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Reflections on the Australian Research Council–Special Research Initiative Science of Learning Research Centre: The promise of a new narrative and evidence base for education

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(Reimanis, 2019)

ABSTRACT
The Science of Learning (SoL) is fundamental to the renaissance of learning, reinstating learning, and how to promote it as the core business of education. Emerging as a new endeavour of study at the beginning of the 21st century, SoL adopts a multi-disciplinary approach to increase our understanding of learning through the convergence of neuroscience, psychology, and education. While many question the potential for SoL to impact education, arguing the gap between neuroscience and the classroom is 'a bridge too far', we suggest a bridge already exists, taking on slightly different forms globally. Here in Australia, the bridge has strong foundations in both research and practice, the product of a collaborative undertaking between academics and educators, and supported by government policy. The triad of academia, education practice, and government policy has worked together to close the divide between research findings and implementation.

KEYWORDS
Science of learning; education; research translation; implementation science; pathways to impact

What will education look like in five, ten, twenty years from now? What can neuroscience tell us about learning that we don't already know? How will the Science of Learning (SoL) revolutionise education? These are commonly asked questions of researchers in the Australian Research Council Science of Learning Research Centre (SLRC) and fellow SoL researchers internationally.

The SoL is fundamental to the renaissance of learning, reinstating learning, and how to promote it as the core business of education. Emerging as a new endeavour of study at the beginning of the 21st century, SoL adopts a multi-disciplinary approach to increase our understanding of learning through the convergence of neuroscience, psychology, and education. Changing the narrative

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around learning, SoL has moved the focus away from *what* students learn, to how they learn, how they regulate their own learning as active learners, how learning growth is measured and achieved, and how educational institutions prepare students for life-long learning.

The momentum for changing this narrative is timely. CoVID-19 has caused a major disruption to education as we know it. Teachers, school leaders and policy makers are now, more than ever, drawing on the fundamental understanding of how students learn in order to redesign delivery of education to cater for learning in a pandemic world. A world where social distancing, isolation and lock downs are the norm. A world of remote learning. A world of new and inflated emotions as students and educators cope with the current environment, whilst bracing for an uncertain future. A world where students have to be more responsible for regulating their own learning. Educators can no longer rely on conducting the process of learning, being with and in front of students throughout the day, and talking, continually questioning, and motivating the learning. Instead, lessons need to include teaching the strategies of learning to accomplish the tasks, such as allowing opportunities for student questioning, reflecting on their progress through to success, and knowing what to do when they get stuck and there is no teacher readily available at that moment. These are all part of the strategies of learning and educators must be able to support students to regulate their own learning.

While many question the potential for SoL to impact education, arguing the gap between neuroscience and the classroom is 'a bridge too far', we suggest a bridge already exists, taking on slightly different forms globally. Here in Australia, the bridge has strong foundations in both research and practice, the product of a collaborative undertaking between academics and educators, and supported by government policy. An example of the triple helix model of university-industry-government interplay in action (Etzkowitz & Leyesdorff, 1995), the triad of academia, education practice, and government policy has worked together to close the divide between research findings and implementation.

Government policy, academic research in SoL, and practitioner engagement with research evidence

International inter-governmental organisations and governments alike have systematically invested in SoL since its emergence as an integrative, interdisciplinary field of research in the late 1990s. Building on a long history of learning as an important research topic for many disciplines, including neuroscience, cognitive psychology, behavioural and social sciences, and education, the new field has the promise of over-turning what the Organisation for Economic Co-operation and Development (OECD, 2019) has described as a looming learning crisis, costing over $129 billion per year. With education systems in high-income countries failing minority groups, the crisis is not limited to third world countries, where there is too much evidence that schooling has been provided but not learning (Pritchard, 2013). Having a dedicated directorate for the Science of Learning since 2003, the United States National Science Foundation has invested over $100 million in SoL. In 2016, IBE-UNESCO and IBRO launched a joint initiative to expand the credible translation of research findings in SoL to education practices, with a specific focus on neuroscience.

In Australia, in response to recommendations made by the 2009 Prime Minister's Science, Engineering and Innovation Council (PMSEIC) report to drive transformational changes in learning and teaching, the Australian Research Council invested in the Special Research Initiative, Science of Learning Research Centre (SLRC) from 2014 to June 2020. This timely investment in SoL has been critical in ensuring that Australia is not only maintaining pace with the rest of the world, but leading the way with respect to education research, evidence-informed education, and most importantly, the translation of education research into education practice and policy.

