



ANNUAL REPORT

2019



University of
South Australia

ABOUT C3L

THE CENTRE FOR CHANGE AND COMPLEXITY IN LEARNING (C3L)

The Centre for Change and Complexity in Learning (C3L), at the University of South Australia, explores how new knowledge processes and economic models influence how universities teach, how individuals learn, and how employability skills are assessed and validated. To effectively address this vision, personal wellbeing, societal impact, economic prosperity, technological advancements, and related factors need to be explored. Higher education plays an increasingly critical role in society by developing the capability for individuals to be productive and engaged participants with the skills and mindsets needed to actively contribute to the advancement of knowledge in the service of humanity. However, the achievement of these objectives is confounded in an era of significant technological progress, dramatic shifts in mainstay economies, complex social restructuring due to global networks, and increasing societal concerns regarding what constitutes the future of work. Not only are these problems new in human history, but the methods for exploring them scientifically are incomplete.

C3L takes a holistic view of the education system and lifelong learning. C3L investigates how present education models can transition to more effectively focus on attributes and processes beyond the cognitive aspect of their curriculum. C3L will seek to research and apply novel approaches that facilitate curriculum models that actively incorporate the skills needed for creative knowledge work, self-regulation, collaboration, and mindsets that enable acceptance of ambiguity and uncertainty. The complex problems that define contemporary education cannot be understood and managed through traditional, often reductionist, research approaches, instead an integrated, holistic, and networked approach is required. The mission and vision for C3L is embodied in a complexity science framework and methodology.

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

- W.E.B. Dubois

DIRECTOR'S FOREWORD
 PROFESSOR GEORGE SIEMENS
 CO-DIRECTOR OF C3L

It's hardly surprising that, in a knowledge economy, learning becomes a greater point of focus across all sectors of society. An educated population is healthier, happier, and contributes substantially to the economic performance of a region. But learning needs have been changing for decades and are becoming increasingly acute in how they differ from the needs of previous generation. Ours is a globalized and connected world where data, information, and knowledge are the foundation of prosperity. How do we prepare individuals to engage in the emerging economy?

In C3L, we investigate how human and artificial cognition impact knowledge processes and society. We do so through a complexity science lens, recognizing that systems of learning need to be evaluated from multiple perspectives and through multiple methodologies. As a result, we have educators, learning scientists, data scientists, computer scientists, engineers, and psychologists working on the most relevant and consequential questions facing society.

This past year was eventful for C3L. We hosted a range of international experts, initiated projects across the primary, secondary, higher education, and corporate learning spaces, fleshed out our research team, and set the foundation for future research success. We developed relationships with partners in Adelaide, Australia, and in USA, China, and Singapore. Our knowledge and talent are world leading. For example, C3L has 6 of the top 12 globally cited scholars in learning analytics. We have exceptionally talented early career researchers, already making an impact globally. We have a growing cohort of doctoral students. And we're just getting rolling.

We expect 2020 to be a year of strengthening international relationships, pursuing relevant and impactful research, and continuing to develop the next generations of academics and scholars.



C3L ANNUAL REPORT 2019

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HUMAN AND ARTIFICIAL COGNITION

The rapid adoption of digital technologies has generated huge data sets that are now being used to train and develop models of cognition. Predictions of the timelines for when machines will be able to perform general cognitive activities at the level of humans, or even the arrival of “super intelligence”, range from years to decades to never.

For researchers, the potential future state of Artificial Intelligence (AI), while provocative and often pursued in popular media, is secondary to important shorter-term questions. How will we work together with technologies and robots that exhibit advanced cognitive capabilities? How will humanity co-exist with algorithms and cognitive agents that are capable of processing data at rates far beyond what humans are capable of doing?

In this project, we focus on the relationship between human and artificial cognition, rather than AI. Our motivation is to deliver accessible and testable hypotheses regarding the ways that cognitive agents intersect with human cognitive process in learning and knowledge work. Our model will provide insight to educators, policy makers, and business leaders regarding the optimal relationship between which cognitive activities should be handed off to the machine and which should remain the domain of human performance.

CONGRESS AT UNISA



C3L will be organising a one-week Human and Artificial Cognition Congress in January 2020 at UniSA. International experts from the fields of cognition, education and computer science will discuss what should be automated, augmented cognition and the skills that will essentially remain human. Invited speakers include [Professor Rose Luckin](#) and [Professor Geriant Rees](#) from University College London, [Professor David Hung](#) and [Dr David Huang](#) from the National Institute of Education in Singapore, [Professor Javaid Sheikh](#) from Stanford University, [Mr Ilkka Tuomi](#) from Meaning Processing Ltd., and [Dr Kelsey Medeiros](#) from the University of Nebraska Omaha.

The main outcome of this congress will be a series of articles to be published later in 2020.

IMPROVING LEARNING STRATEGIES

ONLINE VIDEO ANNOTATION FOR LEARNING - OVAL

Example of OVAL video annotations in an online course

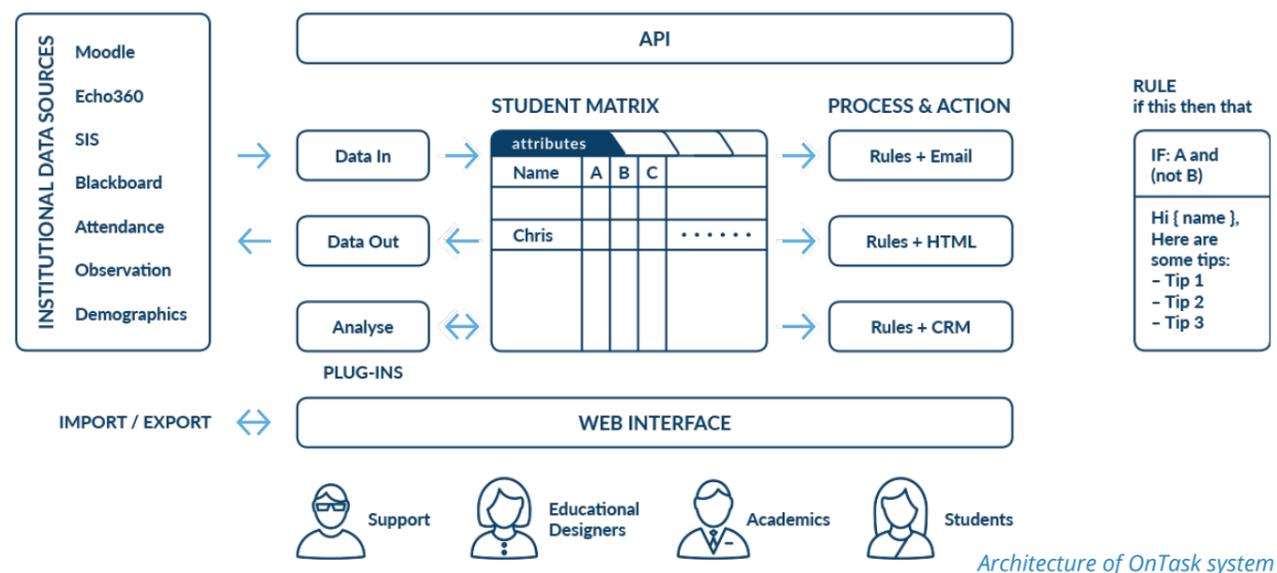
Videos are rapidly replacing lectures in online education. However, one major limitation is that learning opportunities can be reduced to passive information transfer. One way of avoiding this potential negative effect is to find a way of making videos more engaging. This can be done by adding in-video quizzes and giving students the opportunity to annotate the videos.

