



ANNUAL REPORT
2020



University of
South Australia

ABOUT C3L

THE CENTRE FOR CHANGE AND COMPLEXITY IN LEARNING (C3L)

The Centre for Change and Complexity in Learning (C3L) focuses on the complex relationship between human and artificial cognition, how it changes society, knowledge processes, and teaching and learning. The C3L uses complexity science methodologies, promotes the uptake of applied research and engages with the community, government agencies (healthcare, education, defence, cultural) and industry to research the lifespan of learning and the role of UniSA in serving all stages of knowledge and learning processes.

We have 4 key Research Streams

- Change in Complex Systems (CCS)
- Infrastructures for AI (IAI)
- Human and Artificial Cognition (HAC)
- Learning Analytics (LA)

'Education must not simply teach work, it must teach life.'

- W.E.B. Dubois

DIRECTOR'S FOREWORD

PROFESSOR GEORGE SIEMENS
CO-DIRECTOR OF C3L

The past year has been challenging for academics and students globally. Rapid, forced, changes to teaching and learning has accelerated the trajectory of digital learning. This digitization achieved what feels like a decade's worth of progress in adoption of new technology in a span of a few months. The impact globally has been dramatic and, in many cases, devastating. For researchers in C3L, our focus is on better understanding the impact of technology and rapid change on how individuals and systems learn. C3L researchers come from diverse backgrounds: computer science, engineering, education, and psychology. This diversity makes us uniquely prepared to evaluate the longer-term impact of digitization on schools, learning, sensemaking, and society in general.

In 2020, our researchers made an impact in Australia and globally. We engaged in projects with partners as wide ranging as local schools in Adelaide to the World Health Organization. We received funding for our work from local agencies and international foundations such as the Bill and Melinda Gates Foundation. Our researchers were featured internationally for their work in digital learning, the psychology of emotion, math and stats anxiety, and in the emerging world of artificial intelligence. Our expertise was expressed through extensive international (online) presentations and publications. As difficult as the year was, the pause in travel provided C3L with the opportunity to shape our research vision with national partners and to sharpen our work in four broad themes: human and artificial cognition, AI infrastructure, social and learning analytics, and complex systems. Additionally, we continued to develop our support for HDR students – with two successful PhD completions and now almost a dozen PhD students within C3L.

We look forward to 2021 as a year that marks an inflection point for C3L. After several years of developing our research mission and organizational processes, we enter 2021 with an exceptionally talented research team and with growing engagement from academics across UniSA. The learning and knowledge work problems that face schools, universities, governments, and businesses are the expertise of our researchers. As the world digitizes and as data becomes an increasingly central part of how decisions are made, the expertise of our team will only continue to grow in importance.



C3L ANNUAL REPORT 2020

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HUMAN AND ARTIFICIAL COGNITION (HAC) CONGRESS



The 2020 Human and Artificial Cognition delegates

After several decades of rapid technological advancement, an important area of research has become emerged regarding the ways that humans and machines coordinate when involved in knowledge work. How do doctors make decisions? How do military personnel manage overwhelming amounts of information? How do banks determine fraudulent transactions? Questions of this nature reveal the need for theories and conceptual models that can be tested and evaluated empirically to determine the optimal ways for human and artificial cognition to interact. In January 2020, C3L organised a one-week Human and Artificial Cognition (HAC) Congress at UniSA. International experts from the fields of cognition, education and computer science discussed what should be automated, augmented cognition and the skills that will essentially remain

human. Invited speakers included Professor Rose Luckin and Professor Geraint Rees from University College London, Professor David Hung and Dr David Huang from the National Institute of Education in Singapore, Professor Javid Sheikh formerly of Stanford University and now with the Weill Cornell Medical School in Qatar, Xiangen Hu from Central China Normal University in Wuhan, Mr Ilkka Tuomi from Meaning Processing Ltd., and Dr Kelsey Medeiros from the University of Nebraska Omaha.

C3L is organising a follow-up event, HAC 2.0, to be held online in mid-2021.

Project lead

Professor George Siemens

EMPOWERING LEARNERS FOR THE AGE OF AI

Learning in digital settings produces data. Data, in turn, gives rise to analytics in order to better understand what is happening when individuals interact with one another, and with curriculum, in online settings. These data soon give rise to one of the most important and impactful trends impacting modern society: Artificial intelligence. Additionally, countries around the world are allocating billions of dollars to prepare for Artificial Intelligence — investing in research, enterprise and human capabilities. To meet this emerging reality, students, professionals and citizens need to learn how to interact with AI.

To explore this area, In December 2020, C3L hosted a two-day conference on Empowering Learners for the Age of AI. The conference drew over 700 participants from around the world. Panelists and keynote speakers explored how AI might impact learning across a range of sectors including healthcare, military, education, and government. Discussion also focused on moral and ethical aspects of AI, such as bias.

International keynote speakers included: Professor Rose Luckin (University College London), Professor Sidney D'Mello (University of Colorado at Boulder), Professor Toby Walsh (University of New South Wales) and Professor Judy Kay (University of Sydney)



Project lead

Professor George Siemens and Professor Maarten De Laat

Partners

Empowering Learners for the Age of AI launches an important area of research for C3L members and our growing network of collaborators. This includes: Professor Simon Buckingham Shum (University of Technology Sydney), Professor Dragan Gašević, (Monash University), Associate Professor Sarah Howard (University of Wollongong), Associate Professor Jason Lodge (University of Queensland), and Professor Lina Markauskaite (University of Sydney)

EPIC CHALLENGES

This project is a brand new initiative in Australia and is being offered to South Australian students for the first time on behalf of C3L and UniSA Connect. Students in the 21st century require a combination of soft skills and STEM-based skills to ensure successful transition into university and the emerging workforce. This course is designed with a project-based curriculum coupled with an enterprise education focus. The innovative nature of the curriculum involves student engagement in an 'Epic Challenge'. An Epic Challenge is defined as an open-ended, real world complex problem which does not have an existing or known solution and is multi-disciplinary by nature. The framework that underpins the project is the Innovative Conceptual Engineering Design (ICED) methodology. The ICED methodology and Epic Challenge program was conceived by Dr Charles Camarda, former NASA Astronaut and Senior Advisor for Engineering Development in the Engineering Directorate at NASA Langley Research Center. The challenge involves proposing a current NASA problem to students to solve and will employ problem based learning pedagogy.

