-analyses have shown that DPL not only produces positive student outcomes, but also that DPL with high levels of personalisation "are significantly more effective than many other instructional methods such as regular classroom instruction, homework assignments, learning with CAI [DPL with limited personalisation] or with textbooks" (Southgate et al., 2019 p. 28).

Proponents claim that DPL can free up teachers in class time or even to provide instruction in low-income countries where there is a lack of suitably qualified teachers (Major et al., 2021). This was seen in El Salvador, where the level of student learning via DPL exceeded that of the local teachers (who had received limited education or training themselves) (Büchel et al., 2022). In systems with suitably knowledgeable teachers, such as Australia, the evidence demonstrates an improvement in learning where DPL is used as a supplement to more traditional teaching, not as a replacement (Escueta et al., 2017). As Mark Grant, Chief Executive Officer of AITSL, wrote [in a recent blog post](#):

"Generative AI might offer valuable insights and support, but there is no substitute for expertise, and the human connection, that teachers and school leaders provide for their students. "

Generation 3 learning management systems

LMS benefit students by allowing easy access to learning materials outside of class times, and a greater variety of learning resources is typically made available, relative to traditional settings (Wastiau et al., 2013). These resources frequently consist of different media types (e.g., audio, video, images, and text) that can better cater to individual learners, thereby promoting student learning and engagement. A frequent criticism of LMS has been that they don't cater for students' need for social connection and the role of this dimension in learning (Turnbull et al., 2020). Anecdotal evidence from the recent pandemic indicated that school students found online learning a lonely, isolating experience where the lack of social interaction and engagement with teachers was very challenging (Ewing & Cooper, 2021). Advances in edtech (particularly social media) have, however, facilitated the transformation of LMS into collaborative and social learning spaces where students can interact, collaborate, and co-create knowledge.



📹 Generation 3 LMS enables greater interaction between students, increasing their sense of connection, engagement and learning.

The term ‘Generation 3 LMS’ refers to recent systems that include features such as discussion boards, real-time chat, and video conferencing to support meaningful peer-to-peer interactions, knowledge sharing, and collective problem solving. These tools also promote constructivist approaches to learning rather than transmission of knowledge models (Lonn & Teasley, 2009) and when implemented in this manner, should improve student outcomes, including both learning and engagement.

“An instructor’s presence within an LMS creates an engaging learning environment. Students can retain their autonomy, enthusiasm, and motivation with LMS use. ”

–Bradley, 2021, p. 68

Interactions with the teacher and peers drive much of the positive outcomes for students in online learning environments (Hillmayr et al., 2020). Collaborative use of edtech has been demonstrated to be more effective than individual learning with the same technology (Selwyn et al., 2020). Peer collaboration through an LMS is mediated by the teacher’s behaviour and beliefs, thus it is a combination of the teacher, learning activities and content that create the optimum conditions for learning on these platforms (Selwyn et al., 2020). Research has repeatedly demonstrated more beneficial effects from the integration of LMS into teaching environments when teachers are trained in the use of LMS features (Hillmayr et al., 2020; Selwyn et al., 2020), emphasising the importance of teachers’ professional learning to support their confidence with, and knowledge of, LMS platforms.

AI-powered chatbots

As previously noted, one of the most well-known AI-powered chatbots is ChatGPT, however, there are now many more options available including the new Bing, Claude and Google’s Bard. Chatbots draw their data from massive amounts of freely available information, thus responses may also contain inaccuracies, present opinion as fact, or not reflect the most recent developments in a field

(Baidoo-Anu & Ansah, 2023; Lo, 2023). AI lacks 'common sense', the foundation needed for human-like intelligence (Shanahan et al., 2020). This is amply demonstrated by Meta's much heralded release of Galactica: a large language model (similar to ChatGPT) that could supposedly "store, combine and reason about scientific knowledge" (Taylor et al., 2022) but which "mindlessly spat out biased and inaccurate nonsense" (Heaven, 2022). Given Meta's scientific basis, facts were relatively easily to check and inaccurate information (such as a history of dogs in space) could be quickly identified. In other subjects, it may be more difficult to fact-check due to the more qualitative nature of the content. Although not a chatbot, [a Queensland trial of an AI-based learning platform](#) demonstrates one solution to this issue, namely by restricting the AI-model solely to information sourced from the relevant curriculum documents.