C3L researchers developed OVAL (Online Video Annotation for Learning), an interactive video tool designed to support self-regulated learning (SRL) through annotations and in-video quiz ([Mirriahi et](#)

[al., 2018](#)). This application has been integrated as a Moodle activity at UniSA. Students and teachers can access OVAL videos via their course site and add annotations to specific points in the video as well as general comments. Annotations and comments can be used to promote learning engagement within the course or as a private study tool.

Our team ran a study to examine how online technologies can be used to promote self-regulated learning ([Van Seville et al., 2018](#)). The results showed a strong positive association between student completion of the in-video quizzes and course grade.

ONTASK



Architecture of OnTask system

The OnTask Project aims to improve the quality of the student learning experience for courses with large cohorts through the delivery of timely, personalised and actionable student feedback throughout their participation in a course. OnTask also seeks to increase the maturity of learning analytics deployments in educational institutions by providing guidelines and suggestions to take adoption of learning analytics beyond institutional initiatives, such as detecting and supporting students at risk, and extend that support to all students in courses with high enrolment figures.

As part of its deliverables and pilot phase, the OnTask project developed three versions of a software tool that implemented different underlying technologies but with the same overall functionality. All three of these tools are open source and can be downloaded or tested on separate demo servers.

Some of the outcomes of this project were:

- An architecture and list of technical requirements to help higher education institutions to deploy data-management procedures to support instructors in the use of PLSAs.
- A set of guidelines to support academics to design PLSAs and personalise them based on indicators extracted for the course design.
- A set of case studies showcasing how PLSAs have been used in large student cohorts in different disciplines and teaching strategies.
- An open source platform for the community of researchers, practitioners and academics to deploy and manage the implementation of PLSAs in their teaching experiences.

IMPROVING LEARNING STRATEGIES

FLIPPED CLASSROOM

Flipped Classroom (FC) is a form of active learning design where students are required to complete learning activities in preparation for face-to-face sessions. It allows for more class time to be dedicated to active learning tasks. Looking at learning analytics in FC can help teachers prepare and tailor their lesson time in a very efficient way. This model is increasingly being adopted in universities and it has been shown to lead to improved students' achievement.

There are challenges linked to FC. Firstly, students are expected to complete pre-class activities and tasks regularly and on time. Secondly, if students do not engage in preparation activities, this will have a negative impact on the face-to-face sessions. These challenges stem from the high level of autonomy and self-regulation skills required from students in FC compared to traditional classes. For this reason, it is important to understand the type of strategies that students adopt, the resources they use most frequently, and their level of engagement with the learning material throughout the course (Pardo et al., 2018b).

Our research group has been looking at learning strategies students adopt when they undertake and complete learning activities in a flipped classroom (Jovanovic et al., 2018). In a recent study, we examined the links between students' regularity and time-management of pre-class activities and their learning performance in a FC (Jovanovic et al., 2019). The results showed that several indicators of regularity of pre-class activities, such as students' time management, their interactions with course videos and the course e-book were significant predictors of course performance. This study



indicates that students need support to effectively use learning resources in pre-class activities.

In another study, we examined the strategies students use to interact with online preparation activities, and the evolution of those strategies over the duration of a course delivered with a FC pedagogy (Pardo et al., 2018b). Results showed that there is a high level of diversity in the learning strategies adopted by students. Students seem to select different types of resources to mediate their engagement and are heavily influenced by the type of assessment included in the activities. The results of this study can help improve the process orientation of feedback by enabling instructors to provide students with timely and personalised feedback on the adequacy of the adopted learning strategies, and to examine if the students acted on the received feedback.

IF YOU WANT TO LEARN MORE...

Watch our OnTask video:

<https://www.youtube.com/watch?v=QNEhB2do7V4>

Visit the OnTask website:

<https://www.ontasklearning.org/>

Watch our OVAL video:

<https://www.youtube.com/watch?v=y8arcTUfAow&feature=youtu.be>

REFERENCES

- Jovanovic, J., Gasevic, D., Pardo, A., Mirriahi, N., & Dawson, S. (2018). An analytics-based framework to support teaching and learning in a flipped classroom. *Learning analytics in the classroom: Translating research for teachers*. Abingdon, UK: Routledge.
- Jovanovic, J., Mirriahi, N., Gašević, D., Dawson, S., & Pardo, A. (2019). Predictive power of regularity of pre-class activities in a flipped classroom. *Computers & Education*, 134, 156-168.
- Mirriahi, N., Jovanovic, J., Dawson, S., Gašević, D., & Pardo, A. (2018). Identifying engagement patterns with video annotation activities: A case study in professional development. *Australasian Journal of Educational Technology*, 34(1).
- Pardo, A., Bartimote-Aufflick, K., Buckingham Shum, S., Dawson, S., Gao, J., Gašević, D., ... Vigentini, L. (2018a). OnTask: Delivering data-informed personalized learning support actions. *Journal of Learning Analytics*, 5(3), 235-249.
- Pardo, A., Gašević, D., Jovanovic, J. M., Dawson, S., & Mirriahi, N. (2018b). Exploring Student Interactions with Preparation Activities in a Flipped Classroom Experience. *IEEE Transactions on Learning Technologies*.
- Pardo, A., Bartimote-Aufflick, K., Shum, S. B., Dawson, S., Gao, J., Gašević, D., ... & Moskal, A. C. M. (2018c). OnTask: Delivering Data-Informed, Personalized Learning Support Actions. *Journal of Learning Analytics*, 5(3), 235-249.
- Pardo, A., Jovanović, J., Dawson, S., Gašević, D., & Mirriahi, N. (2019). Using learning analytics to scale the provision of personalised feedback. *British Journal of Educational Technology*, 50(1), doi:10.1111/bjet.12592
- Van Sebille, Y., Joksimovic, S., Kovanović, V., Mirriahi, N., Stansborough, R., & Dawson, S. (2018). Extending video interactions to support self-regulated learning in an online course. *Open Oceans: Learning Without Borders*, 262.

