Large language models, explained with a minimum of math and jargon

by Timothy B Lee and Sean Trott

Originally published in Understanding AI

Summary: This post is a good primer on large language models. It explains how they work with minimal jargon and technical terms.

Read the post.

Citation: Lee, T. B., & Trott, S. (n.d.). Large language models, explained with a minimum of math and jargon. Understating AI. https://www.understandingai.org/p/large-language-models-explained-with

← Towards social generative AI for education: theory, practices and ethics

This material is based upon work supported by the National Science Foundation under grant 2021159. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Center for Integrative Research in Computing and Learning Sciences

Towards social generative AI for education: theory, practices and ethics

By Mike Sharpels

Published in Arxiv

Summary: This paper explores educational interactions involving humans and artificial intelligences not as sequences of prompts and responses, but as a social process of conversation and exploration. In this conception, learners continually converse with AI language models within a dynamic computational medium of internet tools and resources.

Read the paper.

Citation: Sharpels, M. (2023). Towards social generative AI for education: theory, practices and ethics. *arXiv:2306.10063.* Chicago

← Any-to-Any Generation via Composable Diffusion Large language models, explained with a minimum of math and jargon →

Center for Integrative Research in Computing and Learning Sciences

Any-to-Any Generation via Composable Diffusion

By Zineng Tang, Ziyi Yang, Chenguang Zhu, Michael Zeng, and Mohit Bansal
Published in Arxiv

Summary: The paper presents Composable Diffusion (CoDi), a novel generative model capable of generating any combination of output modalities, such as language, image, video, or audio, from any combination of input modalities. Unlike existing generative AI systems, CoDi can generate multiple modalities in parallel and its input is not limited to a subset of modalities like text or image. Despite the absence of training datasets for many combinations of modalities, the authors propose to align modalities in both the input and output space.

Read the paper.

Citation: Tang, Z., Yang, Z., Zhu, C., Zeng, M., & Bansal, M. (2023). Any-to-Any Generation via Composable Diffusion. *arXiv preprint arXiv:2305.11846.* Chicago

← What is Data Science?

Towards social generative AI for education: theory, practices and ethics →

CIRCLS Center for Integrative Research in Computing and Learning Sciences

Determining Capacity within Systemic Educational Reform

by Jeanne Rose Century

Summary: The idea of "capacity" is particularly important in the reform of educational systems because the system can be both the initiator and the subject of change. In fact, the requirement for capacity is present at all levels of the system in systemic reform. In educational change, four types of capacity are generally considered: (1) human capacity; (2) organizational capacity; (3) structural capacity; and (4) material capacity. Because there are so many types of capacity, evaluators may find a general organizing structure for looking at capacity useful before they set out to identify specific questions and indicators for evaluating capacity. A matrix is provided to allow evaluators to focus on the different types of capacity as "drivers" of targeted studies designed to match the more immediate strategies and goals of the reform. Examining capacity is one of the ways educational evaluators and researchers can examine reform efforts more thoroughly.

Read the paper.

Citation: Century, Jeanne Rose (1999). Determining Capacity within Systemic Educational Reform. Washington D.C.: Distributed by ERIC Clearinghouse, https://eric.ed.gov/?id=ED434162

← Assessment in the age of artificial intelligence

What is Data Science? →

This material is based upon work supported by the National Science Foundation under grant 2021159. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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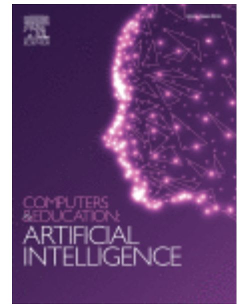
Assessment in the age of artificial intelligence



by Zachari Swiecki, Hassan Khosravi, Guanliang Chen, Roberto Martinez-Maldonado, Jason M. Lodge. Sandra Milligan, Neil Selwyn, Dragan Gašević

Abstract: In this paper, we argue that a particular set of issues mars traditional assessment practices. They may be difficult for educators to design and implement; only provide discrete snapshots of performance rather than nuanced views of learning; be unadapted to the particular knowledge, skills, and backgrounds of participants; be tailored to the culture of schooling rather than the cultures schooling is designed to prepare students to enter; and assess skills that humans routinely use computers to perform. We review extant artificial intelligence approaches that–at least partially–address these issues and critically discuss whether these approaches present additional challenges for assessment practice.

