The University of Edinburgh

The Moray House School of Education

School Postgraduate Studies Committee

18 August 2015

New Course Proposal: Learning Analytics: Process and Theory

Brief description of the paper

A new course proposal for Learning Analytics as an option for MSc in Digital Education

Action requested

For approval

Resource implications

Does the paper have resource implications? Yes

As this is a new course, there is an intention to take it to the Policy and Resources Committee at the first available opportunity. We recognise this is out of the normal sequence.

Risk assessment

Does the paper include a risk analysis? No

Equality and diversity

Have due considerations been given to the equality impact of this paper? Yes

Freedom of information

Can this paper be included in open business? Yes

Any other relevant information

A collaboration with Teachers College, Columbia University is planned, and it is therefore hoped that the course can run in January.

Originator of the paper

Professor Dragan Gasevic

Course Rationale

The analysis of data from user interactions with technologies is literally changing how organisations function, prioritise and compete in an international market. All industries have been influenced or impacted by the so called digital revolution and the associated analysis of user data (Barton & Court, 2012). In the education sector, this wave of data analytics has flowed through the concept of learning analytics (Siemens & Gašević, 2012). The adoption of information systems in different aspects of the sector has afforded a new opportunity to gain insight into student learning. As with most information systems, students' interactions with their online learning activities are captured and stored. These digital traces (log data) can then be 'mined' and analysed to identify patterns of learning behaviour that can provide insights into education practice. This process has been described as learning analytics. Learning analytics offer a new premise for decision making, planning, resource allocation, teaching delivering, and intervention.

Despite the relative infancy of this research field many commentators have noted the vast potential of learning analytics for improving the quality of teaching and addressing challenges related to student retention and personalised and adaptive learning. Statements range from learning being a game changer for higher education (Oblinger, 2012), to the more tempered claims for analytics informing incremental improvements to learning and teaching practice (Ferguson, 2012). These improvements include concerns regarding student retention and academic performance, demonstration of learning and teaching quality, advanced insights into learning progression and formative feedback provision, and developing models of personalised and adaptive learning.

The learning analytics field has gained a significant attention in the sector through the investment and implementation of learning analytics in schools in higher education institutions (Johnson, Adams Becker, Estrada, & Freeman, 2015; Mandinach, 2012). Despite this high interest and investment in learning analytics, there is a considerable gap in learning analytics capabilities among various stakeholder groups involved in education (Colvin et al., 2015) such as senior leaders, decision makers, academic and support staff, teachers, and students. In order to unlock the full potential of learning analytics, it is necessary to bridge this gap and create educational opportunities in learning analytics.

In spite of a high interest in learning analytics, there are presently limited educational opportunities for learning analytics. The first postgraduate master's degree was launched at Teachers College, Columbia University in the autumn of 2014 and offered admission to its first cohort of students. There are also individual courses dedicated to learning analytics in the institutions such as Carnegie Mellon University and George Mason University. However, availability of learning analytics courses in the United Kingdom and Europe is much more limited compared to the opportunities available to the United States. Moreover, availability of postgraduate courses in learning analytics through online delivery could not be found at the time of proposing this course. The only known courses are massive open online courses (DALMOOC offered through edX and LAK'11 and LAK'12 offered as connectivist courses by the Society for Learning Analytics Research), which are co-taught by Professor Dragan Gasevic. This creates a high opportunity for this course to attract many students. Although offered as part of the MSc in Digital Education program, this course has a high potential to attract students outside of the program as well.

The proposal for this course aims to address this growing demand on the global and national scenes and the specific demand of many students who are enrolled into the MSc in Digital Education program. Many students in this program would like to make use of learning

analytics as part of their research or would like to acquire learning analytics skills for their careers. Not only will this course provide a significant complement to the existing MSc in Digital Education courses (especially the research methods course), but it will increase the overall data literacy of the program graduates who will be able to apply data-informed processes in their digital education practice and research.

This course recognizes that learning analytics is a bricolage field drawing on research, methods, and techniques from numerous disciplines such as learning sciences, data mining, information visualization, and (educational) psychology. Therefore, the learning outcomes of the course are defined and the course is structured to focus on the learning analytics process and guide students to draw connections between learning analytics methods and educational theory and practice. Although desirable to have some background in statistics, the course does not have any specific prerequisites in order to accommodate to the diverse interests, perspectives, and academic backgrounds of the prospective students.