PROFESSIONAL LEARNING

Experiential and project-based learning offer highly engaging environments in which learners, instructors and mentors can interact around team-based projects. A key element to transform these environments into effective learning experiences is to provide personalised feedback to learners throughout their journey. C3L researchers are working on lifelong, professional education with two external partners, ModMed and Practera. This work focuses on developing personalised learning and providing effective online feedback for professionals.

**MODMED**

ModMed is a company that offers professional development for medical practitioners. They provide a practical and adaptive structure to meet educational needs of health professionals and supervisors for the entirety of registrar training. Their online learning content is mapped to Royal Australian College of General Practitioners and Australian College of Rural and Remote Medicine curricula. It also includes educational content, teaching support materials, in-built programmatic assessment to ensure that key competencies are met, and administrative tools, generating large scale data about learners and their learning.

Continuing professional development (CPD) is one of the most important components of medical education. From the learning perspective there are several conditions that make it unique: professionals need to acquire certain skills both in their domain of knowledge, but also soft skills, the acquisition is strongly influenced by the environment, and requires flexible yet effective structures to guarantee its success. Audits and feedback are crucial in CPD and scaling the delivery of these elements is challenging. ModMed and C3L are working together to use machine learning algorithms combined with detailed mapping of the curriculum and competencies to support doctors through their CPD with personalised and frequent suggestions to comply with the requirements of the medical regulatory bodies.

PRACTERA

Practera is a platform for extra-curricular programs such as work-readiness programs and internships. They offer a virtual environment for collaborative work in which students go through a highly active set of activities to develop their soft skills. Learners undertake their real-world projects, upload their deliverables, inputs and reflections. A team of mentors and reviewers gives them personalised feedback for the next stages. This feedback cycle requires a comprehensive knowledge of the students and is challenging to deploy for large student cohorts. The objective of this collaborative research is to identify indicators of learners' development that can inform the establishment of personalised, timely, automated, and adaptive feedback.

C3L researchers and Practera are working together to explore how learning analytics methods can support this teaching environment, and designed a data capture, analysis and intervention workflow that:

- Provides instructors with a clear connection between the activities present in a learning design and the data captured for knowledge discovery
- Offers instructors and students valuable insights about the learning approaches adopted in the course
- Offers the opportunity to provide personalised feedback for large cohorts of students.

Privacy-Preserving Analytics for the Education Technology Industry – Project awarded CRC-P grant

Dr Srecko Joksimovic, Dr Vitomir Kovanovic, Professor Abelardo Pardo and their partners have been awarded \$1.995 million in government funding by the Commonwealth's Cooperative Research Centres Projects (CRC-P) Round 7 grants program. They will develop a product for education providers to provably preserve the privacy of student data records in collaboration with Practera and CSIRO's Data61.

Learning analytics and AI research while preserving student privacy

The project will develop a product for education providers to provably preserve the privacy of student data records. This will enable education companies to maximise the value of their student datasets, for example in learning analytics and training of artificial intelligence algorithms. The product will be applied initially to Practera's experiential learning platform which supports programs such as project programs, internships and skills credentialing.

DATA INFRASTRUCTURE FOR LEARNING SCIENCES RESEARCH - PARTNERSHIP WITH BOEING

The growing need for timely and personalised learning for knowledge workers requires broadening the types of data collected during learning and knowledge building processes. This in turn requires the development of new technologies, tools, and instrumentation so insight from a wide range of data sources can be used to understand knowledge practices and to better support individuals as they engage in learning activities. Existing data sources are fragmented and each source (such as a Learning Management System, social media, and knowledge management system) is self-contained with limited overlap. As a consequence, insights are lost due to disconnectedness of the data environments.

**COLLABORATION WITH BOEING**

C3L researchers have been working with Boeing and University of Texas Arlington to develop an integrated, multi-faceted data infrastructure. This infrastructure enables researchers to:

- Get a better understanding of how people learn in digital environments
- Integrate formal learning into work practices
- Personalise learning constructs needed by knowledge workers
- Define the affective and psychological profiles of learners to address emerging soft skills
- Effectively integrate human and artificial cognition through intelligent agents.

This environment includes centralisation of edX, YellowDig, platform data sources. Additional captured data include survey data, psychological instruments (such as Big Five), demographic data, and derived outcomes such as social network engagement, social capital, and follow up interviews and surveys to assess the integration of learning back into the work environment. This data infrastructure was designed to enable future expansion of learning data in additional courses and additional data captured (for example, future data additions could include mobile learning data, on the job support data, connection to existing Boeing knowledge management software).

This environment will contribute to future development of interventions, learning profile development (personal learning graphs), as well as career development and trajectory recommendations. It will also provide researchers with the data needed to visualise learning patterns and to improve learning design of course materials.

LEARNING ANALYTICS FOR ASSESSING THE ATTAINMENT OF GRADUATE QUALITIES

Rapid changes in the modern economy caused by globalisation, job automation and advanced technologies have placed increased emphasis on developing transferable qualities, skills and attributes, collectively known as graduate qualities. The transition from a curriculum that emphasises knowledge to the development of 21st-century literacies aims to enable students to be better prepared for, and capable of, navigating the changing and increasingly complex workplaces. Schools and universities are challenged by the need to develop, measure and report on student progress and attainment of graduate qualities and competencies.



COLLABORATION WITH TRINITY COLLEGE



TRINITY COLLEGE

Graduate qualities have been identified as one of the critical areas that can drive the continuous improvement of teaching and learning practice. The primary goal of this project is to examine the validity of the existing surveys and their use for assessing students' self-regulated learning and metacognitive skills.

For this research, C3L collaborates with [Trinity College](#), an independent school in Gawler, South Australia. This project focuses on combining survey and learning trace data to assess students' development of graduate qualities, with a focus on SRL and metacognition.

VISITORS

DR CLAUDIA MAZZIOTTI



Dr Claudia Mazziotti is a postdoctoral educational research scientist at the Institute of Educational Research at the Ruhr-Universität Bochum in Germany. Her research focuses on developing, evaluating and scaling-up adaptive educational technologies and on collaborative learning mainly in failure-based learning settings. In her PhD, she investigated whether the beneficial effect of Productive Failure also transfers to young students and what students' small group collaboration plays for the effectiveness of this learning approach. Building upon on her previous work at the Stanford Research Institute and in close collaboration with the C3L-team, she currently investigates how to implement educational technologies and learning analytics in Australian schools. Dr Mazziotti visited C3L between January and March 2019.