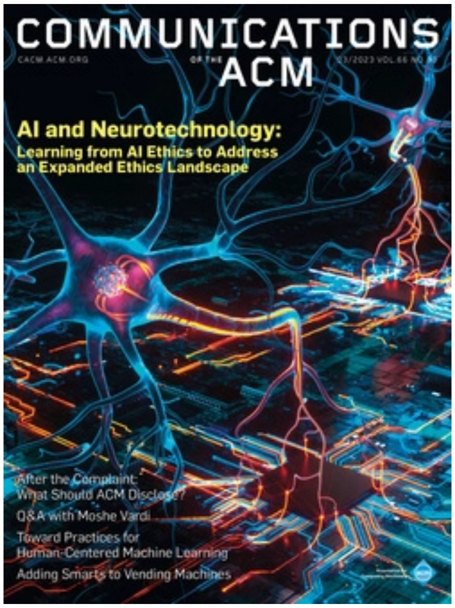
Read the paper.

← CIRCL Center: Understanding Universal Design for Learning Primer

Determining Capacity within Systemic Educational Reform →

This material is based upon work supported by the National Science Foundation under grant 2021159. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

What is Data Science?



By Koby Mike and Orit Hazzan

Published in Communications of the ACM, February 2023, Vol. 66 No. 2, Pages 12-13

Summary: If you ask a group of data scientists what data science is, you would probably hear different definitions. Indeed, although many attempts have been made to define data science, such a definition has not yet been reached. One reason for the difficulty to reach a single, consensus definition for data science is its multifaceted nature: it can be described as a science, as a research paradigm, as a research method, as a discipline, as a workflow, and as a profession. One single definition just cannot capture the diverse essence of data science. In this blog, we attempt to present the essence of each of these perspectives.

Read the post.

CIRCLS | Center for Integrative Research in Computing and Learning Sciences

Conceptualizing AI literacy: An exploratory review

by Davy Tsz Kit Ng, Jac Ka Lok Leung, Samuel Kai Wah Chu, and Maggie ShenQiao

Abstract: Artificial Intelligence (AI) has spread across industries (e.g., business, science, art, education) to enhance user experience, improve work efficiency, and create many future job opportunities. However, public understanding of AI technologies and how to define AI literacy is under-explored. This vision poses upcoming challenges for our next generation to learn about AI. On this note, an exploratory review was conducted to conceptualize the newly emerging concept "AI literacy", in search for a sound theoretical foundation to define, teach and evaluate AI literacy. Grounded in literature on 30 existing peer-reviewed articles, this review proposed four aspects (i.e., know and understand, use and apply, evaluate and create, and ethical issues) for fostering AI literacy based on the adaptation of classic literacies. This study sheds light on the consolidated definition, teaching, and ethical concerns on AI literacy, establishing the groundwork for future research such as competency development and assessment criteria on AI literacy.

Read more.

← Podcast series: Fairness and Equity in AI for Education

CIRCL Center: Learning Sciences Primer →

This material is based upon work supported by the National Science Foundation under grant 2021159. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Learning Sciences

Contributors: Jeremy Roschelle, Shuchi Grover, Janet Kolodner
Questions, or want to add to this topic or to a new topic? Contact CIRCL.

Overview

The Learning Sciences is a field of scientific research that developed in the 1980s, from influences which include cognitive science, computer science, information processing psychology, child development, anthropology, and linguistics. The International Society of the Learning Sciences (ISLS) hosts conferences, organizes journals and provide ongoing forums which bring learning scientists together, worldwide. The two ISLS journals, Journal of the Learning Sciences and the International Journal of Computer-Supported Collaborative Learning, consistently rank among the top 10 educational research journals. The number of university-based Learning Sciences programs has expanded greatly since 2000, signifying institutional recognition of the importance of this field of inquiry.