Since its release in late November 2022, ChatGPT has seen teachers scrambling to adapt, given the implications include the potential for students to cheat in assessment tasks. Australia's government school systems mostly responded with an initial ban on ChatGPT and AI-powered writing tools, but independent schools were more likely to integrate such programs as a teaching aid. Since the initial disruption, there have been more calls for government school systems to follow suit, amid fears of a growing digital divide. A National AI Taskforce was therefore established by the 9 Education Ministers, with a draft National AI in Schools Framework developed and released for feedback in July 2023. Following public consultation and updates, the [Australian Framework for Generative AI in Schools](#) was agreed by [Education Ministers in October 2023](#) and [publicly released on 1st December 2023](#).

As noted by the Minister for Education, Jason Clare:

"If we get this right, generative AI can help personalise education and make learning more compelling and effective, and this Framework will help teachers and school communities maximise the potential of this new technology."

Responsible student use of AI-powered writing tools like Jasper.ai and Google's Bard, such as employing the tool to brainstorm ideas, facilitate collaboration or even as a personalised virtual tutor, can be scaffolded to existing syllabus content. However, when AI-based models are used in learning, it is crucial that the critical thinking and digital literacy skills of students are sufficiently developed (Southgate, 2019). Similarly, teachers will also require sufficient professional learning to enable them to use AI safely and securely, whilst understanding the implications of online data collection for ethics and student privacy (Independent Education Union, 2023). This is required due to concerns about the accuracy, reliability and bias of these tools (Southgate et al., 2019). For example, when ChatGPT was asked to name 10 famous philosophers, the response lacked any diversity in gender or cultural background (Connolly & Watson, 2023).

Despite these reservations, recent research shows promising results for the potential use of AI-powered chatbots within schools (Wu & Yu, 2023). This research is still in the early experimental phase, thus it is possible that wider adoption across educational systems may not deliver the anticipated student outcomes (as has been the case with some other edtech). Excitingly, 8 schools in South Australia are currently trialling use of these technologies with the initial findings expected soon.

Extended reality

Extended reality (XR) refers to technology that creates highly realistic representations in which users can interact with virtual objects. These objects will contain layers of information, such as learning content, photos, sound or video (Gaol & Prasolova-Førland, 2022). XR encompasses both

augmented reality (AR) and virtual reality (VR), with the main difference between these technologies being that in AR, virtual information is overlaid onto real world images or objects, whilst in VR, the environment is entirely simulated. As such, VR simulations are sometimes referred to as virtual environments. These technologies have found applications in several subjects, most notably mathematics and science.

Key benefits of XR technologies are that they can create collaborative learning experiences, promote spatial awareness, and provide active learning opportunities. VR in particular allows students to engage in realistic scenarios and gain practical skills; for example, science students can participate in virtual experiments or other laboratory-based activities. Similarly, these technologies have been applied within initial teacher education, often with an emphasis on the development of classroom management techniques (AITSL 2023c).

Earlier this year, AITSL published a [Spotlight summarising the use of XR in initial teacher education](#) (Australian Institute for Teaching and School Leadership, 2023c) and highlighting the suite of XR technologies currently used at the University of Newcastle as a case study. That Spotlight outlines how XR allows pre-service teachers to practice implementing classroom management strategies; these experiences help bridge the gap between theoretical learning and real-life application. The structured XR experiences support communities of practice where educators and pre-service teachers actively engage in collaboratively exploring classroom management practices.

In tertiary settings, XR has similarly been used for the development of skills and knowledge in several other fields, including medicine (see example below), psychology, engineering and management (Chernikova et al., 2020). XR has also been proposed as a solution for remote school students to virtually access facilities or work experience opportunities that may not otherwise be available to them. However, a Slovenian study using simulations to replace in-person experiments during the recent pandemic found that over a quarter of high school chemistry students missed the interaction with their teacher and peers when learning via this method (Babinčáková & Bernard, 2020). Given how vital social dimensions of learning are, this suggests that XR may not be as effective as more collaborative methods of learning (when these are available).