Students participate in a connected learning environment and develop skills in areas such as team development, knowledge capture (problem definition and problem immersion), creative concept generation (creativity tools, creative ideation, concept evaluation), rapid concept development (analysis, prototype, test, design/optimize), and finally concept evaluation and selection. Students also develop STEM skills such as engineering design practices, mathematical literacy, technical expertise and the ability to generate, analyse and understand empirical data. Engaging in this program may help students achieve success at university. The course



NASA astronaut Dr Charles Camarda speaking to Epic Challenges students

currently runs as a UniSA Connect short course with the aim to develop the course so students can receive UniSA credits when they take this course as high school students.

If you want to learn more

You can find more information on our Epic Challenges website. <https://epiceducationfoundation.org/>

Project lead

Dr Rebecca Marrone and Dr Vitomir Kovanovic

Partners

Ana Gebejes (Chief Learning Officer, Epic Education Foundation) and Charlie Camarda (former NASA astronaut).

COVID-19 SCHOLAR PEER HUB – THE GENEVA LEARNING FOUNDATION



The Geneva Learning Foundation (TGLF) is a Swiss non-profit with the mission to develop, trial, and scale up new ways to lead change to tackle the challenges that threaten our societies. As part of their global initiatives, the Foundation organises "Teach to Reach", a new Scholar Accelerator programme open to immunisation professionals involved in workforce training and professional development at national and sub-national levels, as well as front-line immunisation staff. The Immunisation Scholar programme has been running in collaboration with the World Health Organisation and other global partners since 2016. Its network comprises over 20,000 alumni from 95 countries. The programme has demonstrated success in fostering peer-learning and sharing of ideas and initiatives between immunisation professionals, leading to better public health outcomes.

To provide support to immunisation professionals, TGLF is starting a new COVID-19 focused programme, supporting immunisation professionals as they reshape programmes in response to the global pandemic.

C3L is working in partnership with TGLF to evaluate the programme's effectiveness and contribute to ongoing decision-making and understanding of the effectiveness of workforce training programmes on public health outcomes. To provide a comprehensive analysis of the programme, the research team developed an extensive dashboard to track and monitor Scholar's learning progress in the course that together paint a picture of the knowledge creation and spread within the learner network, and also the impact of such exchanges on immunisation programme performance.

If you want to learn more

To learn more, follow the link to the UniSA press release. <https://www.unisa.edu.au/Media-Centre/Releases/2020/covid-19-peer-hub-combats-vaccine-avoidance-amid-pandemic/>
Visit the TGLF website: <https://www.learning.foundation/>

Project lead

Dr Vitomir Kovanovic

Partners

The Geneva Learning Foundation <https://www.learning.foundation>

Funding

This project is funded by the Bill and Melinda Gates Foundation administered by the Geneva Learning Foundation

MATHEMATICS ANXIETY

By mid to late secondary school, about a third of Australian students report feeling tense, nervous or helpless when dealing with mathematics. The short-term effect of this anxiety is a decline in mathematics achievement, but the long-term impact is the development of a negative attitude towards mathematics and the avoidance of subjects, courses and careers that involve mathematics.

We published an article in the Australian Journal of Education which confirmed that students with higher levels of maths anxiety have lower levels of mathematical literacy. The analysis of 2012 PISA data also revealed higher levels of maths anxiety are associated with lower levels of:

- Instrumental motivation (the degree to which students believe mathematics is important)
- Self-concept (students' beliefs in their own mathematical abilities)
- Perseverance (students' willingness to work on difficult problems)
- Self-efficacy (students' beliefs about their ability to solve specific maths problems)

Crucially, our study showed the domino effect of these variables upon one another. Using structural equation modelling, the data showed that low instrumental motivation and self-concept lead to maths anxiety, which affects perseverance, which in turn affects self-efficacy and negatively impacts mathematical achievement. The results support previous research that shows a student's maths anxiety may be alleviated by increasing their self-concept in mathematics.



We will keep developing our research program on mathematics anxiety in 2021 and we are collaborating with Loreto College in Marryatville (SA) and Oxley College (NSW).

If you want to learn more

You can find the original paper on the [Australian Journal of Education website](#). This article was featured on the [ACER Discovery website](#).

Project lead

Dr Florence Gabriel and Dr Rebecca Marrone

Partners

Dr Sarah Buckley (ACER)

STATISTICS ANXIETY

Statistical training is important in a wide range of fields, but many students dislike it or even fear it. Negative attitudes towards statistics can reduce academic performance and disrupt the teaching-learning process, making it important to better understand these attitudes so that effective interventions can be designed. In this project, we explore the nature of statistics anxiety and its links to mathematics anxiety.

We conducted an exploratory and descriptive study of the relationships between different dimensions of attitudes towards statistics, a preliminary step in the process of designing better teaching strategies. University students completed the Auzmendi Scale to Measure Attitudes towards Statistics, which measures five dimensions of attitudes about statistics: perceived utility-value, anxiety, security-confidence, pleasantness, and motivation. Early results from Canadian and Spanish samples showed that the anxiety items are the most strongly interrelated and that pleasantness predicted the motivation, security-confidence, and value-utility dimensions. In turn, security-confidence predicted value-utility, and both combined with motivation predicted anxiety. Additional data were collected on Australian students and are currently being analysed.

If you want to learn more

Early results have been published in the [INTED2020 conference proceedings](#).

Project lead

Dr Fernando Marmolejo-Ramos and Dr Florence Gabriel

Partners

Professor Ana Ruiz-Ruano García (University of Granada), Professor Jorge López Puga (University of Granada), Professor Andrew Miles (University of Toronto Mississauga)

CORPORATE LEARNING ANALYTICS: ANALYTICS-BASED TECHNOLOGIES FOR CORPORATE LEARNING AND DEVELOPMENT

The corporate learning industry is booming with a vast array of digital learning tools for developing the future workforce. The industry is valued at \$14.23 billion as of 2017 and expected to reach \$49.87 billion by 2026 (Corporate E-Learning, 2019). Educational technology solutions are also booming; with this industry growing at 16.3%, it is expected to double in the next five years and reach \$404 billion in total global expenditure (Global EdTech Market, 2020). Companies are increasingly aware of the need to learn and develop their employees. According to the latest Deloitte survey, 75% of companies believe they need to focus on employee learning, upskilling and knowledge creation but only 9% perceive themselves as ready for this challenge (Deloitte, 2020).

Through the Corporate Learning Analytics project, C3L examines what technologies are available for learning and development at the enterprise, what data are available to corporate leaders, and how they are using it for capability development. The project targets two distinct groups of businesses: SMEs that comprise a larger part of the economy and require to be agile to adapt to digitization processes; large corporations with resources and wide range of tools available to their employees.