Whereas traditional educational research sometimes determines what to study by looking at education as an institution (e.g. with policies, practices, organizational structures, etc.), learning science research more often starts with a **focus on learning**: how do people learn, what resources and supports enable learning, and how do features of settings and contexts interact with the learning process. Also, whereas traditional educational research focuses primarily on students' test scores or attainment of credentials, learning scientists are often concerned with knowledge, skills, and abilities that are not yet measured well by commonplace test scores nor yet signified by established credentials — for example, their knowledge of an emerging scientific topic like nanoscience, their skills in participating in a scientific discussion, or their ability to work with others to build knowledge. Learning science is willing to be future-directed, imaginative and risky — to explore how learners could develop in ways that are clearly valuable, but presently hard to learn. Learning scientists also investigate how people develop identity, as well as other social and emotional outcomes. Overall, learning scientists focus on learners and their needs.

Although learning scientists actively use a wide range of methods in order to conduct rigorous investigations of learning in these and other areas, two particular methods are much more common in learning sciences than in related fields. First, learning scientists often engage in ***design*** of new ways to facilitate learning in order to study whether issues in learning are constrained by existing resources or pedagogies and whether new technologies or approaches might overcome these limits and advance learning. Learning scientists tend to believe that technology can promote learning, but only if carefully designed and integrated into the life of the learner in a learning environment. Often, design is pursued by teams with multiple sources of authority and expertise, which can include teachers and other participants.

The need for contextual inquiry and the focus on design in the learning sciences prompted the birth of the design-based research (DBR). Second, learning scientists almost always seek to **capture details of how learning processes unfold** over time in interaction with people and materials and a setting — not just inputs and outputs, and not just discrete snapshots of learning at particular times. Methods to capture these interactions are therefore prominent, such as use of video and audio records, system log data, and observation. Presentations, reports, and journal articles often show examples of new designs and also display transcribed conversations and other interactions which would allow the reader to closely follow the process of learning as it unfolded over time.

Learning scientists study learning in specific ways. Learning scientists study learning in natural environments or in designed environments which could fit into realistic settings — and engage with the messiness of learning in realistic settings, rather than controlling variation precisely. For example, the learning sciences is strongly focused on studying human learning (rather than learning of other animals or machine learning). Most learning sciences work is deeply concerned with subject matter, such as mathematics, science, or history. When learning scientist study learning in a subject matter, they examine constructs and process which are important to the specific subject, and not just issues of memory and attention which apply similarly to all subjects. Topics can include how students can learn to engage in scientific inquiry, to understand fundamental but difficult math concepts, can participate in disciplinary practices of argumentation and explanations, and how students can learn subjects which are not ordinarily taught in schools in authentic ways, such as data science, nanoscience, or robotics. Learning scientists are also deeply engaged in how to measure and assess student learning, particularly when the target knowledge or skill is important to measure and not easily captured by conventional tests. Learning Scientists most often conduct studies in naturalistic settings (schools, museums, homes, community centers, etc.) rather than in highly controlled laboratories.

Learning sciences research is often concerned with designing environments, tools, materials and practices for optimal learning and tends to accumulate around design principles which interlink with empirical findings. Four exemplary areas include:

1. **Modeling learning progressions** and adapting learning experiences, resources and feedback to support learners' progress. Design principles in this area relate to how to to design learning environments, sequence instruction and optimize feedback both to learners and to teachers. These have been realized in intelligent tutoring systems, for example.
2. **Collaborative learning** and scaffolding, scripting, and orchestrating social interaction. Design principles in this area relate to how to organize social learning (often in small groups) to overcome known challenges and to increase the opportunities to learn deeply and may include designing particular structures, conversational supports, or ways for teachers to modulate the setting.
3. **Simulations, visualization, modeling, and representation**. Design principles in this area link new possibilities for displaying information to cognitive processes involved in making sense of scientific models or phenomena and/or mathematical constructs and notations — often with an emphasis on real-time, dynamic presentations which could not be easily portrayed on paper or in books, and with an emphasis on engaging students in an inquiry or investigative stance.
4. **Opportunities to engage in hands-on constructive activities**, when carefully designed to include well-designed materials, challenges, and allow for playful interactions, interest-driven learning, and sufficient mentoring or guidance, as a way to developing students' identity as a participant in challenging domains of expertise.

Learning scientists tend to be less enthusiastic about black box experiments, in which only inputs and outcomes are reported, with little empirical documentation of how the inputs contributed to the outcomes. Learning scientists want to go beyond only studying users' perceptions of how much they enjoyed a particular learning experiences or found it useful, unless this data is triangulated with other data that tracks the quality of the learning process. Learning scientists also tend to be less involved in large-scale survey methods or secondary analysis of existing data sets, as these methods tend to only have snapshots in time. While learning scientists value self-reflections about a learning experience, they work to move from insights to empirical accounts, which can be more easily verified by others.

