

Teachers College, Columbia University
Technology and Human Development
HUDK4035

Instructor: Ryan S. Baker (in semester-by-semester coordination with John Black)

Office: 464 GDH

Phone : 212-678-8329

Email: ryanshaunbaker@gmail.com

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, 11am-1240pm

In some cases, discussions may be switched to Thursdays, same time

Weekly reflections: All weekly reflections should be posted by Monday at 9am
(starting 2/1)

Text: No text, just readings online

Description: Examines the use and design of various educational technologies (computer software, multimedia software, TV, WorldWideWeb sites, video games, mobile games, etc.) from the perspective of basic research and theory in cognition and development. The goal of the course is to provide a framework for reasoning about the most effective uses of technology for people at different ages.

Assignments:

Assignment 1: Critical literature review paper (25%)

The goal of this assignment is to write a literature review paper (approx. 1,500 words) on a topic related to technology and human development. 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 half of the assessment weighting for assignment 2.

Assignment 3 – Technology and Human Development planning paper (35%)

This assignment is the development of a detailed plan for application or research in technology and human development. 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 14% 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. All weekly reflections should be posted by Monday at 9am.

Research Studies (6%)

To gather an understanding of where the course material comes from, you must participate in 3 hours of research studies (or summarize 3 extra journal articles).

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.

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.
- The course will primarily consist of asynchronous online activities. To increase access to the instructor, the course will feature weekly synchronous discussion sessions with the instructor, typically held Tuesdays at 11am.

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

TC Policies:

1. The College will make reasonable accommodations for persons with documented disabilities. Students are encouraged to contact the Office of Access and Services for Individuals with Disabilities (OASID) for information about registration. You can reach OASID by email at oasid@tc.columbia.edu, stop by 163 Thorndike Hall or call 212-678-3689. Services are available only to students who have registered and submit appropriate documentation. As your instructor, I am happy to discuss specific needs with you as well. Please report any access related concerns about instructional material to OASID and to me as your instructor.
2. The grade of Incomplete will be assigned only when the course attendance requirement has been met but, for reasons satisfactory to the instructor, the granting of a final grade has been postponed because certain course assignments are outstanding. If the outstanding assignments are completed within one calendar year from the date of the close of term in which the grade of Incomplete was received and a final grade submitted, the final grade will be recorded on the permanent transcript, replacing the grade of Incomplete, with a transcript notation indicating the date that the grade of Incomplete was replaced by a final grade. If the outstanding work is not completed within one calendar year from the date of the close of term in which the grade of Incomplete was received, the grade will remain as a permanent Incomplete on the transcript. In such instances, if the course is a required course or part of an approved program of study, students will be required to re-enroll in the course including repayment of all tuition and fee charges for the new registration and satisfactorily complete all course requirements. If the required course is not offered in subsequent terms, the student should speak with the faculty advisor or Program Coordinator about their options for fulfilling the degree requirement. Doctoral students with six or more credits with grades of Incomplete included on their program of study will not be allowed to sit for the certification exam.
3. Teachers College students have the responsibility for activating the Columbia University Network ID (UNI) and a free TC Gmail account. As official communications from the College – e.g., information on graduation, announcements of closing due to severe storm, flu epidemic, transportation disruption, etc. -- will be sent to the student's TC Gmail account, students are responsible for either reading email there, or, for utilizing the mail forwarding option to forward mail from their account to an email address which they will monitor.
4. It is the policy of Teachers College to respect its members' observance of their major religious holidays. Students should notify instructors at the beginning of the semester about their wishes to observe holidays on days when class sessions are scheduled. Where academic scheduling conflicts prove unavoidable, no student will be penalized for absence due to religious reasons, and alternative means will be sought for satisfying the academic requirements involved. If a suitable arrangement cannot be worked out between the student and the instructor, students and instructors should consult the appropriate department chair or director. If an additional appeal is needed, it may be taken to the Provost.
5. Sexual Harassment and Violence Reporting - Teachers College is committed to maintaining a safe environment for students. Because of this commitment and because of federal and state regulations, we must advise you that if you tell any of your instructors about sexual harassment or gender-based misconduct involving a member of the campus community, your instructor is required to report this information to the Title IX Coordinator, Janice Robinson. She will treat this information as private, but will need to follow up with you and possibly look into the matter. The Ombuds officer for Gender-Based Misconduct is a confidential resource available for students, staff and faculty. "Gender-based misconduct" includes sexual assault, stalking, sexual harassment, dating violence, domestic violence, sexual exploitation, and gender-based harassment. For more information, see <http://sexualrespect.columbia.edu/gender-based-misconduct-policy-students>.