Activities

- Review of grey literature and analysis of 80 analytics-based technologies available for learning and development in the corporate sector. The research resulted in an official report funded for the Institute for Adult Learning (IAL), Singapore.
- Submission of a large grant to the Workforce Development Applied Research Fund (WDARF) targeting corporate learning analytics in small and medium enterprise

- Interviews with Chief Learning Officers of international corporations. Preliminary analysis of the data is to be disseminated at the Corporate Practitioner Track of the International Conferenc.

If you want to learn more

The Corporate Learning Analytics report can be accessed at tiny.cc/clarepor

Project lead

Dr Sasha Poquet, Professor Maarten De Laat, Professor George Siemens, Lisa Lim

Partners

Dr Helen Bound (IAL), Dr Alexander Biotteau (National University of Singapore)

Funding

Research assistance support funded collaboratively by the Institute for Adult Learning in Singapore and C3L; further funding sought.

DEVELOPMENT OF LEARNING ANALYTICS FRAMEWORK FOR PRIMARY AND SECONDARY SCHOOLS



St Michael's College is a large Independent Catholic R-12 school located in the western suburbs of Adelaide, South Australia. St Michael's is a progressive school increasing its uptake and utilisation of educational technologies, which affords new opportunities to investigate data-driven and learning analytics approaches for establishing measures of learning success and student skill development.

With the recent calls for significant changes in the Australian school system by Gonski et al. (2018), there is a growing need to support students in their learning progression, enable more personalised learning and support teachers in monitoring student progressions. In this regard, novel analytics technologies have been identified as one of the promising avenues for further exploration, resulting in a significant push towards their adoption in Australian schools. However, as previous research by Colvin et al. (2016) has identified, successful adoption of analytics requires significant preparation by institutions and appropriate level of institutional readiness to enable full utilisation of analytics systems in practice.

To provide the foundation for the development of novel learning analytics models within St Michael's College, this project outlines the comprehensive preparatory research and development work necessary for successful development and adoption of learning analytics systems and their use to inform teaching and learning practice. This includes:

1. Develop institutional capacity for learning analytics adoption through the organisation of professional development workshops for school staff and management.
2. Support school leadership in conceptualising the role of learning analytics in supporting learning and teaching at the College.
3. Conduct collaborative research project to develop a comprehensive learning analytics adoption framework, encompassing different aspects of Learning Analytics adoption within the College.
4. Explore further avenues for future collaboration regarding potential research and applied learning analytics projects.

Project Lead

Dr Vitomir Kovanovic and Dr Srecko Joksimovic

Partners

St Michael's College, Henley Beach

Funding

The project is funded by the St Michael's College, Henley Beach

TALKHUB



The Teaching and Learning Knowledge (TALK) hub is a platform where teachers can share their challenges by asking questions. These questions are then forwarded to relevant researchers who will provide answers and academic resources based on current evidence-based practices. TALKhub, acting as a national platform in bringing educational knowledge and expertise together, will deliver on the third priority of the Gonski et al. (2018) report by linking best-practice and supporting evidence-based innovation in education.

The aim of TALKhub is to be a place where productive teacher-researcher interactions are driven by questions from classroom experiences and addressed with insights from educational research. TALKhub will:

- Reduce the gap between theory and practice, and increase research impact
- Develop a practice-based research agenda
- Develop a learning community

TALKhub is based on the principle of knowledge circulation. As soon as questions are posted on the online platform, they are linked with existing research evidence and through research translation, accessible and contextualised answers are provided to address the teachers' needs. All the questions and answers are made publicly available to share experiences and increase the scale and uptake of research evidence

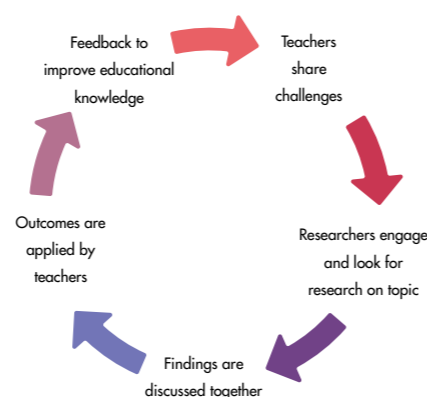
in classrooms. Through direct personal engagement, it is easier for teachers to ask specific questions in their own words and explain the teaching and learning challenges that they have experienced. As a result, there will be a fast and personalised connection between research and practice to expose and engage schools and teachers with new insights to improve learning outcomes. This relationship will also be reciprocal as dialogue and feedback from teaching practice will help academics to adjust their research program, following practitioners' needs.

If you want to learn more
Visit the TALKhub website to find out more.

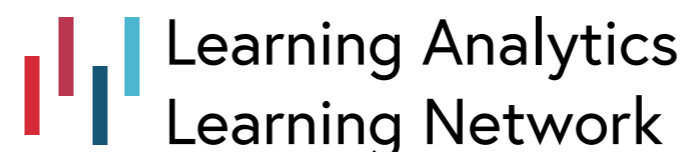
Project lead
Dr Florence Gabriel and Professor Maarten de Laat

Partners
Professor Martin Westwell (SACE Board), Dr Justin Dellinger (University of Texas at Arlington), Dr Niek van den Berg (Netherlands Initiative for Education Research), Ms Emma Smerdon (Teacher ambassador, Adelaide)

Knowledge Circulation Process



LEARNING ANALYTICS LEARNING NETWORK (LALN)



Data science has emerged as an important part of educational research and practice in recent years, producing a rapidly growing demand for a workforce that is literate in data science methods and cyberinfrastructure, as well as competence in the specific nature of educational data, research, and practice. However, there is not enough graduate programs or other sustained training activities to meet this need. As a result, much of the learning analytics workforce lacks key competencies.

To address this gap, a consortium consisting of the University of South Australia, the University of Pennsylvania, and the University of Texas Arlington have worked to create the Learning Analytics Learning Network (LALN). Monthly meetups are being held worldwide and local research community leaders in 30 cities have agreed to participate, from New York City and Silicon Valley to Kyoto, Manila, and Frankfurt.

Cities take turns hosting a distinguished speaker, streaming the event online so other cities can join (events are recorded for asynchronous participation). Moderated discussions are held locally and online in Canvas. There is also a learning activity and time for project group formation and networking. Activities and exercises are focused on beginner, intermediate, and expert categories. They range from introducing participants to learning analytics to helping them learn to use modern and emerging cyberinfrastructure for data science, including activities such as Python and

R in cloud computing, deploying common learning analytics algorithms such as Bayesian Knowledge Tracing efficiently at scale, or analysing unstructured text data.