Learning Sciences research is particularly important as a key vector of cyberlearning investigations. The presence of a potentially transformative learning technology, alone, is not sufficient for a cyberlearning investigation. Rather, cyberlearning is realized through the interweaving of technology with learning science and other methods that illuminate processes of learning with theoretical depth and empirical precision. This interweaving requires research in computation, STEM or other fields to intersect with principles of how people learn as informed by the learning sciences.

Issues

Learning scientists are looking for ways to add rigor both to the theoretical basis of design and the empirical claims about efficacy, especially as educational technology surges in the marketplace but often lacks depth in theory and rigor in empirical evidence.

Learning sciences intersects with other emerging fields, such as learning analytics. As an example, see Roy Pea's address at the ELI 2013 annual meeting – Learning Sciences and Learning Analytics: Time for a Marriage).

Historically, learning sciences research has examined smaller populations of learners in great depth, often revealing insights that would not be apparent in larger populations and aggregate data. However, to maintain relevance, learning sciences has to evolve to interpolate between larger-scale and smaller-scale studies, and slower and more agile research methods.

Learning sciences has had a healthy mix of public and policy engagement along with the mechanisms for growing a strong internal research community through a society, journals, conferences, and other efforts. Continued effort to address broad, important policy issues while conducting high quality research is important to the health of the field.

Readings

Key readings documenting the thinking behind the concept, important milestones in the work, foundational examples to build from, and summaries along the way.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (1999). How people learn: Brain, mind, experience, and school. National Academy Press.

Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. The Journal of the Learning Sciences, 2(2), 141-178.

Collins, A. (1992). Toward a design science of education (pp. 15-22). Springer Berlin Heidelberg.

Hoadley, C. & Van Haneghan, J. (2011). The Learning Sciences: Where they came from and what it means for instructional designers. In Reiser, R.A., & Dempsey, J.V. (Eds.) Trends and Issues in Instructional Design and Technology (3rd ed., pp. 53-63). New York: Pearson.

Lavigne, N. C., & Mouza, C. (2013). Emerging technologies for the classroom: A learning sciences perspective. New York ; London: Springer.

Sawyer, R. K. (2006). Introduction: The New Science of Learning. In R.K. Sawyer (Ed.), The Cambridge handbook of the learning sciences (1-16). Cambridge: Cambridge University Press.

Kelly, A. & Lesh, R. (2000). Handbook of research design in mathematics and science education. Dordrecht, Netherlands: Kluwer.

Resources

To learn more about the learning sciences visit The International Society of the Learning Sciences (ISLS) web site, as well as the Journal of the Learning Sciences (JLS) and the International Journal of Computer-Supported Collaborative Learning (ijCSCL).

The International Society of the Learning Sciences Network of Academic Programs in the Learning Sciences (ISLS Naples).

A brief history of the learning sciences by Chris Hoadley (ISLS Naples webinar recording).

Understanding Universal Design for Learning

Contributors: Gabrielle Rappolt-Schlichtmann, Marianne Bakia, Jose Blackorby, David Rose
Questions, or want to add to this topic or to a new topic? Contact CIRCL.