<https://www.youtube.com/watch?v=CEyH7Vs5UfM>

3D Organon MEDVERSE: *This VR-based anatomy module allows users to learn detailed anatomy as they magnify structures of interest and observe and manipulate 3D models from various viewpoints. Additionally, users can talk with their tutors and peers in real-time via voice chat and messages, thus promoting a more collaborative learning experience. Source: 3D Organon*

A recent review of the impacts of XR on mathematics learning in schools reported that at least one positive outcome was noted in every study (Cevikbas et al., 2023). For example, 68% of studies noted an improvement in learning, and an increase in student motivation or engagement was also found in 44% of the studies. The authors reported that students demonstrated greater capacity for mathematical learning when using AR games and location-based AR, than in traditional classrooms (Cevikbas et al., 2023). A review of 7 studies of the use of AR game-based apps in primary and secondary school environments reported positive outcomes, including increased collaboration and communication as well as a deeper understanding of complex issues or conceptual knowledge (Cevikbas et al., 2023). A more extensive review of VR technologies used in primary schools found that immersive VR resulted in larger learning gains than VR viewed on desktop computer screens (Villena-Taranilla et al., 2022). These authors also reported that moderate effects on learning gains were observed with use of VR for both kindergarten and primary school students.



📺 Immersive VR can improve student motivation, engagement, and perceptions of their own learning gains.

Multiple studies have demonstrated that XR promotes critical thinking, problem-solving skills and digital literacy (Maas & Hughes, 2020). Additionally, there is evidence that when learning via XR, students are more attentive and focused, will participate more and are less likely to deviate in conversation and attention than in a traditional classroom (Maas & Hughes, 2020). Based on 64 studies from around the globe, the use of immersive VR in science was more effective than desktop VR or traditional teaching in stimulating attitudinal and behavioural change (Matovu et al., 2023). Students reported increased motivation and engagement when using immersive VR, as well as more positive perceptions of how useful the activities were for improving their learning (Matovu et al., 2023). This is despite some students experiencing negative effects from using immersive VR including dizziness and motion sickness. Furthermore, these authors report that multiple studies have previously found that immersive VR is effective for improving learning outcomes in science.

Virtual work experience has been suggested as a potential option for overcoming limited opportunities available to students in remote areas although reduced social interactions may reduce the quality of these interactions, as noted above. Similarly, a virtual work experience day in the United Kingdom's National Health Service offered to school students during the pandemic found that students were happier about their potential career choice having completed the session, but noted that they particularly appreciated the opportunity to ask staff questions (Bailey et al., 2021). Conversely, students who participated in a virtual conference aimed to provide students with information about a career as a doctor, found that the simulations were most useful for encouraging students to apply (Keshtkar et al., 2021). One virtual work experience for aspiring medical students has reached 55,000 students globally (Patel et al., 2022) although it is unclear how much of this experience consists of presentations and quizzes as well as more traditional simulations. Care must be taken to identify appropriate resources as "virtual work experience" as these can range from recorded talks, or non-interactive simulations with relevant professionals talking participants through the activity, through to more interactive presentations and videos as well as more immersive simulations in a truer sense.

Focusing on XR learning interventions, current research suggests that the adoption of collaborative learning (CL) ^[2] approaches within XR achieves the greatest improvements in student outcomes (Garzón et al., 2020), potentially because this approach may reduce the cognitive overload that can sometimes result from XR use. Ironically, this is one of the less-used pedagogical approaches used in conjunction with XR (Beckman et al., 2019). The cognitive theory of multimedia learning (CTML) ^[3] and project-based learning (PBL) are also effective approaches for AR interventions (Garzón et al., 2020). Interestingly, although situated learning ^[4] was the most popular approach within schools, this pedagogical approach appears less effective in K-12 settings than in higher education (Garzón et al., 2020).

Collectively, the current evidence suggests that XR, and especially immersive VR, offers significant potential for improving a range of student outcomes, whether related to motivation and engagement, subject-specific knowledge or 21st century skills such as critical thinking. History indicates, however, that other edtech has also appeared very promising whilst those technologies were still in early stages of adoption and integration into mainstream education. Only time will tell whether XR will withstand adoption more broadly to deliver these potential benefits to students across Australia, especially those who are currently under-achieving or facing other types of disadvantage.

Gamification

Gamification aims to increase student motivation and engagement with learning by incorporating game design elements in teaching practices (Dichev & Dicheva, 2017). The inclusion of games and competition within the classroom is not a new concept, nor is edtech explicitly required for a game-based approach. Previous research has demonstrated that the application of game-related concepts (such as awarding points and creating leader-boards) can improve student motivation in both traditional classroom settings as well as online (for example, in LMS). However, as this Spotlight focuses on edtech, this section focuses on the research and evidence base for digital game-based learning (DGBL).