PROFESSOR JELENA JOVANOVIC



Jelena Jovanovic is a Professor at the Department of Software Engineering at the University of Belgrade in Serbia. She teaches undergraduate and postgraduate courses in programming, applied artificial intelligence, and social network analysis. As a researcher, she used to be primarily focused on semantic technologies and their application in the educational domain. In recent years her focus has been on statistical and machine learning methods and techniques, social network analysis, text analytics, and other computational approaches that allow for data analysis and extraction of meaningful information from raw data. She is particularly interested in combining human and machine intelligence for better understanding of the learning process and making thus obtained insights actionable through appropriate instructional interventions. Professor Jovanovic visited C3L between February and August 2019.

SOFIA SHAN

Sofia Shan is a student experience researcher at the University of Edinburgh in Scotland. Her research focuses on the first-year academic transition experiences of home students studying in the two Biomedical Sciences programmes in the source and host country – UK and China. In her PhD, she explores the learning experience of Chinese masters' students and how they make adaptation into Western higher education contexts. Her aim is to provide insights and explanations for the mismatching expectations between Chinese students and their Western teachers. Sofia visited C3L between May and July 2019. During her stay, she investigated the perception and challenges of using educational technologies and learning analytics in Australian schools.

FULBRIGHT SPECIALIST SCHOLAR – COLLABORATION WITH ROGER AZEVEDO



Professor Roger Azevedo is a [Fulbright Specialist Scholar](#) from the [University of Central Florida](#). His research looks into how we learn from different technologies, from how children and adults STEM subjects, right through to how cancer researchers are engaging with new technologies to better diagnose cancers. He is a collaborator of the Centre for Change and Complexity in Learning at UniSA.

FOCUS ON SELF-REGULATED LEARNING

Self-regulation is an important area of research in education and one of the key topics being investigated at C3L. Studies show that self-regulated learning (SRL) has a positive and long-lasting impact on students' academic development, employability, and career progression. Schools and universities are challenged to develop these skills in students. While specific models designed to foster SRL vary based on the ages of learners, they generally involve processes linked to the control of attention and executive functions, socio-emotional functioning, meta-cognition, and motivation. These skills are essential for graduates entering an environment of constant economic, social and technological change, yet they are not generally addressed by conventional courses.

As universities use technology mediated learning (e.g. online and blended) there is a shift in how students can both develop and demonstrate these key SRL processes. For example, these processes might include the ability to work in groups online, identify social and emotional cues, identify and fulfil personal learning goals, self-assess and redirect learning effort, monitor and regulate strategy use, engage in emotional regulation, change motivational beliefs performance, and communicate with impact.

Learning analytics is a promising approach to understand the development of SRL and establish empirical measures for assessing the impact of interventions designed to promote SRL skills. There is a potential for measuring SRL processes through the use of automated and personalised feedback mechanisms.

Professor Azevedo's research in collaboration with C3L aims to develop an integrated approach that will enable teachers to align their teaching practices to promote the student's development SRL skills and mindsets.

ADVANCED LEARNING TECHNOLOGIES

Intelligent tutoring systems, hypermedia, multimedia, simulations, serious games and immersive virtual learning environments are increasingly part of both formal and informal teaching and learning environments. While Professor Azevedo understands the challenges that artificial intelligence and the immersion of robots may present to our learning lives, he believes robots will become our collaborators and learning companions, delivering great benefits to education.

“Any projection into future learning will show that it will be immersed in AI which will influence faster learning and enhanced performance. AI offers so much potential to remove the mundane, not only from our lives but our learning – leaving time and space for the pursuit of excellence.”

IMPLICATIONS FOR TEACHING

Teachers have the ability to help their students develop SRL skills but it requires explicit instruction. Across the three main phases of student SRL (planning, performance and self-reflection), teachers can support students through a number of means:

- **Planning:** help students analyse the task, set goals and plan.
- **Performance:** model and give students strategies for learning, help them monitor the effectiveness of these strategies and help them with time management.
- **Self-reflection:** help the students assess their performance (e.g. SRL skill use) on how the learning task went. Did they plan and strategize well? How will they modify their SRL in subsequent task performance?

Digital tools can be used to support the development of SRL skills. UniSA developed and trialled software called OnTask, which gathers and assesses data about students' activities in online courses, and provides individualised feedback about their overall learning process and self-regulation effort.

C3L visit and plans for continued collaboration

Professor Azevedo visited C3L in May and June 2019. During his stay, he delivered a university-wide research talk on SRL and advanced learning technologies. He conducted two workshops for researchers, faculty, high school administrators and learning and instructional designers. With a focus on classrooms, on-line teaching and learning technology-based environments, Professor Azevedo demonstrated how to detect, measure and foster cognitive, affective, metacognitive and motivational processes. Following his visit at UniSA, Professor Azevedo

IF YOU WANT TO LEARN MORE...



In this [interview](#), Professor Azevedo discusses self-regulating learning, metacognition, the role of technology in education and how teachers can help their students develop SRL skills.

Professor Roger Azevedo's bio

Professor Roger Azevedo is a Professor in the [Department of Learning Sciences and Educational Research](#) at the University of Central Florida. He is also an affiliated faculty in the Department of Computer Science and in the Department of Internal Medicine at the University of Central Florida and the lead scientist for the Learning Sciences Faculty Cluster Initiative. His main research area examines the role of cognitive, metacognitive, affective, and motivational self-regulatory processes during learning, problem solving, and reasoning with advanced learning technologies. His overarching research goal is to understand the complex interactions between humans and intelligent learning systems.

REFERENCES

- Azevedo, R., Mudrick, N. V., Taub, M., & Bradbury, A. (2019). Self-regulation in computer-assisted learning systems. In J. Dunlosky & K. Rawson (Eds.), *Handbook of cognition and education* (pp. 587-618). Cambridge, MA: Cambridge University Press.
- Azevedo, R., & Gasevic, D. (2019). Analyzing multimodal multichannel data about self-regulated learning with advanced learning technologies: Issues and challenges. *Computers in Human Behavior*, 96, 207-210.
- Mudrick, N.V., Azevedo, R., & Taub, M. (2019). Integrating metacognitive judgements and eye movements using sequential pattern mining to understand processes underlying successful multimedia learning. *Computers in Human Behavior*, 96, 223-234.
- Taub, M., & Azevedo, R. (2019). Using sequence mining to assess self-regulated learning and scientific inquiry based on levels of efficiency and emotional expressivity during game-based learning. *Journal of Educational Data Mining*, 10, 1-26.
- Azevedo, R., Taub, M., & Mudrick, N.V. (2018). Using multi-channel trace data to infer and foster self-regulated learning between humans and advanced learning technologies. In D. Schunk & Greene, J.A (Eds.), *Handbook of self-regulation of learning and performance* (2nd ed., pp. 254-270). New York, NY: Routledge.
- Greene, J. A., Moos, D. C., & Azevedo, R. (2011). Self-regulation of learning with computer-based learning environments. *New directions for teaching and learning*, 126.
- Greene, J. A., & Azevedo, R. (2010). The measurement of learners' self-regulated cognitive and metacognitive processes while using computer-based learning environments. *Educational psychologist*, 45(4), 203-209.
- Azevedo, R. (2009). Theoretical, conceptual, methodological, and instructional issues in research on metacognition and self-regulated learning: A discussion. *Metacognition and Learning*, 4(1), 87-95.