Week

Topics and Readings

Links to Readings are Posted on Moodle

January 26

Introduction

Piaget's Theory of Cognitive Development

See Moodle

Logo Programming Environment History

See Moodle

February 2

Declarative Knowledge, CAI and Concept Mapping

Hendrickson, C., Pasquale, A., Robinson, W., & Rossi-Velasco, M. (1986). Applications of computer aided instruction. *Journal of Professional Issues in Engineering*, 112(3), 194-202.

Anderson, J.R. (1996) ACT: A simple theory of complex cognition. *American Psychologist*, **51**, 335-365

Pavlik, P.I., Anderson, J.R. (2008) Using a model to compute the optimal schedule of practice. *Journal of Experimental Psychology: Applied*, 14 (2), 101-117.

Novak, J.D., and Canas, A.J. (2008) The theory underlying concept maps and how to construct and use them. IHMC 2008-01.

Inspiration Concept Mapping Software
www.inspiration.com

Cmap Concept Mapping Software
cmap.ihmc.us

Assignment 1: Critical literature review TOPIC DUE 2/3

February 9 No Class

February 11 Procedural Knowledge and ITS

Anderson, J. R., Corbett, A. T., Koedinger, K., & Pelletier, R. (1995). Cognitive tutors: Lessons learned. *The Journal of Learning Sciences*, 4, 167-207.

Koedinger, K. R., Corbett, A. T., & Perfetti, C. (2012). The Knowledge-Learning-Instruction framework: Bridging the science-practice chasm to enhance robust student learning. *Cognitive Science*, 36(5), 757-798.

Steenberger-Hu, S, and Cooper, H. (2014) A meta-analysis of the effectiveness of Intelligent Tutoring Systems on college students' academic learning. *Journal of Educational Psychology*, **106**, 331-347.

LearnLab (Pittsburgh Science of Learning Center)
www.learnlab.org

ACT-R based Cognitive Tutors
www.carnegielearning.com

February 16 Mental Models and Simulations

Gobert, J.D., Sao Pedro, M., Raziuddin, J., Baker, R. (2013) From Log Files to Assessment Metrics: Measuring Students' Science Inquiry Skills Using Educational Data Mining. *Journal of the Learning Sciences*, **22** (4), 521-563.

D. Schwartz and J. Black (1996) Shuttling between depictive models and abstract rules: Induction and fallback. *Cognitive Science*, **20**, 457-497.

Chan, M.S. and Black, J.B. (2006) Direct-manipulation animation: Incorporating the haptic channel in the learning process to support middle school students in science learning and mental model acquisition. *Proceedings of the International Conference of the Learning Sciences*. Mahwah, NJ: LEA.

Stella Systems Thinking Software
www.iseesystems.com

February 23

Grounded Embodied Cognition

Black, J.B., Segal, A., Vitale, J. and Fadjo, C. (2012). Embodied cognition and learning environment design. In D. Jonassen and S. Lamb (Eds.). *Theoretical foundations of student-centered learning environments*. New York: Routledge.

Han, I. and Black, J. (2011) Incorporating haptic feedback in simulations for learning physics. *Computers and Education*. 57, 2281-2290.

Glenberg, A.M., Goldberg, A.B., and Zhu, X. (2011) Improving early reading comprehension using embodied CAI. *Instructional Science*, **39**, 27-39.

Assignment 1: Critical literature review paper DUE 2/26

March 1 Video Games

Adams, D., Mayer, R., MacNamara, A. Koenig, A. and Wainess, R. (2012) Narrative games for learning: Testing The discovery and narrative hypothesis. *Journal of Educational Psychology*, **104**, 235-249.