The course builds on the recent university investment in hiring chairs in digital education and technology enhanced science learning. The course is proposed and will be taught by Professor Dragan Gasevic who is Chair in Learning Analytics and Informatics. Professor Gasevic has done a pioneering work in establishing and consolidating the field of learning analytics and is the current President of the Society for Learning Analytics Research, founding editor of the Journal of Learning Analytics, and co-founder of the International Conference on Learning Analytics and Knowledge and the Learning Analytics Summer Institute. He brings the leadership and expertise in learning analytics field accompanied with the experience in teaching learning analytics through massive open online courses and on campus courses and workshops. The Digital Education grouping has a growing expertise in learning analytics with Dr. Jeremy Knox who is developing a research program in learning analytics (e.g., his PTAS award) and who has necessary content expertise to teach this course. In addition to the core academic staff members, several PhD students in the school and the university conduct their research in the field of learning analytics and could provide teaching input into the course. Finally, the Digital Education grouping is centrally positioned in the field of learning analytics and has close collaborations with and access to many leading research groups and universities in the field.

The course is based on the existing course offered at Teachers College, Columbia University and in collaboration with Associate Professor Ryan Baker. The pedagogical model of the course builds on the previous online teaching and scholarship of Professor Dragan Gasevic. The course also makes use the experience gained through the delivery of the massive open online course – Data, Analytics, and Learning (DALMOOC) – which was co-taught by Professor Gasevic with edX and in collaboration with Professor George Siemens (University of Texas, Arlington), Associate Professor Ryan Baker (Teachers College, Columbia University), and Associate Professor Carolyn Penstein Rosé (Carnegie Mellon University). Thus, the investment into the development of the course is minimal, while its quality is assured by making use of the existing course, strong collaboration ties, and the pedagogical model proven through its use in several online post-graduate courses.

References

Barton, D., & Court, D. (2012). Making advanced analytics work for you. *Harvard Business Review*, *90*(10), 78–83.

Colvin, C., Rogers, T., Wade, A., Dawson, S., Gašević, D., Buckingham Shum, S., … Fisher, J. (2015). *Student retention and learning analytics: A snapshot of Australian practices*

and a framework for advancement (Research Report). Canberra, Australia: Office of Learning and Teaching, Australian Government.

Ferguson, R. (2012). Learning analytics: drivers, developments and challenges. *International Journal of Technology Enhanced Learning*, *4*(5), 304–317. http://doi.org/10.1504/IJTEL.2012.051816

Johnson, L., Adams Becker, S., Estrada, V., & Freeman, A. (2015). *NMC Horizon Report: 2015 Higher Education Edition*. Austin, Texas: The New Media Consortium.

Mandinach, E. B. (2012). A Perfect Time for Data Use: Using Data-Driven Decision Making to Inform Practice. *Educational Psychologist*, *47*(2), 71–85. http://doi.org/10.1080/00461520.2012.667064

Oblinger, D. (2012). *Game changers: Education and information technologies*. Louisville, CO: Educause. Retrieved from http://net.educause.edu/ir/library/pdf/pub7203.pdf

Siemens, G., & Gašević, D. (2012). Special Issue on Learning and Knowledge Analytics. *Educational Technology & Society*, *15*(3), 1–163.