Running in parallel, in Australia and globally, there is a growing imperative for educators to engage with research-informed evidence and adopt evidence-informed best practice. The second

Gonski review (Gonski et al., 2018) called for the establishment of a national evidence institute to ensure that education funding is spent on evidence-based initiatives proven to boost student learning. Receiving bipartisan support at a Federal level, this institute is on the verge of becoming a reality with the support of each of the State departments of education. At a State level, individual education departments have already developed their own evidence repositories (e.g., the Queensland Department of Education's Evidence Hub and Victoria's Vision for Learning). Meanwhile, engagement with evidence is now used as a measure of proficiency in the Australian Institute for Teaching and School Leadership's Professional Standards for Teachers framework, articulating that graduate teachers must 'demonstrate knowledge and understanding of research into how students learn and the implication for teaching'.

Creating a new narrative around learning

The Australian SLRC has played an integral role in creating a new narrative around learning. The Centre's achievements highlight the impressive impact that can be achieved, both scientifically and in practice, when synergies between researchers, community institutions, and educational providers are harnessed. Scientifically, significant neuroscience-led discoveries by our Chief Investigators have generated new interventions in educational practice, with many doctoral students and postdoctoral fellows being supervised across neuroscience, psychology, and education. We have shown that an individual's moment-to-moment level of attention can be characterised through the brain's electrical activity and used to predict readiness for learning (Foxe & Snyder, 2011; Harris et al., 2017). Moreover, the ability to exert cognitive control is a key operation when it comes to being an effective learner (Collins & Frank, 2013; Filmer et al., 2017; Vergehese et al., 2016), that teacher-student and student-student social synchronicity plays a key role in student engagement and learning (MacMahon, Carroll, & Gillies, 2020), and attention and emotional training paradigms can be used to alter cognition and enhance learning (Carroll, McCarthy et al., 2020; Sherlock & Mulvihill, 2020). In practice, a research-driven SLRC numeracy program lifted NAPLAN outcomes in a test region in South Australia, resulting in additional State Government and Foundation funding for further studies (Leonard & Westwell, 2020) and an intervention to reduce mathematics anxiety in pre-service teachers has been developed and validated (Buckley et al., 2020). See Carroll, Cunnington, and Nugent (2020) for further details of studies conducted.

Internationally, the SLRC has made significant contributions to our understanding of student learning while also making important progress to the implementation of research findings to practice. Showcasing its achievements at the 2017 International Conference Science of Learning – Research to Reality, and the 2019 Science of Learning Symposium, the Centre's research translation was seen as 'gold-standard' by researchers globally (US Science of Learning Centers, University of Hong Kong, National Institute of Education – Nanyang Technological University Singapore, Lundt University, and Brazil Science of Learning Network) for its deeply embedded partnerships with education bodies, schools and individual teachers. Figure 1 illustrates the integration of research and translation activities within the Centre.

Translating research findings from SoL

Through the concerted outreach and translation efforts of the SLRC Translation Arm, the Centre has established itself as a valued member of the national education community, being a trusted authority for policy makers, schools and the broader education community. With strong and enduring partnerships with education bodies, the SLRC has been able to influence changes in educational practice and policy, particularly around the evidence-base and teacher research