Shute, V. J., Ventura, M., & Kim, Y. J. (2013). Assessment and learning of qualitative physics in newton's playground. *The Journal of Educational Research*, 106(6), 423-430.

P. Wolters, C von Nimwegen, H, van Oostendorp, E. van der Spek (2013) A meta-analysis of the cognitive and motivational effects of serious games. *Journal of Educational Psychology*, **105**, 249-265

Black, J.B., Khan, S.A.and Huang,S.C.D.(2014) Video games as grounding experiences for learning. In F. C. Blumberg (Ed.) *Learning by playing: Frontiers of videogaming in education*. New York: Oxford University Press.

Play Physics Playground through MARI
<https://www.mari.com>

March 8

Multi-User Virtual Environments (MUVes)

Ketelhut, D. J., Dede, C., Clarke, J., Nelson, B., & Bowman, C. (2007). Studying situated learning in a multi-user virtual environment. In E. Baker, J. Dickieson, W. Wulfeck & H. O'Neil (Eds.), *Assessment of problem solving using simulations*. Mahwah, NJ: Lawrence Erlbaum Associates.

Kamarainen, A., Metcalf, S., Grotzer, T., & Dede, C.J. (2014). Exploring ecosystems from the inside: How immersion in a multi-user virtual environment supports epistemologically grounded practices in ecosystem science instruction. *Journal of Science Education and Technology*.

Rowe, J., Mott, B., McQuiggan, S., Robison, J., Lee, S., & Lester, J. (2009). Crystal island: A narrative-centered learning environment for eighth grade microbiology. In *Workshop on intelligent educational games at the 14th international conference on artificial intelligence in education, Brighton, UK* (pp. 11-20).

Barab, S. A., Zuiker, S., Warren, S., Hickey, D., Ingram-Goble, A., Kwon, E.-J., Kouper, I., & Herring, S. C. (2007). Situationally Embodied Curriculum: Relating Formalisms and Contexts. *Science Education*, **91**, 750-782

March 22 Agents and Dialogue Tutors

Schwartz, D. Chase, C. Chin, D., Oprezzo, M., Kwong, H., Okita, S. Roscoe, R. Jeong, H., Wagster, J. and Biswas, G. (2009) Interactive metacognition: Monitoring and regulating a teachable agent. In D. Hacker, J. Dunlosky, and A. Graesser (Eds.) *Handbook of metacognition in education*.

Chase, C., Chin, D., Oprezzo, M., and Schwartz, D. (2009) Teachable agents and the Protégé Effect; Increasing the effort towards learning. *Journal of Science Education and Technology*.

Bai, X. and Black, J.B. (2011) Enhancing intelligent tutoring systems with the agent paradigm. In S. Stankov, M. Rosov, and V. Glavinic (Eds.) *Intelligent tutoring systems in eLearning environments: Design, implementation and evaluation*. Hershey, PA: IGI Global Publishing

Rus, V., D'Mello, S., Hu, X., & Graesser, A. (2013). Recent advances in conversational intelligent tutoring systems. *AI magazine*, 34(3), 42-54.

March 29 Mobile Learning and Augmented Reality

Squire, K., & Klopfer, E. (2007). Augmented reality simulations on handheld computers. *Journal of the Learning Sciences*, 16(3), 371 - 413.

Grotzer, T., Powell, M., Derbiszewska, K. Courtier, C., Kamarainen, A. Metcalf, S. and Dede, C. (2014) Turning transfer inside out: The affordances of virtual worlds and mobile devices in real world contexts for teaching about causality across time and distance in Ecosystems. *Technology, Knowledge and Learning*.

Swart, M., Friedman, B., Kornakasem, S. Black, J., and Vitale, J. (2015) M3-Situating embodied learning: embedding gestures in narratives to learn mathematical *Fractions* in a digital tablet environment. In Noelle, D. C., Dale, R., Warlaumont, A. S., Yoshimi, J., Matlock, T., Jennings, C. D., & Maglio, P. P. (Eds.) (2015) *Proceedings of the 37th Annual Meeting of the Cognitive Science Society*. Austin, TX: Cognitive Science Society.

Assignment 2: Collaborative formulation of application or research proposal due Apr. 1

April 5 Television and Video

Kirkorian, H., Wartella, E., and Anderson, D. (2008) Media and young children's learning. *Future of Children*, **18**, 39-81.

