HUDK 4051: Learning Analytics: Process and Theory
Teachers College, Columbia University
Spring 2016
Professor Ryan Baker

SYLLABUS

Instructor Info
Phone: 212-678-8329
Email: baker2@exchange.tc.columbia.edu
Office: Grace Dodge Hall 464
Office hours: Mondays and Tuesdays 2pm-330pm (but emailing to schedule a meeting is strongly preferred)
Course time: Most online discussions will be held Tuesdays, 9am-1040am USA Eastern
In some cases, discussions may be switched to Thursdays, 9am-1040am USA Eastern (see online schedule)
Weekly reflections: All weekly reflections should be posted by Monday at 9am USA Eastern
Course discussion forum: https://www.moodle.is.ed.ac.uk/course/view.php?id=780
(contact instructor for login access if you have not received it by the first day of class)

Number of points: 3

Required Texts

- Simon, H.A. (1996) *Sciences of the Artificial.*
- Trochim, W.M.K., Donnelly, J.P. (2007) *The Research Methods Knowledge Base.*

Course readings can be found within the course discussion forum.

Course Goals: This course provides a framework for understanding and critically discussing the emerging field of learning analytics. Students will learn about the distinction between learning analytics, educational data mining, and big data, and the relationship of these 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.

Learning Outcomes:

By the end of the course, students will be able to:
- Describe and critically analyze learning analytics process and theory;
- Review, integrate and critically assess emerging trends in learning analytics literature;
- Develop a proposal for a piece of research or application using learning analytics in an educational setting, based in a critical understanding of the literature
- Develop a detailed plan for the learning analytics application or research proposed, and critically assess its main elements.

Course Pre-requisites: None, but some prior experience with statistics or data mining recommended.

Assignments:

Assignment 1: Critical literature review paper (35%)

The goal of this assignment is to write a literature review paper (approx. 1,500 words) on a learning analytics topic. This assignment will help define a research problem for the project that the students will be pursuing in assignments 2 and 3.

Assignment 2: Collaborative formulation of application or 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. Students will provide constructive feedback to their peers about their proposed research, the quality of which will be assessed and contribute to the final mark.

A research proposal of 500 words will be written by each student, which will be shared in the course space for peer feedback. All students will be expected both to provide feedback, and to respond constructively to feedback from others. The participation in the discussions about peers' proposals will constitute 20% of the assessment weighting for assignment 2.

Assignment 3 – Learning analytics planning paper (40%)

This assignment is the development of a detailed plan for the application or research proposed in learning analytics. This assignment builds on the literature review from Assignment 1, and the research problem formulated and developed in Assignment 2.

Students will write a research paper of 2,500 words which will constitute 80% of the assignment weighting. Students will provide constructive feedback to their peers about their proposed research, the quality of which will be assessed and contribute 20% of the assessment weighting for assignment 3.

Weekly Reflections

Students will also write weekly reflections on the course readings and critically evaluate each other's reflections, which will constitute the final 5% of the course grade. Consistent with the literature in online education, the purpose of this is to receive formative feedback from both peers and the instructor and encourage social knowledge construction activities that will contribute to the three assessments in the course.

Formative Feedback

Formative feedback will be provided throughout the course through instructor and peer feedback on discussion posts. Peer feedback will also be provided on the assignments, including the final presentation.

Assignment Policy

Extensions for the assignment deadlines will only be available in case of instructor error or extreme circumstances (assignments in other classes, research studies, and so on do not count as extreme circumstances; serious injury, illness, or death in the family do count as extreme circumstances). Outside of these circumstances, late hand-ins will not be accepted (e.g. zero credit will be given).

Course Design

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.
- Each of these readings will be accompanied by a series of instructor-provided questions that will help scaffold participants' posts to asynchronous online discussion posts. The purpose of these discussions is to create a space for the participants to engage with 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.
- To increase the flexibility necessary to a globally-distributed cohort, asynchronous online activities are primarily planned. To increase access to the tutor, the course will feature weekly synchronous discussion session with the instructor and scheduled weekly online chats.

The course will be offered through Moodle and the Moodle accessibility guidelines will be followed.

This course will be conducted in conjunction with a course at the University of Edinburgh, in Scotland. That course is taught by Professor Dragan Gasevic, the world's first permanent endowed chair in Learning Analytics. The courses at TC and Edinburgh will share activities and assignments, enabling students at TC to collaborate with the world-class graduate students at Edinburgh.

Course Schedule

Learning Analytics: Process and Theory
Professor Ryan S. Baker

Week One
Introduction
No Online Session This Week

Readings

- TBD

Week Two
Methodological Pluralism
Weekly Reflections 1/25 9am
Online Session 1/26 9am

Readings

- McKeon, R. (1987) Philosophic Semantics and Philosophic Inquiry. Unpublished Article presented at the Illinois Philosophy Conference. Carbondale, Illinois.
- Anderson, J.R., Reder, L.M., Simon, H.A. (1996) Situated Learning and Education. *Educational Researcher*, 25 (4), 5-11.
- Greeno, J.G. (1997) On Claims That Answer the Wrong Question. *Educational Researcher*, 26 (1), 5-17.
- Anderson, J.R., Reder, L.M., Simon, H.A. (1997) Situative Versus Cognitive Perspectives: Form Versus Substance. *Educational Researcher*, 26 (1), 18-21.