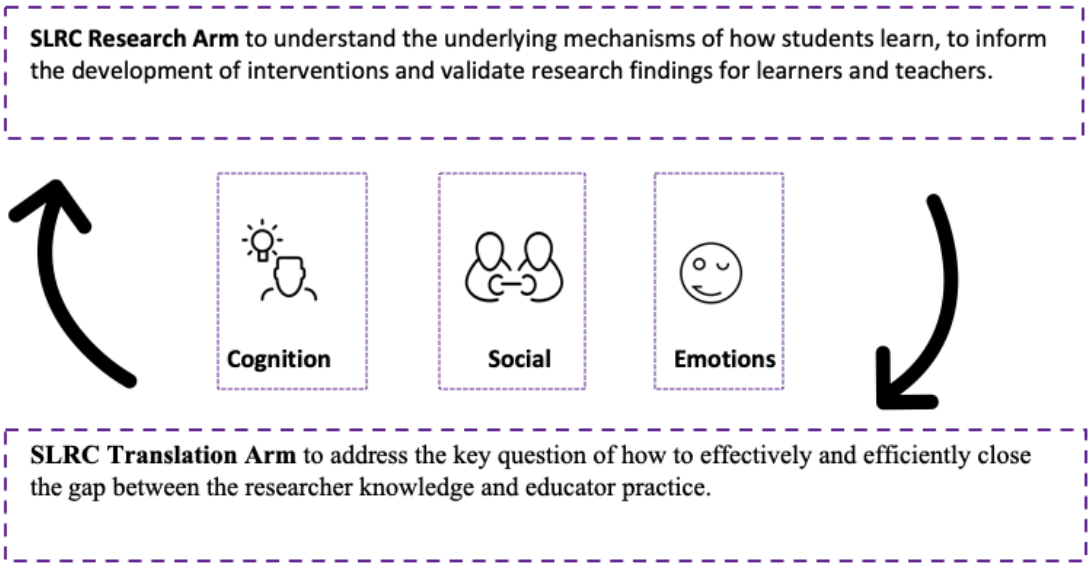

Figure 1. Integration of research and translation arms of SLRC.

capabilities. Numerous translational activities have been ongoing to ensure that the research findings are widely known and translated into actionable outcomes. These include:

- the creation of preservice and postgraduate courses in SoL at The University of Queensland and the University of Melbourne with increasing numbers of undergraduate and postgraduate students now trained in SoL;
- the SLRC's professional development training programs which have been delivered in schools in South Australia, Victoria and Queensland, covering research-based topics including focusing learner attention, effective feedback, social emotional learning, and problem solving;
- the creation of a set of 12 evidence-based principles of learning known as the PEN Principles (Psychology, Education, Neuroscience) which are available in freely downloadable fact sheets, podcasts and videos;
- the development of a set of resources for teachers, students and families to support remote learning; the development of a Massive Open Online Course (MOOC) *Deep Learning through Transformative Pedagogy*; the establishment of the *Nature Partner Journal Science of Learning* with the Community pages;
- the development of the SLRC Higher Education Learning Framework, a set of seven principles for effective learning, that have been trialled in courses across disciplines and is now embedded across a number of teaching and learning initiatives at The University of Queensland (Carroll et al., 2018; Nugent et al., 2018);
- and the SLRC regular seminar series which is now being hosted in partnership with the Australian Council for Educational Leaders.

Since 2017, the SLRC Research Translation team has continued to work collaboratively with key partners to not only translate the research findings from SoL but to transform educational practices in a sustainable and scalable way through developing an evidence-informed model of research translation through our Partner Schools Program (MacMahon, Leggett et al., 2020). Acknowledging the research-practice gap and that a one-size-fits-all approach to the application of research findings to practice will not, and does not work, the Centre has developed an evidence-informed research translation model, which captures the important bi-directional interaction between educators and researchers, using a research broker to help bridge the gap between research and practice (see MacMahon, Nugent, & Carroll, 2020). Teachers and school leaders are supported through the Partner Schools Program to identify a school-based phenomenon or problem of practice and to engage

with research to investigate and evaluate it. Through these partnerships, we co-construct new knowledge around SoL that is relevant and specific to individual school needs and that can be supported over time to have an actionable, scalable and sustainable impact on learner outcomes. Moreover, we build teacher capacity in understanding and engaging with research and evidence that is relevant to their context, and to actively implement, monitor, evaluate, reflect upon and adapt the interventions as necessary (see MacMahon et al., 2020, for a full description of the SLRC Partner Schools program).

In sum, our researchers, all world leaders in their respective fields, have been bridging the gaps between neuroscience, education and psychology, providing truly integrated solutions for education. Working closely with the education community at a policy, school and teacher level, they have demonstrated that it is possible to impact not only what students learn, but how they learn. Figure 2 displays the pathways to impact that the SLRC has had in its seven years of operation.