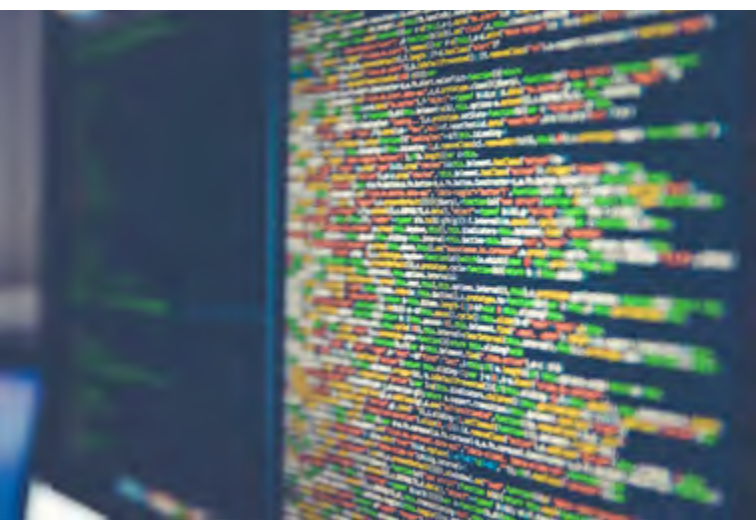
Our activities serve both as an introduction to methods for new members of the field and as continuing education for existing members of research workforce, responsive to changes in the tools, algorithms, and the technologies needed for data science. Schedules are determined centrally, but local coordinators take turns creating activities and exercises for a broader audience.

If you want to learn more
You can find more information on the [LALN website](#) as well as workshop materials and recording of previous events on the [Resource Hub](#).

Project leads
Dr Florence Gabriel and Professor George Siemens

Partners
Dr Justin Dellinger (University of Texas at Arlington) and Professor Ryan Baker (University of Pennsylvania)

TRUST IN ALGORITHMS



Algorithms are being adopted by institutions, organisations and governments to crunch the vast amounts of information amassed by these social sectors. More importantly, algorithms have a great social power as they are being trusted to assist in decision making in high and low-stake contexts. However, given that algorithms are of a statistical nature and have an associated degree of explainability, it can be entertained that a person's level of statistical literacy may play part in the level of trust placed on algorithms. Statistical literacy is essential in that it is needed to make sense of probabilistic and statistic related information. This research line examines the role of statistical literacy in trust in algorithms.

Project lead
Dr Fernando Marmolejo-Ramos

Partners
Dr Florence Gabriel, Dr Rebecca Marrone, Professor George Siemens, Dr Kelsey Medeiros (University of Nebraska) and several other research teams from international universities.

The fourth industrial revolution is characterised by the ubiquity of information and digital technologies. This revolution is epitomised in what is known as artificial intelligence (AI); broadly speaking, any type of technology that automates processes and that exhibits human-like intelligence.

AI relies on 'data' and 'algorithms' and, together, permeate many sectors of society. While data can be defined as information about objects, events, processes and persons that is encoded digitally, algorithms are defined as procedures designed to perform automated tasks by using datasets and assist reasoning and decision-making. In other words, data are used to feed algorithms and algorithms are used to drive AI agents; i.e. algorithms are the 'ghost in the shell', the agents that connect data and AI and drive the observed behaviour of both in learning processes.

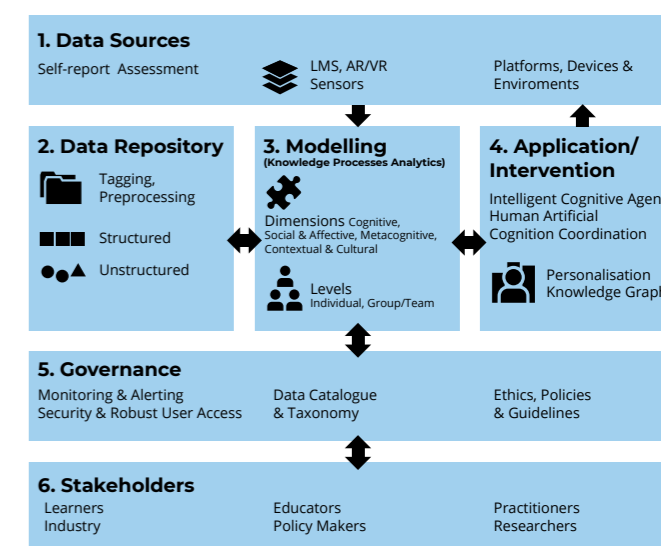
INTELLIGENT COGNITIVE ASSISTANTS IN LEARNING ENVIRONMENT - BOEING

Digital networked technologies can improve how people engage in knowledge processes such as learning and sensemaking. To date, this potential has been pursued through research into personalized learning, intelligent tutoring systems, learning analytics, and adaptive feedback. Despite the volume of work and innovations, the potential of advanced technologies is yet to be fully realized. We posit that the limitations associated with existing data infrastructures act as a critical barrier to developing next generation approaches to learning and knowledge processes in general. The affordances of advanced machine learning and AI methods cannot be fully leveraged using traditional data structures and limited data sources. To address this challenge we propose a data infrastructure that a) integrates data from multiple sources, b) enables various access permissions to different stakeholders, c) provides model building and algorithm development within the data lake, and d) allows for the implementation of real-time analysis outputs including adaptive feedback and dashboards for both learners and teachers. This technical environment is foundational for the utilization of AI in knowledge processes and to establish advanced applications such as personal knowledge graphs and contextual learning supports that are indicative of true personalized learning and sensemaking, simultaneously advancing research and practice.

If you want to learn more
Visit <https://www.unisa.edu.au/research/c3l/our-research/Infrastructure-for-AI/>

Project lead
Dr Srecko Joksimovic, Dr Jing Gao, Dr Chen Zhan

Partners
Boeing, Comunet



TRUSTED ANALYTICS - CRC-P

The project is developing a platform that allows education providers to share student data and learning analytic algorithms while still preserving the privacy of students. Led by [Practera](#), a Sydney-based EdTech start-up and long-term collaborator, C3L is leading UniSA engagement in this project in collaboration with CSIRO's [Data61](#), global education company [Navitas](#), Education Technology and innovation industry hub [EduGrowth](#), and cybersecurity solution provider [Cybermerc](#).

The solution is being developed and tested within Practera's experiential learning platform which supports work-integrated learning programs, internships and skills credentialing. Previous engagement between C3L and Practera was centred around the development of personalised, analytics-driven interventions supporting students at risk of not completing the program and evaluating the impact of these interventions. A particular focus was on understanding collaboration and cooperation in team-based projects and deploying interventions to improve students' teamwork skills. This CRC-P engagement continues this work, with the additional element of adapting previously developed algorithms to work on privacy-enhanced datasets produced

by Data61. This will involve direct collaboration between Data61 and C3L to iteratively adapt their privacy preserving algorithms to learning analytic algorithms.