The enhanced course descriptor

Course Name	Learning Analytics: Process and Theory
Course Level	PG
Availability	Only for students on PG Dip/ MSc Digital Education
SCQF Credit Volume	20
SCQF Credit Level	11
Home Subject Area	Education
Other Subject Area	N/A
Course Organiser	Professor Dragan Gasevic
Course Secretary	Angela Hunter
% Not taught by this institution	%0
Collaboration information	In the first offering of the course (January 2016), a collaboration with Teachers College, Columbia University is planned. A shared digital space will be created with the access to the students from both the MSc in Digital Education and those who will be enrolled into the same course at Teachers College, Columbia University. This will offer opportunities for the participants to build connections with the participants from another world leading institution and get exposure to and engage into conversations with different perspectives to the topics studied in the course. Teachers College, Columbia University already has a full MSc program in learning analytics, which is the first post-graduate academic program in learning analytics in the world. The participants from the University of Edinburgh will submit their assignments to the servers hosted by the university and will be graded by the tutor from the University of Edinburgh. If the collaboration is successful, it will be continued in the future course offerings and additional collaboration opportunities will be envisioned, as the part of the on-going preparation for signing a memorandum of understanding between Teachers College and MHSE. This collaboration is planned in consultation with the HoS of MHSE, program director of MSc in Digital Education, convener of the Digital Education grouping in the MHSE, Director of International Affairs and Chair of Department of Human Development at Teachers College, Columbia University, and A/ Prof Baker (course instructor at Teachers College). A/Professor Ryan Baker, Teachers College, Columbia University is the founding president of the International Educational Data Mining Society (IEDMS).
Total Contact Teaching Hours	
Costs to be met by students	N/A
Pre-requisites	None, but some prior experience with statistics or data mining recommended.
Co-requisites	N/A
Visiting Student Pre-requisites	N/A
Summary Course	This course provides a framework for understanding and critically

Description	discussing the emerging field of learning analytics. Students will learn about the primary perspectives on what the field should be, including Learning Analytics, Educational Data Mining, and Big Data perspectives, and the relationship to related and existing fields. Perspectives on what learning analytics should be will be connected to philosophy and theory on the nature of design and inquiry. We will consider what it means for a learning analytics analysis or model to be valid, and the key challenges to the effective and appropriate use of learning analytics.
Keywords	Learning analytics, educational theory, educational data mining, big data
Fee Code if invoiced at course level	N/A
Examination and Assessment Information	CA [Class and Assignment]
Default Delivery Period	N/A
Marking Scheme	Common Marking Scheme
Taught in Gaelic	No
Course type	Online
Learning outcomes	• Describe, critically review and critically discuss literature in learning analytics; • Discuss and argue about current topics in learning analytics through the use of a coherent theoretical and process framework; • Conduct a learning analytics project and argue, justify and discuss the decisions made during this project
Special Arrangements	N/A
Components of Assessment	Summative *Assignment 1: Literature review paper (25%)* This assignment consists of two main tasks: - to write a literature review paper on a learning analytics topic – 80%; - to review (double blind) papers prepared by peers – 20%. This assignment emphasises the importance of the ability to prepare a comprehensive literature review in an area of learning analytics in order to: (i) learn about pre-existing solutions in the area of the students' research/interest; (ii) clarify the importance of the students' research objective, with respect to the approaches that have been proposed by other researchers; (iii) enhance the relevance of the students' topic by demonstrating that you are aware of other research in the field; and (iv) define a research problem for the project that the students will be pursuing in assignment 3. *Assignment 2: Research proposal (20%)*

	The goal of this assignment is to help students formulate their research proposals for the project in assignment 3 and discuss their research proposal with the peers. The sections that are expected to be submitted as part of their research proposals can serve as the first versions of the sections required in the paper requested in assignment 3. This assignment is accomplished through knowledge construction and interaction with the peers in the class. Thus, it is of critical importance that the students provide constructive feedback to their peers about their proposed research method, help them deepen all the potential challenges they will need to deal with in their projects, and reflect on how their proposed research related to their own ideas and the available peer-reviewed papers of relevance. The essential skills for this assignment are critical discussion, research methods, research synthesis, and validation. There are two main tasks for this assignment: ▪ proposal (75% of the Assignment 2 mark) ▪ Responses to the posts of your peers on your proposal (25% of the Assignment 2 mark) ▪ Participation in the discussions of the peers' proposals (5 marks of the 15 participation marks) In addition, participation in the discussions in this assignment contributes the final 5 marks of the 15 marks for participation. *Assignment 3 – Learning analytics project (40%)* This assignment is an individual research project in learning analytics. The objective is to demonstrate a synthesis of the evidence of achieving the learning outcomes of the course. This assignment builds on the literature review from Assignment 1, and the research problem formulated in the scope of that assignment. The assignment also builds on the research proposal developed in Assignment 2. There are two main deliverables for this assignment: • Research paper (75% of the Assignment 3 mark) • Presentation (25% of the Assignment 3 mark) In addition, participation in the discussions in this assignment contributes the final 5 marks of the 15 marks for participation. *Participation (15%)* The participation is assessed through the three main

