

ZACHARY A. PARDOS

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Education

2006, BS, Computer Science – Worcester Polytechnic Institute
2012, PhD, Computer Science – Worcester Polytechnic Institute
2013, Postdoc, Computer Science / Physics – Massachusetts Institute of Technology

Professional History

July 2020 - Present, Associate Professor – University of California, Berkeley
Graduate School of Education (100%), Cognitive Science (affiliate)
July 2019 – 2020, Associate Professor - University of California, Berkeley
Graduate School of Education (50%), School of Information (50%)
July 2013 - 2019, Assistant Professor - University of California, Berkeley
Graduate School of Education (50%), School of Information (50%)
2012-2013, Postdoctoral Associate - Massachusetts Institute of Technology
Computer Science AI Lab (CSAIL), Research Lab of Electronics (RLE)

Research Interests

Knowledge Representation, Adaptive Learning, Learning Analytics, Recommender Systems, Education Data Mining, Data Science, Digital Learning Environments, Cognitive Modeling, Big Data in Education, Knowledge Tracing, Formative Assessment, Intelligent Tutoring Systems, Massive Open Online Courses, Machine Learning, Online Learning, Psychometrics

Awards and Honors

2019, Best Paper (first author), ACM Learning @ Scale Conference, Chicago, IL
2018, New and Future AI Educator, awarded @ AAI-18 (NSF sponsored)
2014, Elected to the Executive Committee of the Artificial Intelligence in Education Society
2013, Best Student Paper (co-author), Educational Data Mining Conference, Memphis, TN
2010, Knowledge Discovery and Data Mining (KDD) Cup, Washington, D.C.
2009, Best Student Paper (first author), Educational Data Mining Conference, Córdoba, Spain
2008-2012, National Science Foundation Graduates in K-12 Education (GK-12) Fellowship
2007-2008, Department of Education Graduates in Areas of National Need (GANN) Fellowship

Select Professional Activity

2020, Co-editor of AERA Open Special Issue on Educational Data Science
2020, Co-chair of AERA Satellite Conference on Educational Data Science
2020, ACT Tech Talk, Invited Talk on Recommendation in Higher Education, Remote
2020, Berkeley Evaluation and Assessment Research Center Seminar, Berkeley, CA
2020, Brazil Economic Society Meeting, Speaker and Panelist, São Paulo, Brazil
2020, Appointed to Advisory Board, Gooru Learning Inc., Redwood City, CA
2019, Stanford Graduate School of Education, Colloquium Talk, Stanford, CA
2019, IEEE Learning with MOOCs Conference, Keynote, Milwaukee, WI
2019, Ohio State University Sesquicentennial Conference, Panelist, Columbus, OH
2019, EdCrunch Conference, Invited Talk, Moscow, Russia

2019, Co-Chair, Multimodal Analytics in Edu (AIMA4EDU) Workshop @ IJCAI, Macau, China
 2019, Weizmann Institute of Social Science Learning Analytics Symposium, Tel Aviv, Israel
 2019, Udemy Seminar, San Francisco, CA
 2018, Reimagine Education Conference, Keynote, San Francisco, CA
 2018, Bay Area Registrars Conference Invited Talk, San Francisco, CA
 2018, Hanyang University's Higher Education Research Institute, Keynote, Seoul, South Korea
 2018, Open edX Conference, Invited Talk, Montréal, Canada
 2018, Columbia Teacher's College EdLab Seminar, New York, NY
 2018, NVIDIA GPU Technology Conference, Speaker, Santa Clara, CA
 2018, UC Davis Institute for Social Sciences Seminar, Davis, CA
 2018, Berkeley Evaluation and Assessment Research (BEAR) Seminar, Berkeley, CA
 2018, 10th Annual California Cognitive Science Conference Keynote, Berkeley, CA
 2018, Stanford American Society for Engineering Education Colloquium, Stanford, CA
 2016, Harvard VPAL Research Group Invited Talk, Cambridge, MA
 2016, National Academy of Education: Big Data and Privacy Workshop Panelist, Washington, D.C.
 2015, ACT Insight Analytics and Emerging Technologies Symposium Keynote, Iowa City, IA
 2015, Educational Testing Service (ETS) Seminar, San Francisco, CA (telecast)
 2014, University of Pittsburgh School of Information Sciences Colloquium, Pittsburgh, PA
 2015, Editorial Board, Journal of Educational Data Mining & Int. Journal of AI in Education
 2014, Intel: Adaptive Learning Summit Keynote, Santa Clara, CA
 2014, White House/OSTP: Big Data and Privacy Workshop Panelist, Berkeley, CA
 2014, Program Co-Chair, International Conference on Educational Data Mining, London, UK
 2013, Chair, Workshop on Massive Open Online Courses (moocshop) @ AIED, Memphis, TN

Reviewing

Journals

Computers and Education
 Handbook of Educational Data Mining
 Handbook of Learning Analytics
 Int. Journal of Artificial Intelligence in Education
 Journal of Educational Data Mining
 Journal of Educational Measurement
 Journal of Learning Analytics
 Journal of Learning and Instruction
 Journal of the Learning Sciences
 PLOS ONE
 Proceedings of the National Academy of Sciences

The Internet and Higher Education
 Transactions on Interactive Intel. Systems
 Transactions on Learning Technologies

Conferences

ACM Learning @ Scale '14, '16-'21
 ACM Learning Analytics and Knowledge '14-'21
 ACM Recommender Systems '19-'21
 ACM SIGCHI '19, '20 (1AC)
 Artificial Intelligence in Education '13-'21
 Educational Data Mining '09-'21
 Int. Conf. of the Learning Sciences '18