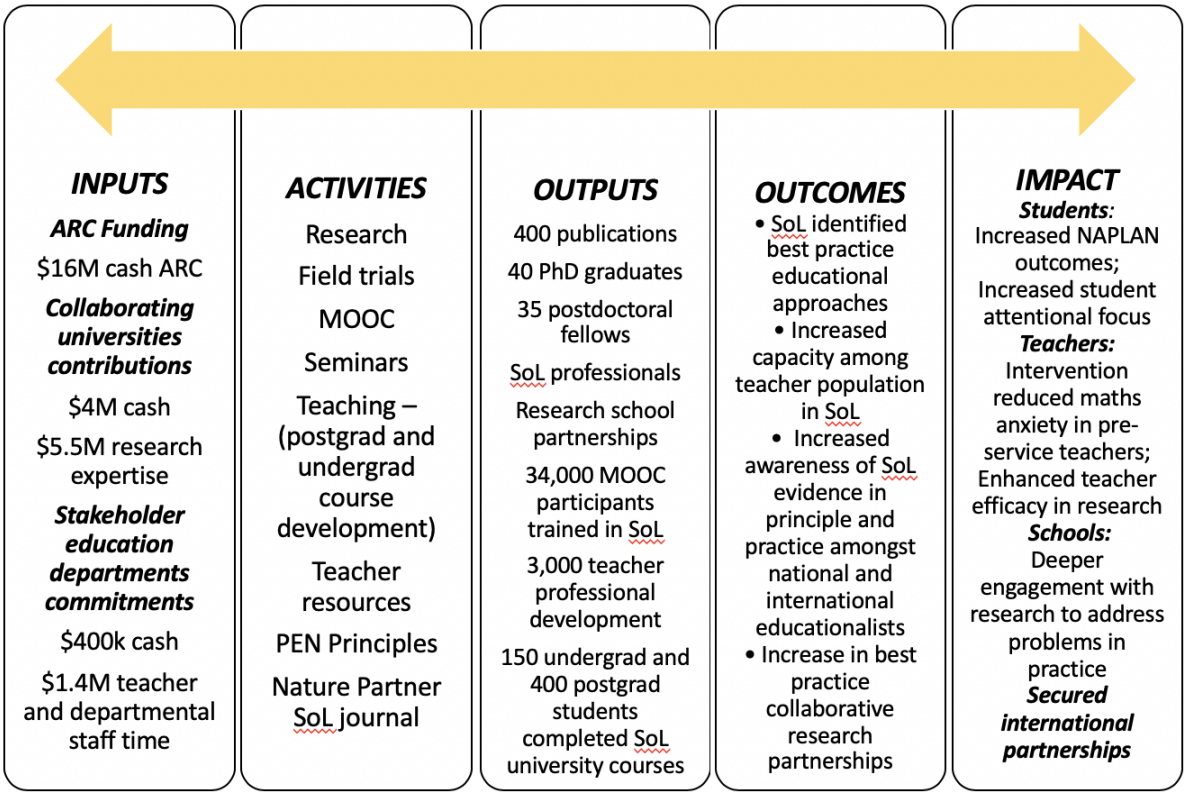

Figure 2. ARC Science of Learning Research Centre (2014-2020)

Continuing to grow our understanding of learning – implementing evidence, building capability and improving student learning outcomes

There is no doubt that the SLRC has been able to contribute important knowledge to an evidence base to inform student learning. In the seven years since it was established, 25 Chief Investigators in neuroscience, education, and cognitive psychology from eight universities have trained over 40 PhD students and 35 postdoctoral researchers creating a workforce of over 100 researchers. Collectively we have produced in excess of 400 publications and our research findings have reached over 8,000 people through seminars, workshops, lectures and the like. To date we have trained more than 3,000 teachers in person through our professional development training programs, and engaged with 34,000 participants through our MOOC. The Community pages of the *Nature Partner Journal Science of Learning* have recorded over 64,600 visits from 44,000 people and 95,400 page views. But the fact

is, there is much work yet to be achieved to impact the 4 million students taught by 290,000 teachers across almost 10,000 schools in Australia.

Through its research translation arm, the SLRC actively promotes educator engagement with evidence with over a third of the Centre's activities dedicated to the implementation and translation of research findings. At the same time there has been a growing imperative for educators and policy makers alike to engage with the expanding body of evidence around learning, as witnessed by the Australian Institute for Teaching and School Leadership's Professional Standards for Teachers and the establishment of the national evidence institute. However, the work of the SLRC has clearly demonstrated that engaging with evidence is not sufficient to bring about change; the evidence must be implemented and its impact evaluated. Learning will only be impacted when the evidence is made actionable. In order to benefit students broadly, the evidence must be made actionable in such a way that it is both sustainable (resilient to staff turnover) and scalable (across classrooms, schools, districts and states). Building capability in our teachers around engaging in research and evidence is also essential for scalability and sustainability.

With a vision to improve learning outcomes for all students, the SLRC has been committed to continuing to improve our understanding of student learning, and the application and translation of this new knowledge for the benefit of all learners, teachers, schools and education departments. The SLRC in partnership with educators and with the support of state and federal government policy has bridged the research – practice divide. The future of education will be determined by how well we are able to maintain and expand the bandwidth of the bridge in order to hasten the knowledge exchange, and establish a new narrative for education that focuses on learning and learner outcomes.

Notes on contributors

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John Hattie has been Director of the Melbourne Educational Research Institute at the University of Melbourne, Australia, since March 2011. His research interests include performance indicators, models of measurement and evaluation of teaching and learning. John Hattie became known to a wider public with his two books Visible Learning and Visible Learning for teachers.

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