COLLABORATION WITH ASTRONAUT CHARLES CAMARDA



Dr Charles Camarda is an American engineer and a NASA astronaut who flew his first mission into space on board the Space Shuttle mission STS-114. He served as Senior Advisor for Engineering Development at NASA Langley Research Center. He created the Epic Challenges program to help students learn and implement innovation and concept design skills. Dr Camarda is an Adjunct Senior Industry Fellow at UniSA School of Engineering and a collaborator at the UniSA Centre for Change and Complexity in Learning.

EPIC CHALLENGES PROGRAM

To create global interest in space and STEM subjects, Dr Camarda, with a team of faculty from NASA, MIT, Georgia Tech, and Penn State University, created and developed an innovative conceptual engineering design methodology to create the “Epic Challenges Program” (ECP)¹. The goal of the program is to present students with authentic challenges that require them to engage in teams in order to solve meaningful problems. The ECP connects teams of students and experts to solve the big challenges facing humanity, and has proven success in the USA and Finland.

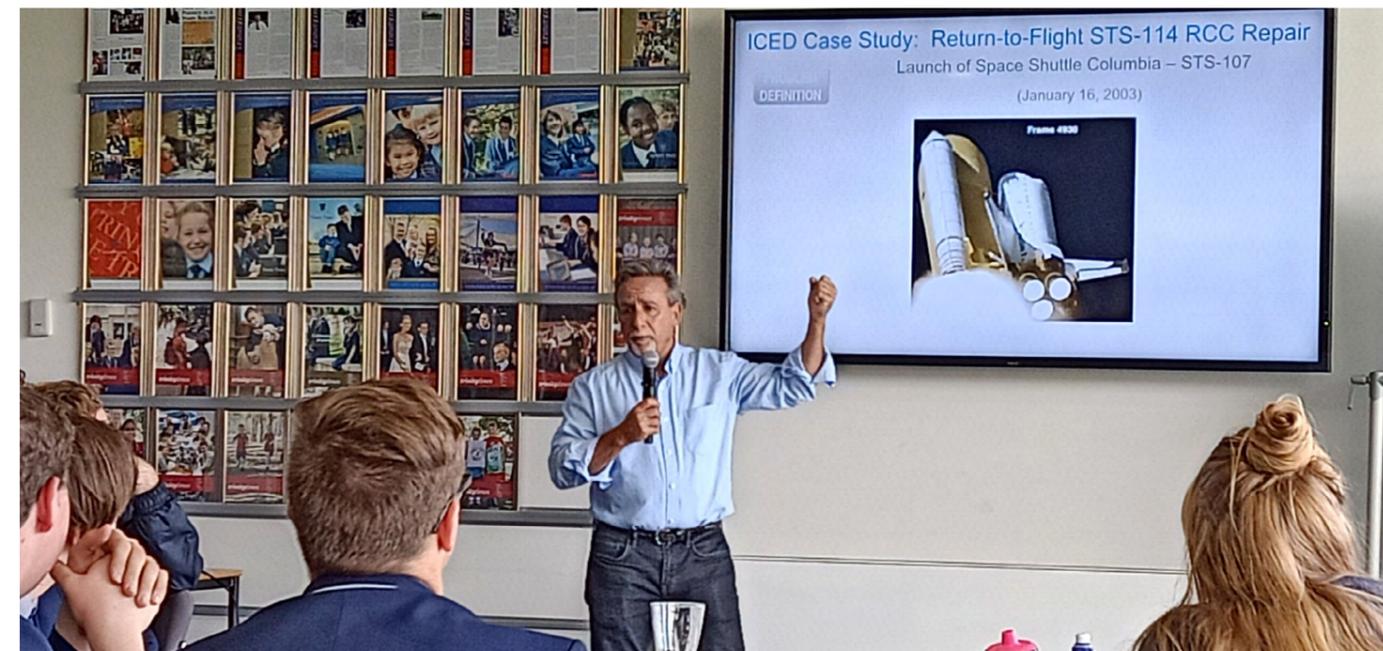
Dr Camarda ran several ECPs for American and Finnish students centred on the following challenges:

- Digging and Drilling on the surface of the moon
- Sustaining Humans on Mars: Designing a Mars Habitat
- Designing a Spacesuit for Mars

The ECP uses a specially developed strategy called Innovative Conceptual Engineering Design (ICED)². The ICED methodology is based on the creation of psychologically-safe virtual and physical environments to solve real-world engineering problems³, and encourages creativity and problem-based learning.

“Epic Challenges are about developing teamwork, creativity and interest in STEM. This program gives students the freedom to fail small, fast, cheap, early and often. With Epic Challenges, students can explore, experiment, fail intelligently and learn from their failures.”

C3L VISIT AND PLANS FOR CONTINUED COLLABORATION



“Contributions provided by the three NASA Researchers Centres were pivotal in understanding the technical cause of the Columbia accident, mitigating the cause of the problem, and developing the necessary technologies to ensure a continued, safe, return to flight. By reaching out to the research communities to use the latest advances in analysis, testing, inspection, monitoring and fabrication, we gained a tremendous amount of insight into how to develop innovative concepts and use innovative solution strategies.”

Dr Camarda visited C3L in August 2019. He gave a public lecture entitled “The Role of Creativity and Innovation in NASA’s Return to Flight STS-114”. His presentation focused on the issues NASA faced when after 27 successful missions the Columbia Space Shuttle disintegrated on re-entry, killing all seven crew members⁴. His lecture was attended by UniSA faculty and staff, Australian Space Agency representatives, and by the South Australia Minister for Education the Hon John Gardner MP.

Dr Camarda gave a second public lecture at the UniSA Innovation & Collaboration Centre (ICC) entitled “How NASA lost its way and how it can recover”. The Q&A was facilitated by Terry Gold, the ICC Entrepreneur in Residence.

Dr Camarda recorded a podcast for RiAus where he discussed NASA, team-based learning, ECP and space tourism. He also met with the Australian Space Agency and the SMART CRC to explore future collaborations in South Australia.

During his two-week visit, Dr Camarda visited public and independent schools in the Adelaide region and conducted ECP workshops with more than 300 high school students. He also gave a presentation on ECP for Senior Curriculum Leaders from the Association of Independent Schools of South Australia. Dr Camarda and researchers from C3L are working together towards rolling out the ECP in schools in South Australia in 2020.

IF YOU WANT TO LEARN MORE...