Select University Service

2019-2020, CIO Executive Advisory Group on Research, Teaching & Learning, UCB
 2019, Senate Task Force on Micro-Credentials, UCB
 2018-2019, Faculty Task Force: Graduate Certificate in Applied Data Science, UCB
 2018-2019, Faculty Task Force: Data Science Undergrad Minor Design, UCB

Sponsored Projects

- 2020-2022, Schmidt Futures. *Data to Drive Smart Course Selection*. P.I., \$235,000.
- 2020-2021, Schmidt Futures. *Seeding an Undergraduate Learning Engineering Fellowship*. P.I., \$330,000.
- 2019-2022, California Governor's Office of Planning and Research: California Education Learning Lab. *Community Sourced, Data-Driven Improvements to Open, Adaptive Courseware*. Co-P.I., \$53,000.
- 2019-2020, Ithika S+R, *Improving Articulation of Credit and Transfer Student Support at CUNY*. P.I., \$35,000
- 2019-2001, Peter Sather Grant, *Embracing Data in Educational Systems: The Use of Learning Analytics to Support Students at Risk*. P.I., \$25,000
- 2015-2019, National Science Foundation, BIGDATA: EAGER: *Deep Learning in Higher Education Big Data to Explore Latent Student Archetypes and Knowledge Profiles*. Sponsor Award ID: 1547055. P.I., \$289,888.
- 2015-2019, National Science Foundation, Collaborative Research: *Personalizing Recommendations in a Large-Scale Education Analytics Pipeline*. Sponsor Award ID: 1446641. P.I., \$99,999.
- 2015-2016, Bill & Melinda Gates Foundation / Smart Sparrow LLC, *Next Generation Courseware Challenge: Inspark Science Network for Postsecondary Success in Entry Level Science for Disadvantaged Students*. UC SPO ID: 038528-002. P.I., \$88,000.
- 2015, Bill & Melinda Gates Foundation, *Development of a Dynamic Knowledge Map Visualization for K-12 Teachers*. UC SPO ID: 038286-002. P.I., \$32,311.
- 2013-2015, Department of Education, *Design and Development of a Dynamic Learning Maps Alternative Assessment System*. UC SPO ID: 036329-002. P.I., \$119,626.
- 2014, Google Faculty Research Grant, *Scaling Cognitive Modeling to Massive Open Environments*. P.I., \$18,000.

Publications

Journal Articles

- Pardos Z. A., Nam A. J. H. (2020) A university map of course knowledge. *PLoS ONE*, 15(9): e0233207. <https://doi.org/10.1371/journal.pone.0233207>
- Fischer, C., Pardos, Z. A., Baker, R. S., Williams, J. J., Smyth, P., Yu, R., Slater, S., Baker, R., Warschauer, M. (2020). Mining Big Data in Education: Affordances and Challenges. *Review of Research in Education*, 44(1), 130–160.
- Pardos, Z. A., Fan, Z., Jiang, W. (2019) Connectionist Recommendation in the Wild: On the utility and scrutability of neural networks for personalized course guidance. *User Modeling and User-Adapted Interaction*, 29(2), 487–525.
- Pardos, Z. A., Horodyskyj, L. (2019) Analysis of Student Behaviour in Habitable Worlds Using Continuous Representation Visualization. *Journal of Learning Analytics*, 6(1), 1-15.
- Pardos, Z. A., Dadu, A. (2018) dAFM: Fusing Psychometric and Connectionist Modeling for Q-matrix Refinement. *Journal of Educational Data Mining*. Vol 10(2), 1-27.
- Pardos, Z. A. (2017) Big Data in Education and the Models that Love Them. *Current Opinion*

in Behavioral Sciences. Vol 18, 107-113. **Invited article**

- Pardos, Z. A., Whyte, A., Kao, K. (2016) moocRP: Enabling Open Learning Analytics with an Open Source Platform for Data Distribution, Analysis, and Visualization. *Technology, Knowledge and Learning*, Vol 21(1), 75-98.
- Stamper, J., Pardos, Z. A. (2016) The 2010 KDD Cup Competition Dataset: Engaging the machine learning community in predictive learning analytics. *Journal of Learning Analytics*, 3(2), 312-316. **Invited dataset summary**
- Pardos, Z. A. (2015) Commentary On "Beyond Time-on-Task: The Relationship Between Spaced Study and Certification in MOOCs." *Journal of Learning Analytics*, 2(2), 70-74. **Invited article commentary**
- Koedinger, K. R., D'Mello, S., McLaughlin, E. A., Pardos, Z. A., Rosé, C. P. (2015) Data Mining and Education. *WIREs Cognitive Science*.
- Pardos, Z. A., Baker, R. S.J.d., 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.
- Rau, M.A., Alevan, V., Rummel, N., Pardos, Z. A. (2014) How Should Intelligent Tutoring Systems Sequence Multiple Graphical Representations of Fractions? A Multi-Methods Study. *International Journal of Artificial Intelligence in Education*. 24(2), 125-161.
- Pardos, Z. A., Gowda, S. M., Baker, R. S.J.D., Heffernan, N. T. (2012) The Sum is Greater Than the Parts: Ensembling Models of Student Knowledge in Educational Software. In *ACM's Knowledge Discovery and Datamining (KDD) Explorations*, 13(2).
- Pardos, Z. A., Dailey, M., Heffernan, N. T. (2011) Learning what works in ITS from non-traditional randomized controlled trial data. *International Journal of Artificial Intelligence in Education*, 21(1-2), 45-63.
- Razzaq, L., Heffernan, N. T., Feng, M., Pardos, Z. A. (2007) Developing Fine-Grained Transfer Models in the ASSISTment System. *Journal of Technology, Instruction, Cognition, and Learning*, Vol. 5(3), 289-304.