	components: ▪ Participation in discussions related to the weekly readings ▪ Participation in discussions related to Assignment 2 ▪ Participation in discussions related to Assignment 3 Formative Formative feedback will be provided throughout the course through tutor and peer feedback on discussion posts. Peer feedback will also be provided on the literature review paper (assignment 1), project proposal (assignment 2) and final project (assignment 3). Tutor feedback on assignment 1 will be relevant to participants' work on assignment 2 of the assessment. Likewise, tutor feedback on assignment 2 will be relevant to participants' work on assignment 3 of the assessment. Tutor feedback will also be provided on the discussion participation will relevant to participants' discussion and following assessments in the course.
Examination Information	N/A
Course Description	The course is structured around a number of activities. Specifically, each week will have a set of: ▪ Readings introducing the topics of learning analytics covered by the course. The topics will be adjusted each to acknowledge the rapid development of the field of learning analytics and its theory and processes. Some of these topics include: Methodological pluralism; Sciences of the artificial; Learning analytics, educational data mining, and Big Data perspectives; Evidence-centred design; Learning analytics validity; Statistical perspectives on validity in data mining; Generalizability of learning analytics results; Automated intervention with learning analytics; Reporting-based intervention; Knowledge engineering; Discovery with models; Methodological pluralism (Reprise) ▪ Each of these readings will be accompanied with a series of tutor-provided questions that should scaffold participants' posts to asynchronous online discussion posts on a weekly basis and that will contribute to the participation grade. More importantly, the purpose of these discussions is to create a space of the participants to engage into social knowledge construction activities, negotiate the meaning of the topics studied with their peers, and get to appreciate and critical discuss different viewpoints to learning analytics. ▪ The summative assessments will be accompanied with formative feedback to inform and guide following assessments in the course. The three main assessments guide the participants through a process of the development of their ideas – from early literature review to project proposal to project execution, and reporting and presentation of the findings. All the assessment points will

	also include peer feedback, as a way to promote cooperative learning and community creation. The community creation will be guided by the main principles of the community of inquiry model – probably, one of the most researched models in online learning literature. ▪ To increase flexibility necessary for the completion of the course, asynchronous online activities are primarily planned (including presentations of the own work through the sharing of recorded presentation via a streaming server). To increase access to the tutor, the course will feature weekly synchronous discussion session with the instructor and scheduled weekly online chats.
Graduate Attributes	A. Research and Enquiry To be able to identify, define and analyse conceptual and/ or practical problems in learning analytics through the critical appraisal of existing evidence. To be able to generative methodologically rigorous, ethics-based, and innovative solutions appropriate to the broader context of learning analytics. B. Personal and Intellectual Autonomy To be able to exercise substantial autonomy and initiative in the identification and execution of their intended learning activities. To be independent learners able to develop and maintain a critical approach to issues in learning analytics . C. Communication To be make effective use of the multimodal capabilities of digital technologies to communicate appropriate knowledge and understanding of emerging concepts and practices in learning analytics. D. Personal Effectiveness To be able to recognise and respond to new opportunities for learning and development informed by learning analytics. To be able to work effectively with others on different issues in learning analytics.
Breakdown of learning & teaching activities	Total Hours: 200 Course readings 40 Synchronous sessions and chats 15 Asynchronous online discussion 25 Literature review 40 Development of research proposal 10 Project 60 Formative peer assessment 10
Study Abroad	
Reading List	Appendix A
Feedback	In addition to tutor and peer feedback received through the formative assessment described under “Components of Assessment”, the participants will be requested to submit reports reflecting on their own participation in online discussions. To purpose of this activity is to increase the community development and offer guidance for the development of communication and social knowledge

	construction skills.
High Demand	

Appendix A – Reading List

Anderson, J.R., Reder, L.M., Simon, H.A. (1996) Situated Learning and Education. *Educational Researcher*, 25 (4), 5-11.