Mares, M. and Pa, Z. (2013) Effects of *Sesame Street*: A meta-analysis of children's learning in 13 countries. *Journal of Applied Developmental Psychology*, **34**, 140-151.

Crawley, A., Anderson, D., Wilder, A., Williams, M., and Santomero, A. (1999) Effects of repeated exposures to a single episode of the television program *Blue's Clues* on the viewing behaviors and comprehension of preschool children. *Journal of Educational Psychology*. **91**, 630-637.

Fisch, S., Lesh, R. Motoki, E., Crespo, S. and Melfi, V. (2010) Children's learning from multiple media in informal mathematics education.

April 12

Robots

Ng-Thow-Hing, V. and Okita, S. (2012) Playdates with robots. *Computer*, IEEE Computer Society, **45**, 89-91.

Okita, S., NG-Thow-Hing, V. and Saradevabhatla (2009) Learning together. IEE Human and Robot Interactive Communication.

Rusk, N., Resnick, M., Berg, R. and Presella-Granlund, M. (2008) New pathways into robotics. *Science Education and Technology*,

Lu, C., Black, J. Kang, S. and Huang, D. (2013) The effect of LEGO robotics and embodiment on elementary science learning. In M. Knauff, M. Pauen, N. Sebanz and I. Wachsmuth (Eds.), *Proceedings of the 35th Annual Conference of the Cognitive Science Society*. Austin, TX: Cognitive Science Society.

April 19 Computational Literacy and Learning by Design

Resnick, et.al. (2009) Scratch: Programming for all. *Communications of the ACM*, 52, 6-67.

Grover, S. and Pea, R. (2013) Computational thinking in K-12: A review of the state of the field. *Educational Researcher*, 42, 38-43.

Hmelo, C.E., Holton, D.L., Kolodner, J.L. (2000) Designing to Learn About Complex Systems *Journal of the Learning Sciences*, **9**, 247-298.

Blikstein, P. (2013). Digital fabrication and 'making' in education: The democratization of invention. *FabLabs: Of machines, makers and inventors*, 1-21.

April 26

Learning Analytics and Educational Data Mining

Baker, R., Siemens, G. (2014) Educational data mining and learning analytics. In Sawyer, K. (Ed.) *Cambridge Handbook of the Learning Sciences: 2nd Edition*.

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

May 3 **No Class**

May 5 **Motivation, Engagement, and Affect**

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child development*, 78(1), 246-263.

D'Mello, S., Lehman, B., Sullins, J., Daigle, R., Combs, R., Vogt, K., & Graesser, A. (2010). A time for emoting: When affect-sensitivity is and isn't effective at promoting deep learning. In *Intelligent tutoring systems* (pp. 245-254). Springer Berlin Heidelberg.

San Pedro, M.O.Z., Baker, R.S.J.d., Bowers, A.J., Heffernan, N.T. (2013) Predicting College Enrollment from Student Interaction with an Intelligent Tutoring System in Middle School. *Proceedings of the 6th International Conference on Educational Data Mining*, 177-184.

Li, D., Lin-Siegler, X. and Black, J (2015). Instruction emphasizing effort improves physics problem solving.

Assignment 3 – T&HD planning paper due 5/6

May 10 **MOOCs and Social Online Learning**

Siemens, G. (2013). Massive open online courses: Innovation in education. *Open educational resources: Innovation, research and practice*, 5.

Clow, D. (2013). MOOCs and the funnel of participation. In *Proceedings of the Third International Conference on Learning Analytics and Knowledge* (pp. 185-189). ACM.

Gašević, D., Zouaq, A., & Janzen, R. (2013). "Choose Your Classmates, Your GPA Is at Stake!": The Association of Cross-Class Social Ties and Academic Performance. *American Behavioral Scientist*.

Crossley, S., McNamara, D., Baker, R.S., Wang, Y., Paquette, L., Barnes, T., Bergner, Y. (2015) Language to Completion: Success in an Educational Data Mining Massive Open Online Course. *Proceedings of the 8th International Conference on Educational Data Mining*, 388-391.