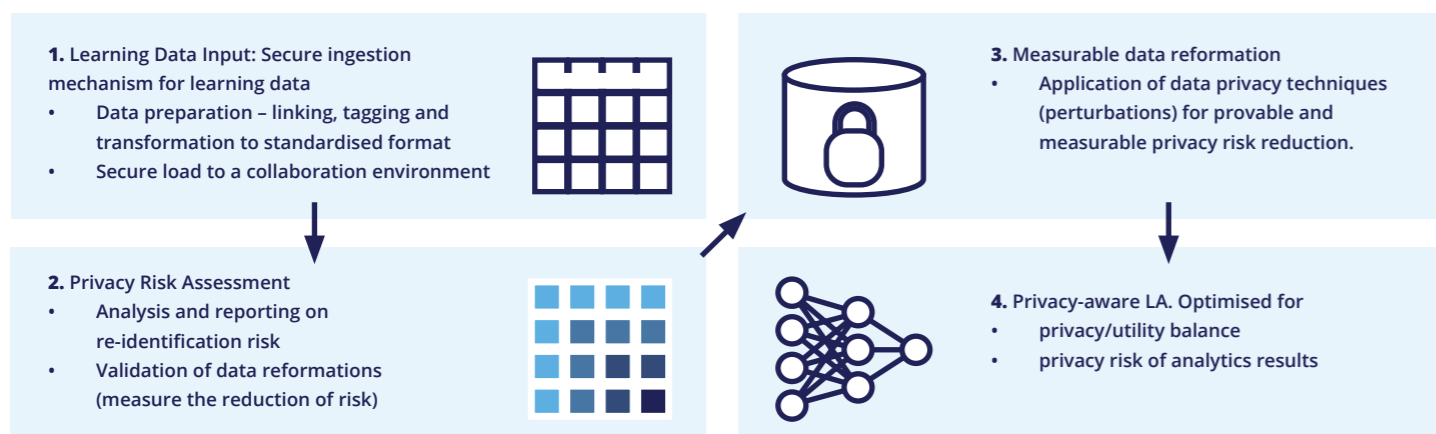
The outcome of this project will enable education institutions and companies to better support the learning needs of students using learning analytics and artificial intelligence algorithms. This will provide teachers and students with insights into what is working during learning processes and how to improve self-regulation, goal setting, and learning strategy selection.

If you want to learn more visit <https://trustedanalytics.com.au/>

Project lead
Dr Srecko Joksimovic, Professor Abelardo Pardo, Dr Chen Zhan, Dr Vitomir Kovanovic

Partners
Ruth Marshall (Practera), Djazia Ladjal (Practera), Thierry Rakotoarivelo (CSIRO Data61)

Funding
Commonwealth's [\(CRC-P\)](#)



LEARNER PROFILES



Significant changes in society and the way we live and work highlight the need for more flexible and innovative ways of teaching and learning. Today's uncertain global economy requires learners who can flourish in complexity. Traditional approaches to assessing learning and tracking progress for all learners, especially Indigenous and under-represented populations, in acquiring needed skills and mindsets are inadequate to meet this challenge. The focus of this research is the development of learner profiles. This research aims to enable individual growth through more adaptive and personalised guidance and feedback.

One of the most significant ideas for improving Australian schools, proposed in the recent Gonski report, is measuring student learning progression and learning gains. Instead of prescribing content for different year levels in absolute terms, the focus should be instead on ensuring students are making a year's worth of learning progress every calendar year. This is different for every child. Such a radical shift in measurement requires greater personalisation of teaching, taking into account each student's developmental progress, abilities, and general aspirations.

In this project, we focus on the array of collected data to examine how it can be used to support teachers in classrooms and enable them to better measure and monitor student learning progress and overall

performance. With the recent COVID-19 pandemic and shift towards blended and online learning, Australian schools quickly adopted a wide range of educational technologies, each generating a set of learning-related data that can provide insight into student progress. The central element of our approach is on the development of learner profiles and learner models specific for different context and student groups. A learner profile would provide a holistic picture of student competencies and attainments in various domains, on a level which is not possible when only relying on academic grades

Project lead
Dr Vitomir Kovanovic, Dr Rebecca Marrone and Professor Shane Dawson

Partners
Department of Education, St Michael's College, Henley Beach, St Joseph's School, Hectorville, St Columba College SA, Andrews Farm

Funding
This research is funded by the Thyne Reid Foundation.

INSTITUTIONAL APPROACHES AND STUDENT PERSPECTIVES ON COVID-19 EQUITY STUDENT SUPPORT INITIATIVES



Disasters disproportionately impact marginalised groups. The COVID-19 pandemic has caused unprecedented disruption in higher education. Universities have rapidly responded, drastically altering students' experiences. This grant seeks to understand how 10 Australian universities have endeavoured to support equity students to retain access to learning through COVID-19. The team will analyse strategies undertaken by institutions and equity students' perspectives on those strategies. They will compare data across three types of universities (research-intensive, innovative, and regional/remote) to identify in what ways institutions with significantly different cohorts can learn from each other to better support equity students in times of (future) crisis. This project is led by the University of Sydney.

If you want to learn more

You can find more information on the [NCSEHE website](#).

Project lead

Dr Florence Gabriel and Professor Abelardo Pardo

Partners

Dr Lucy Mercer-Mapstone (University of Sydney – Lead), Professor Pauline Ross (University of Sydney), Professor Susanna Scarparo (Monash University), Professor Jessica Vanderlelie (La Trobe University), Professor Tricia McLaughlin (RMIT University), Dr

Ian Zucker (University of Technology, Sydney), Professor Amanda Able (University of Adelaide), Professor Phil Levy (University of Adelaide), Mrs Sarah Jane Gregory (Griffith University), Professor Deborah West (Flinders University), Dr Lisa Bricknell (Central Queensland University), Professor Janelle Wheat (Charles Sturt University), and Dr Kasia Banas (University of Glasgow)

Funding

2020/21 [NCSEHE Research Grants Program](#)

EXAMINING TEACHERS' TALK AND LEARNING WITHIN NETWORKED LEARNING COMMUNITIES

In recent years, there has been a proliferation of NLCs in Singapore at both macro (national) and exo (zonal, cluster) levels, based on the belief that professional dialogue among teachers across schools contributes to teacher learning. NLCs are considered one of MOE's "key professional development programmes" (Goh & Tan, 2016). However, there is to date limited research on NLCs in Singapore. One local study indicated NLC fostered lateral interactions between key personnel and teachers, which apparently supported teacher learning, but there were no details on the learning (Huang et al., 2018). There is also scarce international research on what and how teachers learn in NLCs or how it shapes their practice. Katz and Earl (2010) observed that there was little research on how networks work in educational contexts and how to facilitate productive networked learning.