Anderson, J.R., Reder, L.M., Simon, H.A. (1997) Situative Versus Cognitive Perspectives: FormVersus Substance. *Educational Researcher*, 26 (1), 18-21.

Arnold, K.E. (2010). Signals: Applying academic analytics. *Educause Quarterly*, 33, 1-10.

Arroyo, I., Woolf, B. P., Cooper, D., Burleson, W., & Muldner, K. (2011). The impact of animated pedagogical agents on girls' and boys' emotions, attitudes, behaviors, and learning. *Proceedings of the 11th IEEE Conference on Advanced Learning Technologies*, 506-510.

Baker, R.S.J.d. (2010) Mining Data for Student Models. In Nkmabou, R., Mizoguchi, R., & Bourdeau, J. (Eds.) *Advances in Intelligent Tutoring Systems,* pp. 323-338. Secaucus, NJ: Springer.

Baker, R.S.J.d., Corbett, A.T., Roll, I., Koedinger, K.R. (2008) Developing a Generalizable Detector of When Students Game the System. *User Modeling and User-Adapted Interaction*, 18, 3, 287-314.

Baker, R.S.J.d., Ocumpaugh, J.L., Gowda, S.M., Gowda, S.M., Heffernan, N.T. (2013) Ensuring Reliability of Educational Data Mining Detectors for Diverse Populations of Learners. Paper Presented at *CREA: Center for Culturally Responsive Evaluation and Assessment: Inaugural Conference*.

Baker, R.S.J.d., Yacef, K. (2009) The State of Educational Data Mining in 2009: A Review and Future Visions. *Journal of Educational Data Mining, 1* (1), 3-17.

Broderick, Z., O'Connor, C., Mulcahy, C., Heffernan, N. & Heffernan, C. (2011). Increasing Parent Engagement in Student Learning Using an Intelligent Tutoring System. *Journal of Interactive Learning Research, 22* (4), 523-550.

Colvin, C., Rogers, T., Wade, A., Dawson, S., Gašević, D., Buckingham Shum, S., Nelson, K., Alexander, S., Lockyer, L., Kennedy, G., Corrin, L., Fisher, J. (2015). *Student retention and learning analytics: A snapshot of Australian practices and a framework for advancement*. Canberra, ACT, Australia: Australian Government's Office for Learning and Teaching.

Corbett, A. (2001) Cognitive computer tutors: Solving the two-sigma problem. *UM2001, User Modeling: Proceedings of the Eighth International Conference*, 137–147.

Ferguson, R. (2012) Learning analytics: drivers, developments and challenges. *International Journal of Technology Enhanced Learning (IJTEL), 4* (5/6), 304-317.

Gašević, D., Dawson, S., & Siemens, G. (2015). Let's not forget: Learning analytics are about learning. *TechTrends*, *59*(1), 64-71.

Greeno, J.G. (1997) On Claims That Answer the Wrong Question. *Educational Researcher*, 26(1), 5-17.

Halevy, A.Y., Norvig, P., Pereira, F. (2009). The unreasonable effectiveness of data. *IEEE Intelligent Systems*, 24(2), 8–12.

Hand, D.J. (1998) Data Mining: Statistics and More? *The American Statistician, 52* (2), 112-118.

Hand, D.J., Blunt, G., Kelly, M.G., Adams, N.M. (2000) Data Mining for Fun and Profit. *Statistical Science, 15* (2), 111-126.

Hershkovitz, A., de Baker, R. S. J., Gobert, J., Wixon, M., & Sao Pedro, M. (2013). Discovery With Models A Case Study on Carelessness in Computer-Based Science Inquiry. *American Behavioral Scientist*, *57*(10), 1480-1499.

Macfadyen, L. P., Dawson, S., Pardo, A., & Gasevic, D. (2014). Embracing big data in complex educational systems: The learning analytics imperative and the policy challenge. *Research & Practice in Assessment*, *9*(2), 17-28.

McKeon, R. (1987). Philosophic Semantics and Philosophic Inquiry. Unpublished Article presented at the Illinois Philosophy Conference. Carbondale, Illinois.

Mislevy, R.J., Almond, R.G., Lukas, J.F. (2003) A Brief Introduction to Evidence-Centered Design. Technical Report, Educational Testing Service.

