

HUDK 4051: Learning Analytics: Process and Theory
Spring 2014
Professor Ryan Baker

SYLLABUS

Instructor Info

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Office: Grace Dodge Hall 290

Office hours: Wednesdays, 1pm-4pm (but I strongly prefer you email me to schedule a meeting)

Course time: Mondays and Wednesdays, 11am-1240pm

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*.

Information on how to obtain course readings (aside from these texts) will be provided in class.

Course Goals: This course provides a framework for understanding the emerging field of learning analytics. Students will learn about the primary perspectives on what the field should be, including Educational Data Mining, Learning Analytics, 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.

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

Assignments:

A theoretical paper will be due on April 21. This theoretical paper will require the student to select a topic (in consultation with the instructor), and argue for a specific position for how the field of learning analytics must change to meet the needs of 21st century education or learning sciences. Students will be required to turn in a 1-page paper prospectus for the theoretical paper on February 24, which will be graded as well. (Note that this is a later deadline than the original deadline, as one class was cancelled due to weather). Extensions for the paper and prospectus 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).

Midterm and final exams will be given. Both exams are open-book; open-resource; open-web. However, collaborating on the exam with other students or anyone else at all is NOT ALLOWED. The exams will be made available on the course webpage 48 hours before the due date.

Class participation involves both attendance and active (and constructive) participation in classroom discussions. While it is not expected that you will memorize every paper assigned for the class, it is

expected that you will have studied the readings to the degree that you can participate actively in discussions.

Grading

- Theoretical Paper Prospectus 10%
- Theoretical Paper 20%
- Midterm Exam 25%
- Final Exam 25%
- Class Participation 20%

Course Schedule

Learning Analytics: Process and Theory

Professor Ryan S.J.d. Baker

Wed, Jan. 22

Introduction

Readings

- None

Mon, Jan 27

Methodological Pluralism

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.

Wed, Jan 29

Attend EdLab Seminar at noon by Professor Baker

Mon Feb 3

Sciences of the Artificial, Part One

Readings

- Simon, H.A. (1996) *Sciences of the Artificial*, Ch. 1-2, 5-6

Wed Feb 5

Class cancelled by TC due to weather

Mon Feb 10

No class

Wed Feb 12

No class

Mon Feb 17

No class

Wed Feb 19
Sciences of the Artificial, Part Two

Readings

- Simon, H.A. (1996) *Sciences of the Artificial*, Ch. 7-8

Mon Feb 24
Educational Data Mining

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.
- Scheuer, O., McLaren, B.M. (2011) Educational Data Mining. In N. Seel (Ed.) *Encyclopedia of the Sciences of Learning*.

Assignment Due: Theoretical Paper Prospectus

Wed Feb 26
Learning Analytics

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*.

Mon Mar 3
Big Data Perspective

Readings

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

Wed Mar 5
Optional session TBA

Mon Mar 10

Evidence-Centered Design

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 Assessment to Monitor and Foster Learning. In U. Ritterfeld, M. Cody, & P. Vorderer (Eds.), *Serious Games: Mechanisms and Effects*, 295-321.

Wed Mar 12

Midterm Exam Due

Mon Mar 17

Spring Break

Wed Mar 19

Spring Break

Mon Mar 24

Validity

Readings

- Trochim, W.M.K., Donnelly, J.P. (2007) *The Research Methods Knowledge Base*. Ch. 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.

Wed Mar 26

No class: LAK2014

Mon Mar 31

Statistical Perspectives on Validity in Data Mining

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.

Wed Apr 2

Generalizability

Readings

- Trochim, W.M.K., Donnelly, J.P. (2007) *The Research Methods Knowledge Base*. Ch. 2-1
- 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*.

Mon Apr 7

No class; AERA2014

Wed Apr 9

Automated Intervention

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.

Mon Apr 14

Reporting-Based Intervention

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*.

Wed Apr 16

No class

Mon Apr 21

Optional session TBA

Assignment Due: Theoretical Paper

Wed Apr 23

Knowledge Engineering

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.

Mon Apr 28

Optional session TBA

Wed Apr 30

Discovery with Models

Readings

- Pardos, Z.A., Baker, R.S.J.d., San Pedro, M.O.C.Z., Gowda, S.M., Gowda, S.M. (in press) Affective states and state tests: Investigating how affect throughout the school year predicts end of year learning outcomes. To appear in *Proceedings of the 3rd International Conference on Learning Analytics and Knowledge*.
- 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*.

Mon May 5

Methodological Pluralism (Reprise)

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.

Wed May 7

Optional session TBA

Mon May 12

Final Exam Due