Book Chapters

- Tang, S., Peterson, J., Pardos, Z. A. (2017) Predictive Modelling of Student Behaviour Using Granular Large-Scale Action Data. In C. Lang, G. Siemens, A.F. Wise & D. Gasevic (Eds.) *The Handbook of Learning Analytics*, Pages 223–233. Society for Learning Analytics Research (SoLAR), Alberta, Canada, 1st Edition.
- Pardos, Z. A., Heffernan, N. T., Anderson, B., Heffernan, C. (2010) Using Fine Grained Skill Models to Fit Student Performance with Bayesian Networks. In C. Romero, S. Ventura, S. R. Viola, M. Pechenizkiy and R. S. J. Baker (Eds.) *Handbook of Educational Data Mining*. CRC Press. Pages 417-426.

Conference Proceedings (stringently refereed)

- Jiang, W., Pardos, Z.A. (In press) Towards Equity and Algorithmic Fairness in Student Grade Prediction. In B. Kuipers, S. Lazar, D. Mulligan, & M. Fourcade (Eds.) *Proceedings of the Fourth AAAI/ACM Conference on Artificial Intelligence, Ethics, and Society* (AIES).
- Badrinath, A., Wang, F., Pardos, Z.A. (In press) pyBKT: An Accessible Python Library of Bayesian Knowledge Tracing Models. To appear in S. Hsiao, & S. Sahebi (Eds.) *Proceedings of the 14th International Conference on Educational Data Mining* (EDM).
- Condor, A., Litster, M., Pardos, Z.A. (In press) Automatic short answer grading with SBERT on out-of-sample questions. To appear in S. Hsiao and S. Sahebi (Eds.) *Proceedings of the 14th International Conference on Educational Data Mining* (EDM).
- Shao, E., Guo, S., & Pardos, Z. A. (2021). Degree Planning with PLAN-BERT: Multi-Semester Recommendation Using Future Courses of Interest. *Proceedings of the AAAI Conference on Artificial Intelligence*, 35(17), 14920-14929.
- Li, Z., Ren, C., Li, X., & Pardos, Z.A. (2021) Learning Skill Transfer Models Across Systems. In N. Dowell, S. Joksimovic, M. Scheffel, & G. Siemens (Eds.) *Proceedings of the 11th International Conference on Learning Analytics and Knowledge* (LAK). ACM. Pages 354-363.
- Cockkalingam, S., Yu, R., Pardos, Z.A. (2021) Which one's more work? Predicting effective credit hours between courses. In N. Dowell, S. Joksimovic, M. Scheffel, & G. Siemens (Eds.) *Proceedings of the 11th International Conference on Learning Analytics and Knowledge* (LAK). ACM. Pages 599-605.
- Chiang, H.-Y., Camacho-Collados, J., Pardos, Z.A. (2020) Understanding the Source of Semantic Regularities in Word Embeddings. In *Proceedings of the 24th Conference on Computational Natural Language Learning* (CoNLL). ACL. Pages 119-131.
- Jadhav, A., Amir, Y., Pardos, Z.A. (2020) Lexical Relation Mining in Neural Word Embeddings. In *Proceedings of the 28th International Conference on Computational Linguistics* (COLING). ACL. Pages 1299-1311.
- Jiang, W., Pardos, Z. A. (2020) Evaluating sources of course information and models of representation on a variety of institutional prediction tasks. In A. Rafferty and J.R. Whitehill (Eds.) *Proceedings of the 13th International Conference on Educational Data Mining* (EDM). Pages 115-125.
- Pardos, Z.A., Jiang, W. (2020) Designing for Serendipity in a University Course Recommendation System. In K. Verbert, M. Scheffel, N. Pinkwart, & V. Kovanovic (Eds.) *Proceedings of the 10th International Conference on Learning Analytics and Knowledge* (LAK). ACM. Pages 350–359.
- Jiang, W., Pardos, Z. A. (2019) Time Slice Imputation for Personalized Goal-based Recommendation in Higher Education. In D. Tikk & P. Brusilovsky (Eds.) *Proceedings of the 13th ACM Conference on Recommender Systems*. Copenhagen, Denmark. ACM. Pages 506-510.