Papert, S. (1990). Perestroika and Epistemological Politics. Keynote Address at World Conference on Computers in Education. Sydney, Australia. http://stager.tv/blog/?p=928

Paquette, L., de Carvalho, A. M., & Baker, R. S. (2014). Towards Understanding Expert Coding of Student Disengagement in Online Learning. In*Proc. of the 36th Annual Cognitive Science Conference* (pp. 1126-1131).

Pardos, Z. A., Baker, R. S., San Pedro, M. O., Gowda, S. M., & Gowda, S. M. (2013, April). Affective states and state tests: Investigating how affect throughout the school year predicts end of year learning outcomes. In *Proceedings of the Third International Conference on Learning Analytics and Knowledge* (pp. 117-124). ACM.

Pavlik, P., Toth, J. (2010) How to Build Bridges between Intelligent Tutoring System Subfields of Research. *Proceedings of the International Conference on Intelligent Tutoring Systems* (pp. 103-112).

Romero, C., Ventura, S. (2007) A Survey from 1995 to 2005. *Expert Systems with Applications,33* (1), 135-146.

Rupp, A.A., Gushta, M., Mislevy, R.J., Shaffer, D.W. (2010) Evidence-Centered Design of Epistemic Games: Measurement Principles for Complex Learning Environments. *The Journal of Technology, Learning, and Assessment, 8* (4), 4-47.

Scheuer, O., & McLaren, B. M. (2012). Educational data mining. In N. Seel (Ed.) *Encyclopedia of the Sciences of Learning* (pp. 1075-1079). Springer US.

Shute, V.J., Ventura, M., Bauer, M., Zapata-Rivera, D. (2009) Melding the Power of Serious Games and Embedded Asssessment to Monitor and Foster Learning. In U. Ritterfeld, M. Cody, & P. Vorderer (Eds.), *Serious Games: Mechanisms and Effects,* 295-321.

Siemens, G. (2013) Learning Analytics: The Emergence of a Discipline. *American Behavioral Scientist, 57* (10), 1380-1400.

Siemens, G., & d Baker, R. S. (2012, April). Learning analytics and educational data mining: towards communication and collaboration. In *Proceedings of the 2nd international conference on learning analytics and knowledge* (pp. 252-254). ACM.

Simon, H. A. (1996). *The sciences of the artificial* (Vol. 136). MIT press.

School course costing model

	HOURS TO DELIVER		Data to be supplied by course organiser
	New	**Standard**	**NOTES/ QUERIES**
Course Title	**Learning Analytics: Process and Theory**		Does this course replace current delivery or is it additional?
Course Credits	20	20	
Estimated students on course	15	15	What is the expected split between home fee and international fee students?
Workshop/Tutorial Group Size	15	15	
Lecture Hours	0		Hours of face to face delivery.
Online Activity Hours	20	20	
No of hours workshop group teaching	0	0	Hours of face to face delivery.
No of workshop /tutorial groups	1	1	Student numbers/group size
Lecture Hours attributable to programme	40	40	Based on current WLM values
Workshop Hours attributable to programme	0	0	Based on current WLM values
Course Teaching and Assessment hours	49.5	49.5	Based on current WLM values, single marking including moderation
Teaching & Learning and Assessment Hours Attributable to Programme	89.5	89.5	
Admin support hours			
Direct cost of delivery	**£2,855**	**£2,855**	
Hrs at 91% recovery (assuming average 40% teaching)	204	204	Full academic cost of teaching

Hrs at 91% recovery plus contribution to School Costs (23%)	250	250	Full cost to School of teaching
Full cost of course (91% recovery plus contribution)	**£7,989**	**£7,989**	
Estimated Course income (2015/16 fee rates)			
20 credit course fee (home)	£900	£900	£8100/9
20 credit course fee (overseas)	£1,835	£1,835	£16500/9 rounded to closest £5.
Gross Income (20 credit fee * students)	£18,175	£18,175	Income attributable to course based on student numbers however, unless new students, this will not be additional income to the School
Net course income (53% of gross)	**£9,633**	**£9,633**	

Estimated net surplus/deficit from course	£1,644	£1,644	