Week Three
Sciences of the Artificial
Weekly Reflections 2/1 9am
Online Session 2/2 9am
Assignment 1 Topic Proposal Due 2/3 9am
Readings

- Simon, H.A. (1996) *Sciences of the Artificial, Ch. 1-2, 5-8*

Week Four
Educational Data Mining
Weekly Reflections 2/8 9am
Online Session 2/9 9am

Readings

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

- 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.

Week Five
Learning Analytics
Weekly Reflections 2/15 9am
Online Session 2/16 9am

Readings

- Ferguson, R. (2012) Learning analytics: drivers, developments and challenges. *International Journal of Technology Enhanced Learning (IJTEL), 4* (5/6), 304-317.
- Siemens, G. (2013) Learning Analytics: The Emergence of a Discipline. *American Behavioral Scientist, 57* (10), 1380-1400.
- Siemens, G., Baker, R.S.J.d. (2012) Learning Analytics and Educational Data Mining: Towards Communication and Collaboration. *Proceedings of the 2nd International Conference on Learning Analytics and Knowledge*.

Week Six
Big Data Perspective
Weekly Reflections 2/22 9am
Online Session 2/23 9am
Assignment 1: Critical literature review paper DUE 2/26 9am

Readings

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

Week Seven
Evidence-Centered Design
Weekly Reflections 2/29 9am
Online Session 3/1 9am

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

No Activities for TC students 3/14 or 3/15: Spring Break

Week Eight

Validity/Generalizability
Weekly Reflections 3/7 9am
Online Session 3/8 9am

Readings

- Trochim, W.M.K., Donnelly, J.P. (2007) *The Research Methods Knowledge Base.* Ch. 2-1, 3-1, 7-1, 12-1
- 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.
- Ocumpaugh, J., Baker, R., Gowda, S., Heffernan, N., Heffernan, C. (2014) Population validity for Educational Data Mining models: A case study in affect detection. *British Journal of Educational Technology, 45* (3), 487-501.

Spring Break
No activities for TC students on 3/14 or 3/15

Week Ten
Influencing Practice and Policy
Weekly Reflections 3/21 9am
Online Session 3/22 9am

Readings

- 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.
- 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.

Week Eleven
Reporting-Based Intervention
Weekly Reflections 3/28 9am
Online Session 3/29 9am
Assignment 2: Collaborative formulation of application or research proposal due Apr. 1 9am

Readings

- Arnold, K.E. (2010). Signals: Applying academic analytics. *Educause Quarterly*, 33, 1-10.
- Broderick, Z., DeNolf, K., Dufault, J., Heffernan, N. & Heffernan, C. (in press). Increasing Parent Engagement in Student Learning Using an Intelligent Tutoring System with Automated Messages. *Journal of Interactive Learning Research*.

Week Twelve
Theories Shaping Learning Activities
Weekly Reflections 4/4 9am
Online Session 4/5 9am

Readings

- Gašević, D., Dawson, S., Rogers, T., Gašević, D. (2016). Learning analytics should not promote one size fits all: The effects of course-specific technology use in predicting academic success. *The Internet and Higher Education, 28*, 68-84.

- Wise, A. F. (2014, March). Designing pedagogical interventions to support student use of learning analytics. In *Proceedings of the Fourth International Conference on Learning Analytics And Knowledge* (pp. 203-211). ACM.

Week Thirteen
Automated Intervention
Weekly Reflections 4/11 9am
Online Session 4/12 9am

Readings

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

Week Fourteen
Knowledge Engineering
Weekly Reflections 4/18 9am
Online Session 4/19 9am

Readings

- Paquette, L., Carvalho, A.M.J.A., Baker, R.S. (in press) Towards Understanding Expert Coding of Student Disengagement in Online Learning. To appear in *Proceedings of the Annual Meeting of the Cognitive Science Society*.
- 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. Section 5: Knowledge Engineering and Data Mining.

Week Fifteen
Discovery with Models

Weekly Reflections 4/25 9am
Online Session 4/26 9am

Readings

- Pardos, Z.A., Baker, R.S., San Pedro, M.O.C.Z., Gowda, S.M., Gowda, S.M. (2014) Affective states and state tests: Investigating how affect and engagement during the school year predict end of year learning outcomes. *Journal of Learning Analytics, 1* (1), 107-128.
- Hershkovitz, A., Baker, R.S.J.d., Gobert, J., Wixon, M., Sao Pedro, M. (in press) Discovery with Models: A Case Study on Carelessness in Computer-based Science Inquiry. To appear in *American Behavioral Scientist*.

Week Sixteen
Statistical Perspectives on Validity in Data Mining
Weekly Reflections 5/2 9am
Online Session 5/5 9am
Assignment 3 – Learning analytics planning paper due 5/6 9am

Readings

- 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.

Week Seventeen
Methodological Pluralism (Reprise)
Weekly Reflections 5/9 9am
Online Session 5/10 9am

Readings

- Papert, S. (1990) Perestroika and Epistemological Politics. Keynote Address at World Conference on Computers in Education. Sydney, Australia. http://stager.tv/blog/?p=928
- 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,* 103-112.