- Dong, M., Yu, R., Pardos, Z. A. (2019) Design and Deployment of a Better Course Search Tool: Inferring latent keywords from enrollment networks. In M. Scheffel & J. Broisin (Eds.) *Proceedings of the 14th European Conference on Technology Enhanced Learning (EC-TEL)*. Delft, Netherlands. Springer. Pages 480-494.
- Pardos, Z. A., Chau, H., Zhao, H. (2019) Data-Assistive Course-to-Course Articulation Using Machine Translation. In J. C. Mitchell & K. Porayska-Pomsta (Eds.) *Proceedings of the 6th ACM Conference on Learning @ Scale (L@S)*. Chicago, IL. ACM. ***Best paper award***
- Kolb, J., Farrar, S., Pardos, Z. A. (2019) Generalizing Expert Misconception Diagnoses Through Common Wrong Answer Embedding. In M. Desmarais, C.F. Lynch, A. Merceron, & R. Nkambou (Eds.) *Proceedings of the 12th International Conference on Educational Data Mining (EDM)*. Montreal, Canada. Pages 342-347.
- Jiang, W., Pardos, Z. A., Wei, Q. (2019) Goal-based Course Recommendation. In C. Brooks, R. Ferguson & U. Hoppe (Eds.) *Proceedings of the 9th International Conference on Learning Analytics and Knowledge (LAK)*. ACM. Tempe, Arizona. Pages 36-45.
- Le, C. V., Pardos, Z. A., Meyer, S. D., Thorp, R. (2018) Communication at Scale in a MOOC Using Predictive Engagement Analytics. In M. Mavrikis, K. Porayska-Pomsta & R. Luckin (Eds.) *Proceedings of the 19th International Conference on Artificial Intelligence in Education (AIED)*. London, UK. Pages 239-252.
- Pardos, Z. A., Farrar, S., Kolb, J., Peh, G. X., Lee, J. H. (2018) Distributed Representation of Misconceptions. In J. Kay & R. Luckin (Eds.) *Proceedings of the 13th International Conference of the Learning Sciences (ICLS)*. London, UK. Pages 1791-1798. ***Crossover track paper*** (reviewed by both AIED and ICLS program committees)
- Pardos, Z. A., Hu, C., Meng, P., Neff, M., Abrahamson, D. (2018) Classifying Learner Behavior from High Frequency Touchscreen Data Using Recurrent Neural Networks. In D. Chin & L. Chen (Eds.) *Adjunct Proceedings of the 26th Conference on User Modeling, Adaptation and Personalization (UMAP)*. Singapore. ACM. Pages 317-322.
- Luo, Y., Pardos, Z. A. (2018) Diagnosing University Student Subject Proficiency and Predicting Degree Completion in Vector Space. In E. Eaton & M. Wollowski (Eds.) *Proceedings of the 33rd Conference on Advances in Artificial Intelligence (AAAI)*. New Orleans, LA. AAAI Press. Pages 7920-7927.
- Pardos, Z. A., Dadu, A. (2017) Imputing KCs with Representations of Problem Content and Context. In F. Cena & M. Desmarais (Eds.) *Proceedings of the 25th Conference on User Modeling, Adaptation and Personalization (UMAP)*. Bratislava, Slovakia. ACM. Pages 148-155.
- Pardos, Z. A., Tang, S., Davis, D., Le, C. V. (2017) Enabling Real-Time Adaptivity in MOOCs with a Personalized Next-Step Recommendation Framework. In C. Thille & J. Reich (Eds.) *Proceedings of the 4th Conference on Learning @ Scale (L@S)*. ACM. Pages 23-32. ***13% acceptance rate***
- Pardos, Z. A., & Nam, A. J. H. (2017) The School of Information and its Relationship to Computer Science at UC Berkeley. In W. Shim & C. Chen (Eds.) *iConference Proceedings*. Wuhan, China. Pages 309-316. <https://doi.org/10.9776/17030>.

- Sharma, K., Jermann, P., Dillenbourg, P., Prieto, L. P., D'Angelo, S., Gergle, D., Schneider, B., Rau, M., Pardos, Z., & Rummel, N. (2017) CSCL and Eye-Tracking: Experiences, Opportunities and Challenges. In B. K. Smith, M. Borge, E. Mercier & K. Y. Lim (Eds.) *Proceedings of the 12th International Conference on Computer Supported Collaborative Learning (CSCL)*. Philadelphia, PA. Vol 2, 727-734.
- Pardos, Z. A., Xu, Y. (2016) Improving efficacy attribution in a self-directed learning environment using prior knowledge individualization. In S. Dawson, H. Drachsler & C. Rosé (Eds.) *Proceedings of the Sixth International Conference on Learning Analytics & Knowledge (LAK)*. Edenborough, UK. ACM. Pages 435-439.
- Pardos, Z. A. & Kao, K. (2015) moocRP: An Open-source Analytics Platform. In B. Woolf, D. Russell & G. Kiczales (Eds.) *Proceedings of the 2nd International Conference on Learning @ Scale (L@S)*. Vancouver, CA. ACM. Pages 103-110.
- MacHardy, Z., Pardos, Z. A. (2015) Evaluating the Relevance of Educational Videos using BKT and Big Data. In C. Romero & M. Pechenizkiy (Eds.) *Proceedings of the 8th International Conference on Educational Data Mining (EDM)*. Madrid, Spain. Pages 424-427.
- Tang, S., Gogel, H., McBride, E., Pardos, Z. A. (2015) Desirable Difficulty and Other Predictors of Effective Item Orderings. In C. Romero & M. Pechenizkiy (Eds.) *Proceedings of the 8th International Conference on Educational Data Mining (EDM)*. Madrid, Spain. Pages 416-419.
- Corrigan, S., Barkley, T., & Pardos, Z. A. (2015) Dynamic Approaches to Modeling Student Affect and its Changing Role in Learning and Performance. In K. Bontchieva, & F. Ricci (Eds.) *Proceedings of the 23rd International Conference on User Modeling, Adaptation and Personalization (UMAP)*. Dublin, Ireland. Springer. Pages 92-103.
- Peterson, J., Pardos, Z. A., Rau, M., Swigart, A., Colin, G., McKinsey, J. (2015) Understanding Student Success in Chemistry using Gaze Tracking & Pupillometry. In C. Conati, N. Heffernan, A. Mitrovic, & M.F. Verdejo (Eds.) *Proceedings of the Artificial Intelligence in Education Conference (AIED)*. Madrid, Spain. Springer. Pages 358-366.
- Pardos, Z. A., Bergner, Y., Seaton, D., Pritchard, D.E. (2013) Adapting Bayesian Knowledge Tracing to a Massive Open Online College Course in edX. In S.K. D'Mello, R.A. Calvo, & A. Olney (Eds.) *Proceedings of the 6th International Conference on Educational Data Mining (EDM)*. Memphis, TN. Pages 137-144.
- Falakmasir, M. H., Pardos, Z. A., Gordon, G. J., Brusilovsky, P. (2013) A Spectral Learning Approach to Knowledge Tracing. In S.K. D'Mello, R.A. Calvo, & A. Olney (Eds.) *Proceedings of the 6th International Conference on Educational Data Mining (EDM)*. Memphis, TN. Pages 28-34. ***Best student paper award***
- Pardos, Z. A., Baker, R. S.J.d., San Pedro, M.O.C.Z., Gowda, S. M., Gowda, S. M. (2013) Affective states and state tests: Investigating how affect throughout the school year predicts end of year learning outcomes. In D.D. Suthers, K. Verbert, E. Duval & X. Ochoa (Eds.) *Proceedings of the 3rd International Conference on Learning Analytics and Knowledge (LAK)*. Leuven, Belgium. ACM. Pages 117-124.