In this [interview](#), Dr Camarda discusses NASA, psychological safety in teams, the Epic Challenges Program and how students can learn how to learn.

REFERENCES

- ¹ <https://epiceducationfoundation.org/>
- ² Hietla, J. & Camarda, C. (2015). Digital Transformation of Learning. Why we need another "Apollo Effect". Arcusys LTD.
- ³ Camarda, C., de Weck, O. & Do, S. (2013). Innovative Conceptual Engineering Design (ICED): Creativity and Innovation in a CDIO-Like Curriculum. 9th International CDIO Conference, MIT Cambridge, MA.
- ⁴ Camarda, C. (2014). Space Shuttle Return-to-Flight Following the Columbia Tragedy. NATO Science and Technology Organization Lecture Series.

LALN – AN INTERNATIONAL NETWORK

Learning Analytics Learning Network

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, as well as competence in the specific nature of educational data, research, and practice. However, there is not a sufficient number of 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 developed a Learning Analytics Learning Network (LALN). Monthly meetups are being held worldwide – local research community leaders in 25 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. Local moderated discussions are then held. The activities range from introducing participants to learning analytics to helping them learn to use modern data science techniques. Our activities serve both as an introduction to methods for new members of the field (such as graduate students and teachers) and as continuing education for existing members of research workforce, responsive to changes in the tools, algorithms, and the technologies needed for data science.

NETWORK OF PRACTICE

Traditional approaches to building capacity slow to scale or limited in scope. The LALN will develop a network of practice, where regional communities come together to collaboratively create resources and learning experiences, leveraging network effects where each additional member increases the benefits and usefulness of being part of the network. We will use formative feedback and data to improve our network of practice, making it long-term sustainable even as it scales to dozens of cities. Learning analytics is underpinning the emergence of key advances in education such as adaptive learning and at-risk prediction and intervention; our network will speed the deployment of existing technologies as well as the development of new technologies that will increase student achievement.

FIRST EVENT HELD AT UNISA

The first LALN workshop, Introduction to Learning Analytics, was organised by C3L and took place at UniSA in October 2019. The aim of this workshop was to introduce teachers and educators to the fast-growing field of learning analytics and explore how digital data can be used for the analysis and improvement of student learning. The workshop was run by Srecko Joksimovic and Vitomir Kovanovic and was attended by teachers, school principals, learning managers and government representatives.

LAK20

We will organise a workshop entitled Building Capacity Through the Learning Analytics Learning Network at the upcoming LAK20 conference in Frankfurt, Germany. This workshop will start with presentations by Professor George Siemens and Professor Shane Dawson. Participants will then explore how to best capitalize on this network and discuss the needs of their own community. Finally, a panel of LALN experts will discuss the challenges and opportunities of this network. You will find more information [on this website](#).



Introduction to Learning Analytics
For High School Teachers and Managers

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School of Education and Centre for Change and Complexity in Learning (C3L),
University of South Australia

October 22, 2019

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 Learning Analytics
Learning Network

The video is available on the [C3L Youtube channel](#), and the slides are available [here](#).

IF YOU WANT TO LEARN MORE...

Follow this link to access the LALN website:
<https://sites.google.com/view/laln/home>

TEACHING AND LEARNING KNOWLEDGE (TALK) HUB



Despite the vast amount of published educational research, there is a significant gap between research and practice where very little of this knowledge trickles down to impact classrooms. A successful approach to narrow this gap has been to increase dialogue between teachers and researchers, which can promote meaningful knowledge circulation and improve the uptake of scholarship in teaching practice.

Through direct engagement, it is easier for teachers to ask specific questions in their own words and explain teaching and learning challenges that they have experienced. Researchers can relate these questions to existing research, provide clear contextual answers that are meaningful to practice, and explore these matters further in a continued conversation.

The aim of the Teaching and Learning Knowledge (TALK) Hub is to design an online space where productive teacher-researcher interactions are driven by questions from classroom experiences and addressed with proven insights from existing educational research. On this platform, teachers can share their challenges by uploading text, video, or audio messages expressing their situation and needs. These questions will be labelled and indexed for accessibility at scale, and answers and academic resources will be provided by researchers. To close

the loop, researchers are encouraged to share stories about how this knowledge was developed and teachers can convey the extent to which it was useful in improving teaching practices or helped in framing or understanding solutions for previously expressed questions or challenges.

This project is a collaboration between C3L, the University of Wollongong and the University of Texas Arlington. You can find more information on our website talkhub.info.

INTERNATIONAL RELATIONSHIPS



Research is a global endeavour. The capacity of a research lab to perform its work and achieve its goals rests heavily on the diversity and quality of its knowledge networks. C3L has developed an extensive global network based through our world recognized researchers. As a result, 2019 resulted in trips and collaborations in Singapore, China, South Korea, USA, Canada, Europe, and New Zealand where C3L staff have edited special issues, delivered keynotes, chaired conferences, and lead workshops. As a young research centre, our impact is already global as is our network.

C3L evaluates problems, and opportunities, from a complexity science lens where we use multiple methods in interdisciplinary teams to provide answers that are contextually relevant and meaningful for practitioners. Our international relationships provide us with access to top scholars in learning sciences, psychology, computer science, engineering, and data science. With the foundation now established, in 2020 our focus will be on enriching and strengthening partnerships in order to pursue national and international grants and funding opportunities.

2019 PUBLICATIONS

Aitchison, C., Harper, R., **Mirriahi, N.**, & Guerin, C. (2019). Tensions for educational developers in the digital university: developing the person, developing the product. *Higher Education Research & Development*, 1-14.

Zhao, T., Huang, Y., Chen, D., Jiao, L., **Marmolejo-Ramos, F.**, Wang, R., & Xie, J. (2019). The modality switching costs of Chinese-English bilinguals in the processing of L1 and L2. *Quarterly Journal of Experimental Psychology*, 1747021819878089.

Matcha, W., Gašević, D., **Jovanović, J.**, **Pardo, A.**, Maldonado-Mahauad, J., & Pérez-Sanagustín, M. (2019, September). Detection of Learning Strategies: A Comparison of Process, Sequence and Network Analytic Approaches. In *European Conference on Technology Enhanced Learning* (pp. 525-540). Springer, Cham.

Gašević, D., Matcha, W., **Jovanović, J.**, **Pardo, A.**, **Lim, L. A.**, & **Gentili, S.** (2019, September). Discovering Time Management Strategies in Learning Processes Using Process Mining Techniques. In *European Conference on Technology Enhanced Learning* (pp. 555-569). Springer, Cham.

Martinez-Maldonado, R., Hernández-Leo, D., & **Pardo, A.** (2019). Preface to the special issue on learning analytics and personalised support across spaces. *User Modeling and User-Adapted Interaction*, 29 (4), 751-758.