This study aims to investigate the learning that takes place within NLCs, with the following research questions:

- What do Singapore teachers talk about in a Networked Learning Community (NLC)? How do they talk about such matters and why?
- What and how do teachers learn from their participation in an NLC?
- What do the teachers do with what they learnt from the NLC?



Project lead

Professor Maarten de Laat

Partners

Dr Phillip A. Towndrow (National Institute of Education, Singapore) & Dr Jeanne Ho (National Institute of Education, Singapore)

Funding

Office of Education Research, Singapore (OER)

SUMMER INTERNSHIPS

Every year, C3L gives UniSA Masters and Honours students the opportunity to develop their research skills during a 4-week summer internship. Students from programs in education, IT, data science and mathematics were part of the 2020 cohort. They worked on various topics including connectivism, mathematics anxiety, analysis of UniSA Online course designs, and presented their work at the end of the internship.



C3L SYMPOSIUM

C3L held a full-day symposium in May where doctoral students and researchers presented their latest research. This space was also used as a hub to discuss ongoing and future studies and scout funding agendas. Some of the topics being covered included:

- Investigating the relationship between cognitive presence, self-regulated learning and cognitive transfer
- Shifting epistemic frames to enable innovative digitally mediated pedagogy
- Examining the impact of learning analytics feedback
- Assessment of learning and development of 21st-century skills within MOOCs: A data-driven psychometric model
- Technology-Mediated Learning and Assessment of Collaborative Problem-Solving Processes Through Learning Analytics
- Educational Jurassic Parks: dinosaurs navigating transition in Clinical and Health Sciences
- Creativity and Innovation in Education: Preparing for the Future of Work

VISITORS

PROFESSOR PHIL WINNE



Phil Winne is Professor at Simon Fraser University and formerly a 2-term Tier I Canada Research Chair. He researches self-regulated learning, metacognition and learning analytics; and develops software technologies to support learners and gather big data for learning science. He is a Fellow of the Royal Society of Canada, the Canadian Psychological Association, the American Educational Research Association, the American Psychological Association, and the Association for Psychological Science. Other honours include the Robbie Case Memorial Award for outstanding contributions to educational psychology in Canada, the Barry J. Zimmerman Award for exceptional theoretical and empirical scholarship in research on studying and self-regulated learning, and the Mentorship Award for a member of the Canadian Society for the Study of Education who supports and encourages graduate students in education as a mentor of educational research.

Professor Phil Winne visited C3L in February 2020. He gave a presentation for UniSA's Teaching & Learning Breakfast Series, entitled *Engineering Serviceable Learning Analytics*.

PROFESSOR CHRIS BROOKS



Chris Brooks is Assistant Professor of Information at the University of Michigan. He builds and studies the effects of educational technologies in higher education and informal learning environments. Dr. Brooks has a particular domain focus on data science education and methodological interests in predictive modelling, learning analytics, and collaborative learning. Professor Brooks is passionate about technical skills instruction and teaches data science courses in both the graduate and undergraduate levels, most notably in the new Master of Applied Data Science program. In addition to this traditional form of education, Brooks teaches applied data science and computer science courses on the Coursera platform, and has impacted over 30,000 learners through these efforts. In 2017 Dr. Brooks was recognized with the UMSI teaching award, and in 2018 he was part of a team awarded the Coursera Innovation award.

Professor Chris Brooks visited C3L in March 2020. He gave a presentation for the webinar, *Issues with Learning Analytics Predictive Models*, co-hosted by C3L and ASCILITE LA-SIG.

C3L'S 2021 ACTIVITIES

After a productive 2020, C3L is turning its attention to an even busier 2021. The key metrics of C3L success include grants, publications, PhD students, and international collaboration. In late 2020, C3L applied for Centre status at UniSA through the DVC-R's Scale and Focus program. This program, successfully confirmed in early 2021, will provide C3L with the resources to expand its research and provide greater collaboration with academics across campus, with over 40 academics representing major university departments. This inter-disciplinary team will conduct research and pursue grants in healthcare, business, education, engineering, computer science, psychology, and related fields. The first three years since C3L's founding were focused on creating internal processes and practices, developing global networks, building research relationships in South Australia and nationally, identifying and recruiting top researchers, and developing a clear and compelling vision research agenda. After a successful 2020, the infrastructure for future success has now been established. The focus of 2021 is to scale and increase the impact of our already stellar success.

Four key research themes have been identified as foundational for C3L and developing each one, as well as bringing in our new research colleagues from the Scale and Focus award, will be the primary work of 2021.

1. Human and artificial cognition. This area of research focuses on how humans and artificial intelligence coordinate in knowledge work, specifically in assigning cognitive activities to artificial agents and determining which should remain the domain of humans.

2. AI Infrastructure. As organizations seek to improve real-time support for students and employees, the short comings of traditional technology infrastructure are soon realized. Data for Artificial Intelligence Research (DAIR) is C3L's next generation technology infrastructure to support the work of students and researchers by providing real time analysis and intervention opportunities.
3. Social and learning analytics. C3L is home to many of the top cited scholars, globally, in learning analytics. As such, our researchers are experts in working with social and learning data in order to gain insights into the habits, dispositions, and behaviours of learners.
4. Complex Systems. Modern life is networked and global. Understanding the role of education and learning in this environment requires the tools and techniques of complexity science. This area of research involves developing leadership to navigation complexity, applying complexity science methodologies in answering research questions, and researching models of systemic change as a result of digitization and datafication.

RECOGNITION

AWARDS/ACHIEVEMENTS

Dr Srecko Joksimovic has been recognised as a Rising Star by the Australian. He is one of Australia's top young researchers in the field of educational technology.

Dr Florence Gabriel was invited to be featured as one of the world-leading experts in behavioural science on the [Psychwire](#) platform.

MEDIA ENGAGEMENT

Professor George Siemens was interviewed and features on numerous local, national, and international media stories on digital learning including: The future of learning and AI: <https://www.theage.com.au/national/empowering-learners-for-the-age-of-artificial-intelligence-20201210-p56mc3.html> and Learning Hack Podcast on Change and Complexity in Learning: <https://learninghack.libsyn.com/lh-24-change-and-complexity-with-george-siemens>.