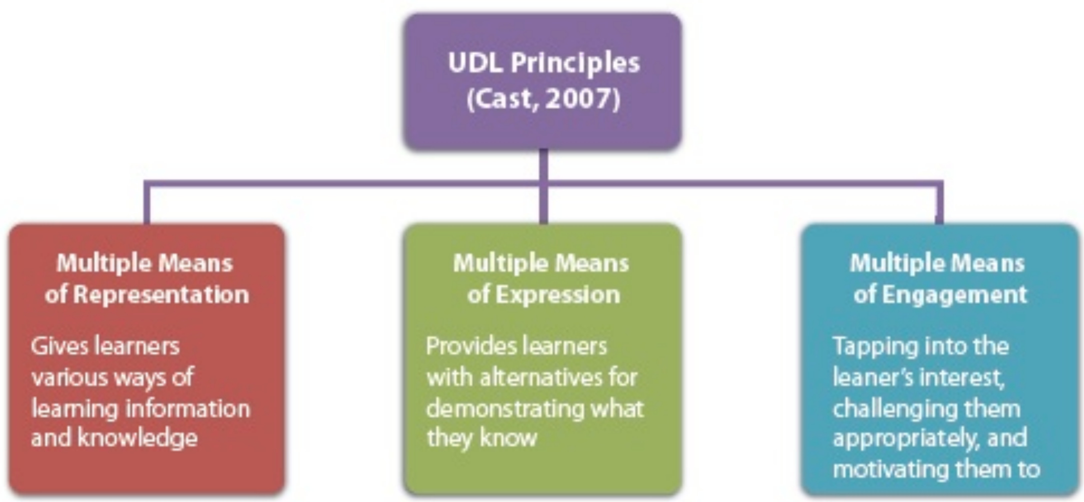
Overview

Universal Design for Learning (UDL) is a research-based framework intended to guide the design of learning technologies that are accessible and effective for all students, including those who are struggling academically and those with special needs. Inspired by the concept of universal design in architecture, the framework was first conceived in the early 1990s and developed over the intervening decades. UDL has entered the public consciousness as many local, state, national and international education settings have moved to adopt the framework. For example, UDL has influenced the design of more accessible museum exhibits and usable K12 curricula for low-vision/blind students. The Higher Education Opportunity Act (HEOA) of 2008 established the statutory definition for UDL, emphasizing that pre-service teacher training incorporate instruction on strategies consistent with UDL. More recently, the U.S. Department of Education's National Educational Technology Plans (2010 and 2015 in preparation), which is meant to guide the use of technologies in transforming education, refers to UDL as a framework that reduces barriers and maximizes learning opportunities for all students.

This attention to UDL within the field of education reflects and leads a broader conceptual shift away from "one size fits all" solutions and toward greater interest in providing "personalized" learning experiences for everyone. The UDL approach takes human diversity as its starting point rather than as an unexpected complication that will later require expensive modification or accommodation. Moreover, by attending early to the challenges of people who may be "in the margins" because they may have a different set of abilities, the UDL approach provides a foundation for educational designs that are powerful and flexible enough to optimize outcomes for all learners.

The theory and practices of UDL depend upon advances in two domains: modern learning sciences and modern learning technologies. From the learning sciences – cognitive neuroscience, affective neuroscience, cognitive science, educational sciences – UDL draws upon research that articulates the consequential differences between learners, differences that must be addressed for a learning technology to be successful for the full spectrum of learners. From modern learning technologies – such as interactive multimedia and networked learning environments – UDL takes advantage of the enormous capacity for personalization and adaptivity that these new technologies offer but that is usually insufficiently realized.

Just as universally designed buildings provide options that accommodate a broad spectrum of users, tools and curricula that are designed using the UDL framework offer a range of options for accessing and engaging with learning materials. The UDL principles can be applied to design of curricula, instructional practices, and assessments and the following three principles (along with actionable guidelines) address challenges that must be addressed to reach all students, and that can be addressed with modern learning technologies: (1) providing multiple means of presentation (e.g., perception, language, comprehension), (2) providing multiple means of action and response (e.g., action, expression, communication), and (3) providing multiple means of engagement (e.g., interest, persistence, self-regulation). UDL offers a means to provide opportunities for flexible and deep learning through the design of customizable methods, materials, and assessments (Meyer, Rose, & Gordon, 2014; Rose & Meyer 2002; Rose, Meyer, & Hitchcock, 2005).



In the design process, UDL requires close attention to learners with "disabilities" — the framework posits that these students are "canaries in the coal mine" that can alert designers and educators to problems and barriers in their methods, materials and assessments. When people with disabilities experience difficulty in an educational environment, it is often a sign that others without disabilities may also have difficulty, though it may be less readily apparent. By attending to the challenges faced by individuals in the margins early in the design process, learning environments can be made more accessible, engaging and effective for a wider array of students. Taking this approach results in a profound change in thinking that moves away from the “child as a problem” perspectives that have dominated our view of human diversity (see Dudley-Marling 2004; Albrecht, Seelman, and Bury 2001) and toward social constructivist views of education that recognize that the barriers and limitations of poor design in the environment are the critical problem to address in a democratic society. In this modern, universal design view, it is the “disabilities” and “handicaps” of our learning technologies that must be the first focus of intervention (see Rappolt-Schlichtmann & Daley, 2013; Thaper et al. 2004).