Student motivation is crucial for effective learning, thus cognitively challenging or complex topics (such as science) can benefit from interactive, multimedia approaches such as DGBL (Chen, 2020; Tsai et al., 2012; Zacharia et al., 2016). Gamification can affect student motivation to learn via in-built reward systems. Individual reward systems, such as collecting coins or passing levels, can be more enjoyable for some students than public rewards such as leaderboards and social rankings, which discouraged some students from participating to their full ability (de-Marcos et al., 2014; Domínguez et al., 2013). Children and young adults are motivated by computer games and simulations, but the challenge is to ensure that the learning persists beyond the game (Higgins, 2012).

Further complicating matters, the impact of DGBL on student learning and motivation may be influenced by learners' prior exposure to digital games (whether for learning or entertainment). New learners may focus more on the practical components of the game, which can detract from their learning. Conversely, experienced video gamers may be so focused on competition or become so absorbed in the game that it has a negative impact on their learning (Tsai et al., 2012).

Almost two decades ago, a meta-analysis found that games and interactive simulations had a moderate impact on increasing cognitive learning (relative to traditional teaching) with girls exhibiting a stronger preference for this style of learning than boys (Vogel et al., 2006). These authors noted positive learning gains relative to traditional instruction only occurred when learners determined when to progress to a new topic. The positive influence of games on the motivation and engagement of children and young people was noted by Higgins et al. (2012), however they noted that there may be

difficulties in translating this enthusiasm to effective learning gains. In contrast, a meta-analysis of the impacts of DGBL used within secondary school and higher education settings found that games were effective at promoting learning (Lamb et al., 2018). A meta-analysis of DGBL in STEM subjects across both primary and secondary schools (relative to traditional teaching practices) showed the largest benefit was to student behaviour, followed by cognitive learning, and then motivation (Arztmann et al., 2023). Effective application of DGBL in STEM education demonstrated learning gains across multiple grades (Martinez et al., 2022; Wang et al., 2022).

“Video games can be an effective educational tool and are beneficial in almost all academic disciplines, particularly in foreign language and science. ”

–MARTINEZ ET AL., 2022, P. 1083

A review of DGBL in mathematics education in K-12 settings reported that gameplay improved students' academic performance, albeit learning gains were mostly in low-order thinking skills rather than the higher-order 21st century skills (Pan et al., 2022). 3D games and simulations were more effective at improving skills than 2D games (Lamb et al., 2018). A meta-analysis evaluating whether video games improved mathematical knowledge also reported in increased student learning across all school grades (relative to traditional instruction), but cautioned most of the included studies focused on early primary settings (Tokac et al., 2019). The positive effects of DGBL on the executive function of kindergarten students (aged 3 to 6) has also been demonstrated (Yang et al., 2020).

Games that specified the type of pedagogical approach based upon the cognitive content had a greater impact on improving learning than games where this was not specified (Lamb et al., 2018). Gamification can also offer social learning opportunities and collaborative gameplay functions as well as chatrooms and messaging. Studies of DGBL that incorporated collaborative learning have all found a positive impact on learning or motivation whereas some variability in impact was seen in individual DGBL.

Edtech: What about the ethics?

As edtech and AI become increasingly integrated into educational settings, it is crucial to address the ethical concerns surrounding its use. Teachers and policymakers must ensure transparency, fairness, and accountability in the design, deployment, and evaluation of edtech (OECD, 2023). Ethical considerations also include safeguarding student privacy, avoiding bias and discrimination, and promoting inclusivity. Stakeholders should establish clear guidelines and policies to ensure the responsible use of edtech, protecting students' rights and promoting equal opportunities (OECD, 2023).

The Australian Government Department of Education previously compiled a report that explores the ethics of advanced edtech in educational settings and provides advice to teachers (Southgate et al., 2019). Given this in-depth coverage of topics such as ethics, student privacy and digital literacy has already been summarised [into a short read](#), this information is not re-presented here. Instead, useful links for teachers and school leaders are shown in the resource list below.

Resource list

Ethical use of edtech

Artificial Intelligence and Privacy: Issues and Challenges

Office of the Victorian Information Commissioner

Provides an in-depth understanding of AI uses in the public sector and highlights some of the challenges and opportunities that AI presents in relation to information privacy.

🔗 <https://ovic.vic.gov.au/privacy/resources-for-organisations>

Safe and Responsible AI in Australia

Australian Government Department of Industry, Science and Resources

Recognising that many relevant Australian Government initiatives are already underway, this paper seeks system wide feedback on actions that can be taken across the economy in relation to AI regulation and governance.