Dr Fernando Marmolejo-Ramos's ground-breaking research "Your face and moves seem happier when I smile. Facial action influences the perception of emotional faces and biological motion stimuli" has received national (e.g. 9 News, ABC radio, 3AW Melbourne) and international (e.g. Forbes magazine, CNBC, RNZ Sunday morning, UNTV Philippines news) media attention.

Dr Florence Gabriel gave interviews about her work on mathematics anxiety for Mix Radio Adelaide, ABC Radio Afternoons, ABC Breakfast and ABC Radio Saturday AM. Her study on mathematics anxiety was also featured in Teacher magazine, Acer Discover, MindFood, EurekAlert!, NewsWise, Scimex and ScienceDaily.

The work on the Covid-19 Scholar Peer Hub led by Dr Vitomir Kovanovic and the Geneva Learning Foundation was featured in Scimex and Open forum. The CRC-P project, Trusted Analytics, led by Practera and Dr Srecko Joksimovic was featured in Campus Morning Mail.

2020 PUBLICATIONS

Ahmad Uzir, N. A., Gašević, D., Matcha, W., Jovanović, J., & **Pardo, A.** (2020). Analytics of time management strategies in a flipped classroom. *Journal of Computer Assisted Learning*, 36(1), 70-88.

Barbosa, G., Camelo, R., Cavalcanti, A. P., Miranda, P., Mello, R. F., **Kovanović, V.**, & Gašević, D. (2020). Towards automatic cross-language classification of cognitive presence in online discussions. In *Proceedings of the Tenth International Conference on Learning Analytics & Knowledge*, 605-614.

Chen, B., & **Poquet, O.** (2020). Socio-temporal dynamics in peer interaction events. In *Proceedings of the Tenth International Conference on Learning Analytics & Knowledge*, 203-208.

Coles, N. A., March, D. S., **Marmolejo-Ramos, F.**, Banaruee, H., Butcher, N., Cavallet, M., et al. (In press). The Many Smiles Collaboration: A Multi-Lab Foundational Test of the Facial Feedback Hypothesis. *Nature Human Behaviour*. <https://doi.org/10.31234/osf.io/cvpuw>

Dawson, S., Pardo, A., & Siemens, G. (2020). SPARK: A Learning Analytics Leadership Framework. Companion Proceedings of the International Conference on Learning Analytics and Knowledge, Frankfurt, Germany.

Dohn, N. B., Jandrić, P., Ryberg, T., & **de Laat, M.** (Eds.). (2020). *Mobility, Data and Learner Agency in Networked Learning*. Springer.

Duff, A., **Zamecnik, A., Pardo, A.**, & Smith, E. (2020). The SEIRA approach: course embedded activities to promote academic integrity and literacies in first year engineering. In *Proceedings of the Tenth International Conference on Learning Analytics & Knowledge*, 218-223.

Fincham, E., Rózemberczki, B., **Kovanovic, V., Joksimovic, S.**, Jovanovic, J., & Gašević, D. (2020). Persistence and performance in co-enrolment network embeddings. Analytics of Student Interactions: Towards Theory-Driven, *Actionable Insights*, 44.

Fulcher, D. P., Wallace, M., & **de Laat, M.** (2020). See You at the Intersection: Bringing Together Different Approaches to Uncover Deeper Analytics Insights. In *Adoption of Data Analytics in Higher Education Learning and Teaching*, pp. 95-111, Springer.

Gabriel, F., Buckley, S., & **Barthakur, A.** (2020). The impact of mathematics anxiety on self-regulated learning and mathematical literacy. *Australian Journal of Education*, 64(3), 227-242 <https://doi.org/10.1177/0004944120947881>

Goodyear, P., Hodgson, V., Jandrić, P., Bonderup Dohn, N., Ryberg, T., **de Laat, M.**, ... & Jones, C. (2020). Networked Learning: Inviting Redefinition. *Postdigital Science and Education*.

Iraj, H., Fudge, A., Faulkner, M., **Pardo, A.**, & **Kovanović, V.** (2020). Understanding students' engagement with personalised feedback messages. In *Proceedings of the Tenth International Conference on Learning Analytics & Knowledge*, 438-447.