- Karlovcec, M., Cardova--Sanchez, M., Pardos, Z. A. (2012) Knowledge Component Suggestion for Untagged Content in an Intelligent Tutoring System. In S.A. Cerri & W.J. Clancey (Eds.) *Proceedings of the 11th International Conference on Intelligent Tutoring Systems (ITS)*. Crete, Greece. Springer. Pages 195-200.
- Pardos, Z. A., Trivedi, S., Heffernan, N. T., Sarkozy, G. (2012) Clustered Knowledge Tracing. In S.A. Cerri & W.J. Clancey (Eds.) *Proceedings of the 11th International Conference on Intelligent Tutoring Systems (ITS)*. Crete, Greece. Pages 405-410.
- Gowda, S., Pardos, Z. A., Baker, S.J.D.R. (2012) Content learning analysis using the moment-by-moment learning detector. In S.A. Cerri & W.J. Clancey (Eds.) *Proceedings of the 11th International Conference on Intelligent Tutoring Systems (ITS)*. Crete, Greece. Pages 434-443.
- Trivedi, S. Pardos, Z. A., Sarkozy, G. & Heffernan, N. T. (2012) Co-Clustering by Bipartite Spectral Graph Partitioning for Out-of-Tutor Prediction. In K. Yacef, O. Zaïane, H. Hershkovitz, M. Yudelson & J. Stamper (Eds.) *Proceedings of the 5th International Conference on Educational Data Mining (EDM)*. Crete, Greece. Pages 33-40.
- Pardos, Z. A., Wang, Q. Y., Trivedi, S. (2012) The real world significance of performance prediction. In K. Yacef, O. Zaïane, H. Hershkovitz, M. Yudelson & J. Stamper (Eds.) *Proceedings of the 5th International Conference on Educational Data Mining (EDM)*. Crete, Greece. Pages 192-195.
- Rau, M., Pardos, Z. A. (2012) Interleaved Practice with Multiple Representations: Analyses with Knowledge Tracing Based Techniques. In K. Yacef, O. Zaïane, H. Hershkovitz, M. Yudelson & J. Stamper (Eds.) *Proceedings of the 5th International Conference on Educational Data Mining (EDM)*. Crete, Greece. Pages 168-171.
- Yumeng, Q., Pardos, Z. A., Heffernan, N. T. (2012) Towards data driven user model improvement. In M.G. Youngblood & P. McCarthy (Eds.) *Proceedings of the 25th annual Florida Artificial Intelligence Research Society Conference (FLAIRS)*. Marco Island, FL. AAAI Press.
- Pardos, Z. A., Heffernan, N. T. (2012) Tutor Modeling vs. Student Modeling. In M.G. Youngblood & P. McCarthy (Eds.) *Proceedings of the 25th annual Florida Artificial Intelligence Research Society Conference*. Marco Island, FL. AAAI Press. Pages 420-425. **Invited article**
- Pardos, Z. A., Heffernan, N. T. (2011) KT-IDEM: Introducing Item Difficulty to the Knowledge Tracing Model. In Konstant et al. (Eds.) *Proceedings of the 20th International Conference on User Modeling, Adaptation and Personalization (UMAP)*. Girona, Spain. Springer. Pages 243-254.
- Trivedi, S., Pardos, Z. A., Sarkozy, G. & Heffernan, N. T. (2011) Spectral Clustering in Educational Data Mining. In M. Pechenizkiy, T. Calders, C. Conati, S. Ventura, C. Romero & J. Stamper (Eds.) *Proceedings of the 4th International Conference on Educational Data Mining (EDM)*. Eindhoven, Netherlands. Pages 129-138.
- Qiu, Y., Qi, Y., Lu, H., Pardos, Z. A., Heffernan, N.T. (2011) Does Time Matter? Modeling the Effect of Time with Bayesian Knowledge Tracing. In M. Pechenizkiy, T. Calders, C. Conati, S. Ventura, C. Romero & J. Stamper (Eds.) *Proceedings of the 4th*