Gašević, D., Matcha, W., **Jovanović, J.**, & **Pardo, A.** (2019). Analytics of time management strategies in a flipped classroom. *Journal of Computer Assisted Learning*.

Tejo, M., Araya, H., Niklitschek-Soto, S., & **Marmolejo-Ramos, F.** (2019). Theoretical models of reaction times arising from simple-choice tasks. *Cognitive neurodynamics*, 13(4), 409-416.

Marozzi, M., & **Marmolejo-Ramos, F.** (2019). Composite indicators in experimental psychology. An example with the semantic space of taste and shape stimuli. *Communications in Statistics-Simulation and Computation*, 1-10.

Pardo, A. (2019). Analíticas de aprendizaje para la retroalimentación personalizada. *Revista Mexicana de Bachillerato a Distancia*, 11(22).

Joksimović, S., Baker, R. S., Ocumpaugh, J., Andres, J. M. L., Tot, I., Wang, E. Y., & Dawson, S. (2019, August). Automated Identification of Verbally Abusive Behaviors in Online Discussions. In *Proceedings of the Third Workshop on Abusive Language Online* (pp. 36-45).

Tsai, Y. S., **Poquet, O.**, Gašević, D., **Dawson, S.**, & **Pardo, A.** (2019). Complexity leadership in learning analytics: Drivers, challenges and opportunities. *British Journal of Educational Technology*.

Zhang, J., Burgos, D., & **Dawson, S.** (2019). Advancing open, flexible and distance learning through learning analytics.

Siemens, G. (2019). Learning analytics and open, flexible, and distance learning. *Distance Education*, 40(3), 414-418.

Joksimović, S., Dowell, N., Gašević, D., **Mirriahi, N.**, **Dawson, S.**, & Graesser, A. C. (2019). Linguistic characteristics of reflective states in video annotations under different instructional conditions. *Computers in Human Behavior*, 96, 211-222.

- Khatin-Zadeh, O., Khoshsima, H., Yarahmadzahi, N., & **Marmolejo-Ramos, F.** (2019). The Impact of Metaphorical Prime on Metaphor Comprehension Processes. *Australian Journal of Linguistics*, 1-14.
- Jovanovic, J., Mirriahi, N., Gašević, D., Dawson, S., & Pardo, A.** (2019). Predictive power of regularity of pre-class activities in a flipped classroom. *Computers & Education*, 134, 156-168.
- Zhao, Y., Morris, A., Marais, B. J., **Pardo, A.**, & Scott, K. M. (2019). Exploring how medical students learn during clinical rotations: a pilot study with a mobile application. *Health and Technology*, 9(3), 257-267.
- Alonzo, D., **Mirriahi, N.**, & Davison, C. (2019). The standards for academics' standards-based assessment practices. *Assessment & Evaluation in Higher Education*, 44(4), 636-652.
- Lim, L. A., Gentili, S., Pardo, A., Kovanović, V., Whitelock-Wainwright, A., Gašević, D., & Dawson, S.** (2019). What changes, and for whom? A study of the impact of learning analytics-based process feedback in a large course. *Learning and Instruction*.
- Gasevic, D., Tsai, Y. S., **Dawson, S., & Pardo, A.** (2019). How do we start? An approach to learning analytics adoption in higher education. *The International Journal of Information and Learning Technology*.
- Joksimovic, S., Jovanovic, J. M., Kovanovic, V., Gasevic, D., Milikic, N. M., Zouaq, A., & van Staaldouin, J. P.** (2019). Comprehensive analysis of discussion forum participation: from speech acts to discussion dynamics and course outcomes. *IEEE Transactions on Learning Technologies*.
- Matcha, W., Gasevic, D., & **Pardo, A.** (2019). A Systematic Review of Empirical Studies on Learning Analytics Dashboards: A Self-Regulated Learning Perspective. *IEEE Transactions on Learning Technologies*.
- Noguchi, K., Abel, R. S., **Marmolejo-Ramos, F.**, & Konietschke, F. (2019). Nonparametric multiple comparisons. *Behavior research methods*, 1-14.
- Helal, S., Li, J., Liu, L., Ebrahimie, E., **Dawson, S.**, & Murray, D. J. (2019). Identifying key factors of student academic performance by subgroup discovery. *International Journal of Data Science and Analytics*, 7(3), 227-245.
- Lim, L., Dawson, S., Joksimovic, S., & Gašević, D.** (2019, March). Exploring students' sensemaking of learning analytics dashboards: Does frame of reference make a difference? In *Proceedings of the 9th International Conference on Learning Analytics & Knowledge* (pp. 250-259). ACM.
- Fincham, E., Whitelock-Wainwright, A., **Kovanović, V., Joksimović, S., van Staaldouin, J. P., & Gašević, D.** (2019, March). Counting Clicks is Not Enough: Validating a Theorized Model of Engagement in Learning Analytics. In *Proceedings of the 9th International Conference on Learning Analytics & Knowledge* (pp. 501-510). ACM.
- Dawson, S., Joksimovic, S., Poquet, O., & Siemens, G.** (2019, March). Increasing the Impact of Learning Analytics. In *Proceedings of the 9th International Conference on Learning Analytics & Knowledge* (pp. 446-455). ACM.
- Matcha, W., Gašević, D., Uzir, N. A. A., **Jovanović, J., & Pardo, A.** (2019, March). Analytics of Learning Strategies: Associations with Academic Performance and Feedback. In *Proceedings of the 9th International Conference on Learning Analytics & Knowledge* (pp. 461-470). ACM.
- Jovanović, J., Gašević, D., Pardo, A., Dawson, S., & Whitelock-Wainwright, A.** (2019, March). Introducing meaning to clicks: Towards traced-measures of self-efficacy and cognitive load. In *Proceedings of the 9th International Conference on Learning Analytics & Knowledge* (pp. 511-520). ACM.
- Gašević, D., **Joksimović, S., Eagan, B. R., & Shaffer, D. W.** (2019). SENS: Network analytics to combine social and cognitive perspectives of collaborative learning. *Computers in Human Behavior*, 92, 562-577.
- Jovanovic, J., Gasevic, D., Pardo, A., Mirriahi, N., & Dawson, S.** (2018). An analytics-based framework to support teaching and learning in a flipped classroom. *Learning analytics in the classroom: Translating research for teachers* Abingdon, UK: Routledge.
- Yoshimura, N., Yonemitsu, F., **Marmolejo-Ramos, F., Ariga, A., & Yamada, Y.** (2019). Task Difficulty Modulates the Disrupting Effects of Oral Respiration on Visual Search Performance. *Journal of cognition*, 2(1).
- Joksimović, S., Kovanović, V., & Dawson, S.** (2019). The Journey of Learning Analytics. *HERDSA Review of Higher Education*, 6, 27-63.
- Herrera-Marmolejo, A., **Marmolejo-Ramos, F., García, E. K. G., & Mejía, C.** (2019). Writing Errors in Deaf Children. *Journal of Developmental and Physical Disabilities*, 1-17.
- Marmolejo-Ramos, F., & Ospina, R.** (2019). Performance of some estimators of relative variability. *Frontiers in Applied Mathematics and Statistics*, 5, 43.
- Hearn, S., Benton, M., Funnell, S., & **Marmolejo-Ramos, F.** (2019). Investigation of the factors contributing to Indigenous students' retention and attrition rates at the University of Adelaide. *The Australian Journal of Indigenous Education*, 1-9.
- Marmolejo-Ramos, F., Arshamian, A., Tirado, C., Ospina, R., & Larsson, M.** (2019). The allocation of valenced percepts onto 3D space. *Frontiers in psychology*, 10, 352.
- Khatin-Zadeh, O., Banaruee, H., Eskandari, Z., & **Marmolejo-Ramos, F.** (2019). Isomorphism: Abstract and Concrete Representations. *Activitas Nervosa Superior*, 1-6.
- Corrin, L., Kennedy, G., French, S., Shum, S. B., Kitto, K., **Pardo, A., ... & Colvin, C.** (2019). The ethics of learning analytics in Australian higher education.
- Kovanović, V., Joksimović, S., Poquet, O., Hennis, T., de Vries, P., Hatala, M., ... & Gašević, D.** (2019). Examining communities of inquiry in Massive Open Online Courses: The role of study strategies. *The Internet and Higher Education*, 40, 20-43.
- Hernández-Leo, D., Martínez-Maldonado, R., **Pardo, A., Muñoz-Cristóbal, J. A., & Rodríguez-Triana, M. J.** (2019). Analytics for learning design: A layered framework and tools. *British Journal of Educational Technology*, 50(1), 139-152.
- Pardo, A., Jovanovic, J., Dawson, S., Gašević, D., & Mirriahi, N.** (2019). Using learning analytics to scale the provision of personalised feedback. *British Journal of Educational Technology*, 50(1), 128-138.