- Joksimovic, S., Siemens, G.** J. Wang, Y. E., San Pedro, M. O. Z., & Way, J. (2020). Beyond Cognitive Ability. *Journal of Learning Analytics*, 7(1), 1-4.
- Jovanović, J., **Dawson, S., Joksimović, S., & Siemens, G.** (2020). Supporting actionable intelligence: reframing the analysis of observed study strategies. In *Proceedings of the Tenth International Conference on Learning Analytics & Knowledge*, 161-170.
- Han, F., **Pardo, A.**, & Ellis, R. A. (2020). Students' self-report and observed learning orientations in blended university course design: How are they related to each other and to academic performance? *Journal of Computer Assisted Learning*.
- Lim, L. A., Dawson, S., Gašević, D., Joksimović, S., Pardo, A., Fudge, A., & Gentili, S.** (2020). Students' perceptions of, and emotional responses to, personalised learning analytics-based feedback: an exploratory study of four courses. *Assessment & Evaluation in Higher Education*, 1-21.
- Lim, L.-A., Dawson, S., Gašević, D., Joksimović, S., Fudge, A., Pardo, A., & Gentili, S.** (2020). Students' sense-making of personalised feedback based on learning analytics. *Australasian Journal of Educational Technology*, 36(6). <https://doi.org/10.14742/ajet.6370>
- Marmolejo-Ramos, F.,** Murata, A., Sasaki, K., Yamada, Y., Ikeda, A., Hinojosa, J. A., ... & Ospina, R. (2020). Your Face and Moves Seem Happier When I Smile. *Experimental Psychology*, 67, pp. 14-22. <https://doi.org/10.1027/1618-3169/a000470>
- Martínez-Flórez, G., Barrera-Causil, C., & **Marmolejo-Ramos, F.** (2020). The Exponential-Centred Skew-Normal Distribution. *Symmetry*, 12(7), 1140.
- Matcha, W., Gašević, D., Jovanović, J., **Pardo, A., Lim, L.,** Maldonado-Mahauad, J., ... & Tsai, Y. S. (2020). Analytics of Learning Strategies: Role of Course Design and Delivery Modality. *Journal of Learning Analytics*, 7(2), 45-71.
- Matcha, W., Ahmad Uzir, N. a., Gašević, D., & **Pardo, A.** (2020). A Systematic Review of Empirical Studies on Learning Analytics Dashboards: A Self-Regulated Learning Perspective. *IEEE Transactions on Learning Technologies*, 13(2), 226-245. <https://doi.org/10.1109/TLT.2019.2916802>
- Navarro, M. C., **Marmolejo-Ramos, F.,** Vásquez, V., Carrea, B., Vélez, J. I., & Chams, M. M. (2020). An Exploratory Study for Assessment of Multimodal Semantic Memory in Colombian Children. *International Journal of Psychological Research*, 13(2), 49-58.
- Ng, J.X., **Poquet, O.** (2020). Exploratory study of analytics-based technologies used for corporate learning and development. [Internal report]. Institute for Adult Learning. Retrieved from tiny.cc/clareport
- Nguyen, Q., **Poquet, O.,** Brooks, C., & Li, W. (2020). Exploring homophily in demographics and academic performance using spatial-temporal student networks. In *Proceedings of the 13th International Conference on Educational Data Mining (EDM 2020)*, 194-201.
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- Pardo, A., & Reimann, P.** (2020). The Bi-directional Effect Between Data and Assessments in the Digital Age. In Bearman M., Dawson P., Ajjawi R., Tai J., Boud D. (eds) *Re-imagining University Assessment in a Digital World*, 165-178, Springer.
- Patston, T., Kaufman, J., Cropley A., & **Marrone R.** (2020) What is creativity in education? A qualitative study of international curricula. *Journal of Advanced Academics*, in press.
- Poquet, O.,** Jovanovic, J., & **Dawson, S.** (2020). Differences in forum communication of residents and visitors in MOOCs. *Computers & Education*, 156, 103937.
- Poquet, O., & Jovanovic, J.** (2020). Intergroup and interpersonal forum positioning in shared-thread and post-reply networks. In *Proceedings of the Tenth International Conference on Learning Analytics & Knowledge*, 187-196.
- Poquet, O.,** Tupikina, L., & Santolini, M. (2020). Are forum networks social networks? A methodological perspective. In *Proceedings of the Tenth International Conference on Learning Analytics & Knowledge*, 366-375.
- Ruiz-Ruano García, A., Miles, A., **Marmolejo-Ramos, F., Gabriel, F. & López Puga, J.** (2020), Network analysis of attitudes towards statistics: the Canada and Spain cases, in L. Gómez Chova, A. López Martínez & I. Candel Torres (eds), *14th International Technology, Education & Development Conference*, IATED Academy, 4322-4328.
- Saint, J., Whitelock-Wainwright, A., Gasevic, D., & **Pardo, A.** (2020). Trace-SRL: A Framework for Analysis of Micro-Level Processes of Self-Regulated Learning from Trace Data. *IEEE Transactions on Learning Technologies*.
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- Torre, I., Santos, O. C., & **Pardo, A.** (2020). Special Section on Data Capture and Analysis to Support Learning Engagement. *IEEE Transactions on Learning Technologies*, 13(4), 646-647. <https://doi.org/10.1109/TLT.2020.3029660>
- Tubb, A. L., Cropley, D. H., **Marrone, R., Patston, T., & Kaufman, J. C.** (2020). The development of mathematical creativity across high school: Increasing, decreasing, or both? *Thinking Skills and Creativity*, 35, 100634.
- Zhan, C.,** Roughead, E., Liu, L., Pratt, N. & Li, J. (2020). Detecting potential signals of adverse drug events from prescription data, *Artificial Intelligence in Medicine*, 104, 1-14.

2020 PRESENTATIONS AND WORKSHOPS

Siemens, G. (January 2020). *The Role of Artificial Cognition in the Future Adult Education Sector*. IAL, Singapore.

Poquet, O. (March 2020). *Evaluating Online Forum Using Digital Data*. Invited talk at the National University of Singapore, ALSET.

Poquet, O. (March 2020). *Peer Effects in Digital University Networks*. The First Learning Analytics and Knowledge Conference Workshop on Modelling Digital Learning Networks, Frankfurt, Germany.

Dawson, S. (March 2020). Learning Analytics – A field on the verge of relevance? Keynote presentation, 10th Learning Analytics and Knowledge Conference, Frankfurt Germany.

Poquet, O. (April 2020). *Analysing Teaching and Learning Using Networks*. Invited webinar delivered in collaboration with Bodong Chen as part of the series by the Society of Learning Analytics and Research.

Siemens, G. (May 2020). *A Complex, Messy, Digital Artificial Future*. Principal Learning Forum, Harvard LILA, Melbourne. Online.

Siemens, G. (June 2020). *Digital Learning and Learning Analytics*. EDULEARN20. Madrid, Spain. Online

Siemens, G. (July 2020). *MOOCS (or more accurately, large scale learning) in a Pandemic*. South Africa. Online.

Gabriel, F. & Siemens, G. (August 2020). *Introduction to digital learning*. Webinar for Pulteney Grammar School.

Siemens, G. (2020). *The Digital University*. XVII Brazilian Congress of Higher Distance Education (ESUD) and the VI International Congress of Higher Distance Education (CIESUD). Online.

Poquet, O. (September 2020). *Using Networks in Learning Analytics*. Invited Online Lecture for the University of Eastern Finland

Marmolejo-Ramos, F., Martínez-Flórez, G., & Barrera-Causil, C. (September 2020). *A new distribution to model reaction time data (part I)*. Abstract presented at Coloquio Virtual de la Asociación Mexicana de Estadística, Mexico DF, Mexico.

Poquet, O. (October 2020). *Social Architectures of Online University Forums: Grade-based similarity in online interactions*. Presented for the Symposium on Network Science in Education, Satellite event of NetSci Conference, 2020.

Gabriel, F. (November 2020). *20 years of PISA in Australia*. Invited webinar, Australian Council for Educational Research.

Siemens, G. (November 2020). *Cognitive Technologies in the Classroom and the Future of Learning*. LILA Harvard. Online.

Marmolejo-Ramos, F., Ospina, R., Yamada, Y., & Allen, C. (November 2020). *Towards open (statistical) science*. Abstract presented at I Congreso Internacional de Ciencias Básicas, Montería, Colombia.

Kovanovic, V. (November 2020). *Learning Analytics in Higher Education: Past, Present, and Directions for the Future*. Keynote presentation at the Digital Transformation of Higher Education Online Research Symposium, University of Leeds, UK (Online).

Dawson, S. (November 2020). Complexity Leadership in Education. Principal Learning Forum, Harvard LILA, Melbourne. Online. This presentation was voted as far better than Prof. Siemens.

Dawson, S. (November 2020). Learning Analytics – Learning Analytics: A Path Less Well Trodden? Keynote presentation, ASCILITE, University of New England, Australia.

Siemens, G. (2020). *The Future of Knowledge Work: Human and Artificial Cognition*. EdCrunch, Moscow. Online.

Siemens, G. (2020). *Human and Artificial Cognition*. Tsinghua University, Beijing. Online



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