- International Conference on Educational Data Mining (EDM)*. Eindhoven, Netherlands. Pages 139-148.
- Feng, M., Heffernan, N. T., Pardos, Z. A., Heffernan, C. (2011) Comparing of Traditional Assessment with Dynamic Testing in a Tutoring System. In M. Pechenizkiy, T. Calders, C. Conati, S. Ventura, C. Romero & J. Stamper (Eds.) *Proceedings of the 4th International Conference on Educational Data Mining (EDM)*. Eindhoven, Netherlands. Pages 295-300.
- Trivedi, S., Pardos, Z. A., Heffernan, N. T. (2011) Clustering Students to Generate an Ensemble to Improve Standard Test Score Predictions. In Biswas et al (Eds.) *Proceedings of the 15th bi-annual Artificial Intelligence in Education Conference (AIED)*. Springer. LNAI 6738. Pages 328–336.
- Baker, R., Pardos, Z. A., Gowda, S., Nooraei, B., & Heffernan, N. T. (2011) Ensembling Predictions of Student Knowledge within Intelligent Tutoring Systems. In Konstant et al (Eds.) *Proceedings of the 20th International Conference on User Modeling, Adaptation and Personalization (UMAP)*. Girona, Spain. Springer. Pages 13-24.
- Nooraei, B., Pardos, Z. A., Heffernan, N. T., Baker, R. S.J.d (2011) Less Is More: Improving the Speed and Prediction Power of Knowledge Tracing by Using Less Data. In S. Ventura, C. Romero & J. Stamper (Eds.) *Proceedings of the 4th International Conference on Educational Data Mining (EDM)*. Eindhoven, Netherlands. Pages 101-110.
- Pardos, Z. A., Heffernan, N. T. (2010) Modeling Individualization in a Bayesian Networks Implementation of Knowledge Tracing. In P. De Bra, A. Kobsa & D. Chin (Eds.) *Proceedings of the 18th International Conference on User Modeling, Adaptation and Personalization (UMAP)*. Big Island of Hawaii. Springer. Pages 255-266.
- Pardos, Z. A., Heffernan, N. T. (2010) Navigating the Parameter Space of Bayesian Knowledge Tracing Models: Visualizations of the convergence of the EM algorithm. In R.S.J.d. Baker, A. Merceron & P.I. Pavlik Jr. (Eds.) *Proceedings of the 3rd International Conference on Educational Data Mining (EDM)*. Pittsburg, PA. Pages 161-170.
- Pardos, Z. A., Dailey, M. N., Heffernan, N. T. (2010) Learning what works in ITS from non-traditional randomized controlled trial data. In V. Aleven, J. Kay, J. Mostow (Eds.) *Proceedings of the 10th International Conference on Intelligent Tutoring Systems (ITS)*. Pittsburg, PA. Vol. 2. Pages 41-50.
- Pardos, Z. A., Heffernan, N. T. (2009) Determining the Significance of Item Order in Randomized Problem Sets. In T. Barnes, M. Desmarais, C. Romero & S. Ventura (Eds.) *Proceedings of the 2nd International Conference on Educational Data Mining (EDM)*. Cordoba, Spain. Pages 111-120. ***Best student paper award***
- Pardos, Z. A., Heffernan, N. T. (2009) Detecting the Learning Value of Items in a Randomized Problem Set. In V. Dimitrova, R. Mizoguchi, B. du Boulay & A. Graesser (Eds.) *Proceedings of the 14th International Conference on Artificial Intelligence in Education (AIED)*. Brighton, UK. IOS Press. Pages 499-507.

- Pardos, Z. A., Beck, J., Ruiz, C., Heffernan, N. T. (2008) The Composition Effect: Conjunctive or Compensatory? An Analysis of Multi-Skill Math Questions in ITS. In R. S.J.d. Baker, T. Barnes & J.E. Beck (Eds.) *Proceedings of the first International Conference on Educational Data Mining (EDM)*. Montreal, Canada. Pages 147-156.
- Pardos, Z. A., Feng, M. & Heffernan, N. T., Heffernan-Lindquist, C. (2007) Analyzing fine-grained skill models using Bayesian and mixed effect methods. In R. Luckin & K. Koedinger (Eds.) *Proceedings of the 13th Conference on Artificial Intelligence in Education (AIED)*. Marina Del Rey, CA. IOS Press. Pages 626-628.
- Pardos, Z. A., Heffernan, N. T., Anderson, B., Heffernan, C. (2007) The effect of model granularity on student performance prediction using Bayesian networks. In C. Conati, K.F. McCoy, & Paliouras (Eds.) *Proceedings of the 11th International Conference on User Modeling (UMAP)*. Corfu, Greece. Springer Berlin. Pages 435-429.