2019 PRESENTATIONS AND WORKSHOPS

Joksimović, S., Siemens, G., Dawson, S., & Kovanović, V. (March 2019). Connectivism: Using learning analytics to operationalize a research agenda, Workshop organised at the 9th International Learning Analytics & Knowledge Conference (LAK'19). Tempe, Arizona, USA.

Wang, Y., San Pedro, M. O., **Joksimović, S.**, & Way, J. (March 2019). Social-Emotional Learning (SEL): Assessment toward Diversity and Inclusion, Workshop organised at the 9th International Learning Analytics & Knowledge Conference (LAK'19). Tempe, Arizona, USA.

Gabriel, F. (April 2019). Learning in a transforming society: The OECD 2030 Learning Compass. School of Education, University of South Australia, Adelaide, Australia.

Joksimović, S. (September 2019). Analytics Infrastructure, AWS Data-Driven Insights Learning Series. Adelaide Hilton, Adelaide, Australia.

Joksimović S. (September 2019). From Product to Process The Analytics of Teamwork and Sensemaking", presented at the "Learning-Centred Analytics: Mission Possible?", Workshop organized by Australasian Society for Computers in Learning in Tertiary Education (ASCILITE) Learning Analytics Special Interest Group, Australia.

Kovanović, V., & Joksimović, S. (October 2019). Introduction to Learning Analytics for High School Context. Learning Analytics Learning Network event. University of South Australia, Adelaide, Australia.

Kovanović, V., & Joksimović, S. (October 2019). Learning Analytics for R-12 Institutions. St Michael's College, St Michael's College, Adelaide, Australia.

Gabriel, F., Marmolejo-Ramos, F., Poquet, O., Dawson, S., Siemens, G. & de Laat, M. (November 2019). Measuring soft skills in authentic learning environments. ALASI, University of Wollongong, Australia.

Joksimović, S. (November 2019). Towards Analytics for Sensemaking presented at #C21LA: Tracking & Assessing 21st Century Competencies with Learning Analytics. ALASI, University of Wollongong, Wollongong, Australia.

Kovanović, V., & Joksimović, S. (November 2019). Introduction to Epistemic Network Analysis. ALASI, University of Wollongong, Australia.

Thompson, K., Leonard, S., Adams, D., **de Laat, M., Gabriel, F.**, Howard, S., Knight, S., Lodge, J., Markauskaite, L. & Reimann, P. (November 2019). Educational research data: linking data for collaborative research about learning and teaching. ALASI, University of Wollongong, Australia.

Alhadad, S., Lodge, J. & **Gabriel, F.** (November 2019). (Critical) Dreams of Open Practices as Researchers and Practitioners of Learning Analytics. ALASI, University of Wollongong, Australia.

Marmolejo-Ramos, F., Rodriguez-Medina, D., Ospina, R., de Bastiani, F., Barrera-Causil, C., Martinez-Florez, G., Cruz-Molina, W., & Posada-Quintero, H. (December 2019). Towards distributional analyses of biomarker data. International Biometric Society (IBS) Australasian Region Conference, Adelaide, Australia.

CONFERENCE AND MEETING INVITATIONS

Pardo, A. (March 2019). Supporting Evidence-Based Education through Learning Analytics. International Symposium on learning analytics, Kyoto, Japan http://eds.let.media.kyoto-u.ac.jp/?page_id=851&lang=en

Gabriel, F. (May 2019). OECD The Future of Education and Skills 2030. International Education conference - 9th Informal Working Group meeting, Vancouver, Canada.

Joksimović, S. (September 2019). Theory and Learning Analytics, Invited lecture, University of Eastern Finland, Finland.

Gabriel, F. (October 2019). OECD The Future of Education and Skills 2030. International Education Conference - 10th Informal Working Group meeting, Goyang, South Korea.

Joksimović, S. & Kovanović, V. (October 2019). Learning Analytics & Data Revolution in Education, Research@SMARTSchool Seminar series. School of Education, University of South Australia, Adelaide, Australia.

Pardo, A. (October 2019). Learning Analytics to Improve Learning Experiences. Pedagogical, Technological and Ethical Aspects. Defence Learning Technologies Conference, Australian Defence College, Weston, Canberra, Australia.

Kovanović, V. (December 2019). Ninth WeB & Serbian Moodle Moot 2019. The University of Belgrade, Belgrade, Serbia

Poquet, O. (December 2019). Using SNA in Learning

Analytics. Invited talk at the University of South Australia, Adelaide, Australia.

Pardo, A. (2019). Can data help to improve learning experiences? Korea National University of Education International Conference. Cheongju, South Korea.

Pardo, A. (2019). How to make the best use of data about learners? University of Tasmania, Hobart, Australia.



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