🔗 <https://storage.googleapis.com/converlens-au-industry/>

Utilising Ethical AI in the Australian Education System

Australian Human Rights Commission

Explores the strengths, risks and challenges of generative AI tools. Also explores the issue of ensuring digital equity.

🔗 <https://humanrights.gov.au/>

DigiCom 2.2. The digital Competence Framework for Citizens

European Commission

Seeks to develop a common understanding of digital competence with an integrate framework and a snapshot of existing reference material.

🔗 <https://publications.jrc.ec.europa.eu>

SELFIEforTEACHERS

European Commission

An online tool to help primary and secondary teachers reflect on how they are using digital technologies in their professional practice. Teachers can use the tool to learn more about the digital skills they have and identify areas where they can develop further.

🔗 <https://educators-go-digital.jrc.ec.europa.eu>

A toolkit with step by step instructions is also available. This includes examples for various professional development scenarios (e.g. an individual, self-led groups, formal professional development).

🔗 <https://op.europa.eu/en/publication-detail>



Conclusions

There is evidence that edtech offers benefits for both students and teachers^[5].

The effects of edtech on student outcomes may show significant variability, however, depending on the research phase that a specific type of edtech is within. For example, the use of XR (and especially immersive VR) is still within the early adoption phase, so although this technology shows significant potential for fostering student learning, motivation and engagement, wider adoption may show more mixed results. Conversely, recent studies of DGBL have shown more positive impacts on student learning than earlier reviews, which were frequently inconsistent (e.g., Higgins et al., 2012; Tsai et al., 2012). This may reflect ongoing advancements within this type of edtech, especially the creation of 3D games and simulations. Whilst both these technologies appear beneficial for students at this stage, greater uptake and evaluation of the impacts is required before more definitive conclusions can be made.

The evidence demonstrates that edtech was frequently effective when teachers used learner-focused teaching strategies. Collaborative, student-led learning showed the greatest benefit for both student learning and motivation, across multiple types of edtech including DGBL and XR. Collaborative skills are expected to be more in demand as advanced digital technologies become more common in workplaces. As such, collaborative learning is likely to result in multiple benefits for students, now and in their future working lives. Where edtech is simply used to transfer traditional teaching methods to an online environment, this will limit the potential benefits for most students. One exception to this is that several different types of edtech (such as IWB and LMS) better enable multiple media formats which typically have a positive impact on student outcomes, especially for students from diverse backgrounds or with some disabilities. More generally, however, under-performing students and those from a low socio-economic background were more likely to benefit from edtech than higher achievers or those from higher socio-economic backgrounds.

Asides from improving outcomes for students, the main benefit edtech offers teachers is the potential to reduce the time required for tasks that don't involve direct contact with students. This is especially relevant for Australian teachers given the multiple demands placed on teachers (Hunter et al., 2022). Collaboration and long-term planning that includes the shared use of digital resources may help reduce the time required for lesson preparation.

AI-powered chatbots seemingly hold great potential for supporting teachers with lesson planning, locating relevant digital products, learning activities, and assessment options. Teachers will, however, need time and support to familiarise themselves with the selected technology to enable them to teach with this as effectively as possible. In order for AI to result in a net benefit for teachers, the time “saved” by using AI needs to more than offset the time spent learning how to use it effectively. Continuous professional development, and support to undertake this, will likely be ongoing requirements throughout a teachers career, so that they can develop their knowledge of, and ideally competence using, future innovations in edtech, thus maximising the benefits for themselves, their students and the education community.

Footnotes

1. Phishing is an attempt to fraudulently obtain personal information (such as credit card details or passwords) via a message falsely claiming to be from a legitimate and often well-known organisation, such as a bank or government department.
2. A collaborative (or cooperative) learning approach involves students working together on a learning activity or task. Well-structured tasks that promote collaboration between group members show the greatest impact on student learning.
3. The cognitive theory of multimedia learning posits that we recognise and process information from two channels: a verbal channel and a visual channel that recognise words and images, respectively (Mayer and Moreno, 2005).
4. Situated learning refers to the concept that learning requires both knowledge and practice in authentic settings; that is the knowledge is gained in context of the situation. XR is thus well positioned to enable situated learning. Situated learning also emphasises relationships and interactions with others in order to build understanding.
5. This article summarises research available up to 10 October 2023. Given how rapidly both technology and research within this area can evolve, readers may wish to consider more recent evidence when making decisions as to how best implement edtech within their own practice area.

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