Workshop and Poster Proceedings (refereed)

- Pardos, Z. A., Jiang, W. (2019) Designing for Serendipity in a University Course Recommendation System. In *Proceedings of the Joint Workshop on Interfaces and Human Decision Making for Recommender Systems (IntRS) at 13th ACM Conference on Recommender Systems (RecSys)*. Copenhagen, Denmark.
- Pardos, Z. A., Jiang, W. (2019) Combating the Filter Bubble: Designing for Serendipity in a University Course Recommendation System. In *Proceedings of the Workshop on Deep Learning for Education (DL4Ed) at the 25th ACM Conference on Knowledge Discovery and Data Mining (KDD)*. Anchorage, AK.
- Jiang, N., & Pardos, Z. A. (2019) Binary Q-matrix Learning with dAFM. In M. Desmarais, C.F. Lynch, A. Merceron, & R. Nkambou (Eds.) *Proceedings of the 12th International Conference on Educational Data Mining (EDM)*. Montreal, Canada. Pages 588-590.
- Wiley, K., Bradford, A., Pardos, Z. A., Linn, M. (2019) Beyond Autoscoring: Extracting Conceptual Connections from Essays for Classroom Instruction. In M. Desmarais, C.F. Lynch, A. Merceron, & R. Nkambou (Eds.) *Proceedings of the 12th International Conference on Educational Data Mining (EDM)*. Montreal, Canada. Pages 675-678.
- Dong, M., Yu, R., Pardos, Z. A. (2019) Design and Deployment of a Better University Course Search: Inferring Latent Keywords from Enrollments. In M. Desmarais, C.F. Lynch, A. Merceron, & R. Nkambou (Eds.) *Proceedings of the 12th International Conference on Educational Data Mining (EDM)*. Montreal, Canada. Pages 540-543.
- Yu, R., Pardos, Z. A., Scott, J. (2019) Student Behavioral Embeddings and Their Relationship to Outcomes in a Collaborative Online Course. In *Proceedings of Learning Analytics: Building Bridges Between the Education and the Computing Communities Workshop held at the 12th International Conference on Educational Data Mining (EDM)*. Montreal, Canada. Pages 1-7.
- Alkaoud, M., Pardos, Z. A. (2019). Degree Curriculum Contraction: A Vector Space Approach. In A. Ogan, E. Millan, & S. Isotani (Eds.) *Proceedings of the 20th International Conference on Artificial Intelligence in Education (AIED)*. Chicago, IL. Springer, Cham. Pages 14-18.

- Swamy, V., Guo, A., Lau, S., Wu, W., Wu, M., Pardos, Z. A., & Culler, D. (2018) Deep Knowledge Tracing for Free-Form Student Code Progression. In M. Mavrikis, K. Porayska-Pomsta & R. Luckin (Eds.) *Proceedings of the 19th International Conference on Artificial Intelligence in Education (AIED)*. London, UK. Springer, Cham. Pages 348-352.
- Xiao, Z., Li, S., & Pardos, Z. (2018) AutoQuiz: A Personalized, Adaptive, Test Practice System. In E.K. Hawthorne & M.A. Pérez-Quiñones (Eds.) *Proceedings of the 49th ACM Technical Symposium on Computer Science Education (SIGCSE)*. Baltimore, MD. ACM. Pages 1089-1089.
- Tang, S., & Pardos, Z. A. (2017) Personalized Behavior Recommendation: A Case Study of Applicability to 13 Courses on edX. In F. Cena & M. Desmarais (Eds.) *Adjunct Publication of the 25th Conference on User Modeling, Adaptation and Personalization (UMAP)*. Bratislava, Slovakia. ACM. Pages 165-170.
- Le, C. V., Pardos, Z. A. (2016) Visualizing Online Learner Patterns. In J. Canny, P. Chau, B. Jiang & A. Khosla (Eds.) *Proceedings of the Workshop on Visualization for Deep Learning at the 33rd International Conference on Machine Learning (ICML)*. New York, NY.
- Tang, S., Peterson, J. C., Pardos, Z. A. (2016) Deep Neural Networks and How They Apply to Sequential Education Data. In V. Aleven, J. Kay & I. Roll (Eds.) *Proceedings of the 3rd Conference on Learning @ Scale (L@S)*. Edenborough, UK. ACM. Pages 321-324.
- McBride, E., Vitale, J. M., Gogel, H., Martinez, M. M., Pardos, Z. A., Linn, M. C. (2016) Predicting Student Learning using Log Data from Interactive Simulations on Climate Change. In V. Aleven, J. Kay & I. Roll (Eds.) *Proceedings of the 3rd Conference on Learning @ Scale (L@S)*. Edenborough, UK. ACM. Pages 185-188.
- Rau, M., Pardos, Z. A. (2016) Adding eye-tracking AOI data to models of representation skills does not improve prediction accuracy. In E. Snow & J. Rowe (Eds.) *Proceedings of the 9th International Conference on Educational Data Mining (EDM)*. Raleigh, North Carolina. Pages 622-623.
- Xu, Y., Johnson, M. J., Pardos, Z. A. (2015) Scaling cognitive modeling to massive open environments. In *Proceedings of the Workshop on Machine Learning for Education at the 32nd International Conference on Machine Learning (ICML)*. Lille, France.
- MacHardy, Z., Pardos, Z. A. (2015) Toward the Evaluation of Educational Videos using Bayesian Knowledge Tracing and Big Data. In B. Woolf, D. Russell & G. Kiczales (Eds.) *Proceedings of the 2nd International Conference on Learning @ Scale (L@S)*. Vancouver, CA. ACM. Pages 347-350.
- Tang, S., McBride, E., Gogel, H., Pardos, Z. A. (2015) Item Ordering Effects with Qualitative Explanations using Online Adaptive Tutoring Data. In B. Woolf, D. Russell & G. Kiczales (Eds.) *Proceedings of the 2nd International Conference on Learning @ Scale (L@S)*. Vancouver, CA. ACM. Pages 313-316.
- Dhanani, A., Lee, S., Phothilimthana, P., Pardos, Z. A. (2014) A Comparison of Error Metrics for Learning Model Parameters in Bayesian Knowledge Tracing. In Z. Pardos & J. Stamper (Eds.) *Proceedings of the Twenty Years of Knowledge Tracing Workshop at*

the 7th International Conference on Educational Data Mining (EDM). London, UK. Pages 153-154.

- Rosenberg-Kima, R., Pardos, Z. A. (2014) Is This Data for Real? In Z. Pardos & J. Stamper (Eds.) *Proceedings of the Twenty Years of Knowledge Tracing Workshop at the 7th International Conference on Educational Data Mining (EDM)*. London, UK. Pages 141-145.
- Pardos, Z. A. (2014) Inference and Analytics: Visualizing results from an adaptive MOOC simulation. In *Proceedings of the First Workshop on Machine Learning and Learning Analytics at the 4th Conference on Learning Analytics and Knowledge (LAK)*. Indianapolis, IN.
- Pardos, Z. A., Schneider, E. (2013) Workshop on Massive Open Online Courses. In Z. Pardos & E. Schneider (Eds.) *Proceedings of the First Annual Workshop on Massive Open Online Courses (Mooishop) at the 16th International Conference on Artificial Intelligence in Education (AIED)*. Memphis, TN. Pages 1-5. <http://ceur-ws.org/Vol-1009/>
- Pardos, Z. A., Yudelson, M. (2013) Towards Moment of Learning Accuracy. In K. Yacef & H.C. Lane (Eds.) *Proceedings of the Simulated Learners Workshop at the 16th International Conference on Artificial Intelligence in Education (AIED)*. Memphis, TN. Pages 61-70.
- Veeramachaneni, K., Pardos, Z. A., O'Reilly, U. (2013) MOOCdb: Developing Data Standards for MOOC Data Science. In Z. Pardos & E. Schneider (Eds.) *Proceedings of the First Annual Workshop on Massive Open Online Courses (Mooishop) at the 16th International Conference on Artificial Intelligence in Education (AIED)*. Memphis, TN. Pages 17-24.
- Xiong, X., Pardos, Z. A., Heffernan, N.T. (2011) An Analysis of Response Time Data for Improving Student Performance Prediction. In J. Stamper & Z. Pardos (Eds.) *Proceedings of the workshop on Educational Data at the 17th Conference on Knowledge Discovery and Data Mining (SIGKDD)*. San Diego, CA. ACM.
- Wang, Q., Kherer, Pardos, Z. A., Heffernan, N. T. (2011) Response Tabling – A simple and practical compliment to Knowledge Tracing. In J. Stamper & Z. Pardos (Eds.) *Proceedings of the workshop on Educational Data at the 17th Conference on Knowledge Discovery and Data Mining (SIGKDD)*. San Diego, CA. ACM.
- Pardos, Z. A., Heffernan, N. T. (2010) Using HMMs and bagged decision trees to leverage rich features of user and skill from an intelligent tutoring system dataset. In J. Stamper & A. Niculescu-Mizil (Eds.) *Proceedings of the KDD Cup Workshop at the 16th ACM Conference on Knowledge Discovery and Data Mining (SIGKDD)*. Washington, D.C. ACM. Pages 24-35.
- Pardos, Z. A., Heffernan, N. T., Ruiz, C. & Beck, J. (2008) Effective Skill Assessment Using Expectation Maximization in a Multi Network Temporal Bayesian Network. In *Proceedings of The Young Researchers Track at the 9th International Conference on Intelligent Tutoring Systems (ITS)*. Montreal, Canada.

Pardos, Z. A., Heffernan, N. T., & Anderson, B., Heffernan, C. L. (2006) Using Fine-Grained Skill Models to Fit Student Performance with Bayesian Networks. In C. Heiner, R. Baker & K. Yacef (Eds.) *Proceedings of the Workshop in Educational Data Mining held at the 8th International Conference on Intelligent Tutoring Systems (ITS)*. Jhongli, Taiwan. Pages 5-12.

Conference Papers (without proceedings)

Dubey, R., Pardos, Z. A. (2016) Understanding & predicting engagement in lecture videos. Paper presentation at the *Workshop on Computational Models for Learning Systems and Educational Assessment*. Las Vegas, NV.

Gogel, H., McBride, E., Vitale, J. M., Pardos, Z. A. (2016) Evaluating the Feasibility of Bayesian Knowledge Tracing for Online Instruction. Paper presentation in *SIG-Online Teaching and Learning at the annual meeting of the American Educational Research Association (AERA)*. Washington, DC.

Pardos, Z. A. (2015) Measuring the Learning Quality of Open Educational Resources in Mathematics. Paper presentation in *SIG-Advanced Technologies for Learning: Emerging Perspectives on Understanding Learning Behaviors in Digital Environments at the annual meeting of the American Educational Research Association (AERA)*. Chicago, IL.

Broaddus, A., Pardos, Z. A., Conrad, Z., & Esen, A. (2014) Validation of a mathematics learning map using Bayesian network analysis. Paper presentation at the annual meeting of the *National Council on Measurement in Education (NCME)*. Philadelphia, PA.

Kingston, N.M, Clark, A.K., Pardos, Z. A., Lee, S. Y. (2014) Determining a reasonable starting place for an instructionally embedded dynamic assessment: Heuristic versus Bayesian Network Analysis. Paper presented at the annual meeting of the *American Educational Research Association (AERA)*. Philadelphia, PA.

Pardos, Z. A. (2014) Learning What Works in MOOCs Without A/B Testing. Paper presented at the *first NSF Conference on MOOCs in STEM: Exploring New Educational Technologies*. San Jose, PA.

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