The research base for UDL in practice is growing, with contributions from a wide range of organizations and professionals and includes descriptive, correlational, and experimental studies. A recent review of the research literature suggests that UDL has made significant inroads into a number of educational communities, as measured by journal spread, intended audience, disability categories (including those with no disabilities), describing work affecting students with a wide age range, from early childhood through adulthood (Okolo and Diedrich, 2015). Studies of efficacy have been fewer, but are beginning to provide evidence of the frameworks value in the design of educational tools and environments at scale (for example, see Rappolt-Schlichtmann, et al., 2013 for efficacy trial of UDL science notebook). Further design-based research is needed to explore the many potential approaches (and innovations) to the instantiation of UDL in technology based STEM learning solutions, as well as implementation research that explores and validates the use of UDL approaches in authentic STEM learning settings.

Issues

The **research base on UDL** and the effect on student learning and affect is growing but still emergent, with most of the work done in literacy and inquiry science.

The **impact of the UDL framework** can be difficult to study using traditional research methods because it can be applied in so many different content areas, grade levels, and contexts.

Current approaches to measuring **fidelity of implementation** is an issue for UDL, and personalization generally, because the specific sequence of instructional activities and supports are intended to vary according to student need. They are not expected all be the same for all students. What works for one students might not work for another.

Kitchen sink perception of UDL. There is a perception that UDL covers too much ground, making technology designs too complicated. We view this as a misconception, but a problem that often emerges when designers first attempt to leverage the framework. When designers start with instructional goals and understand what is flexible and not, the application of UDL principles can be applied consistent with of the needs of learners, and in ways that make the technology less and not more complicated from a user-experience design perspective.

Adaptive learning principles have been applied successfully, especially in mathematics. But from a UDL perspective, some of these solutions miss the forest for the trees – they serve academic learning, but do not necessarily meet the broader, key goal of UDL about preparing students to be expert learners. Many questions persist as to how adaptive learning approaches can be used to support UDL goals, like inclusion and independent self-regulation in learning.

Perception that UDL is only for students with disabilities. UDL design benefits from considering the needs of students with disabilities and they often benefit from UDL solutions. It does not mean that they are designed only for that population. Rather, UDL solutions are intended to provide benefit to all students, as the architectural curb-cuts have done for so many.

Projects

Examples of NSF Cyberlearning projects that overlap with topics discussed in this primer (see project tag map).

Accessibility and learning

- CAP: AccessCyberlearning
- DIP: Collaborative Research: Taking Hands-on Experimentation to the Cloud: Comparing Physical and Virtual Models in Biology on a Massive Scale
- EXP: Exploring Augmented Reality to Improve Learning by Deaf Children in Planetariums

- EAGER: Promoting Algebra Learning Through an Accessible Expression System for Students with Visual Impairments and Blindness

More posts: accessibility-and-technology

Personalized learning

- EXP: Attention-Aware Cyberlearning to Detect and Combat Inattentiveness During Learning
- EAGER: Towards Knowledge Curation and Community Building within a Postdigital Textbook
- Badge-Based STEM Assessment: Current Terrain and the Road Ahead
- DIP: EMBRACEing English Language Learners with Technology
- DIP: Collaborative Research: Impact of Adaptive Interventions on Student Affect, Performance, and Learning

More posts: personalized-learning

Resources

National Center for UDL

UDL Guidelines

Implementation Research Metwork for UDL (IRN)

Office of Education Technology: Ed Tech Developers Guide (see Oppertunity 8)

Higher education UDL course design support

NEA Research Spotlight on UDL

AEM Center, accessibility guidence as related to UDL

DO-IT Center, accessibility gudience related to UDL

CAST

Talk by Todd Rose from CAST, at Cyberlearning 2012 Summit

Readings

This section includes references and key readings documenting the thinking behind the concept, important milestones in the work, foundational examples to build from, and summaries along the way.

Meyer, A., Rose, D. H., & Gordon, D. (2014). Universal design for learning: Theory and practice. Wakefield, MA: CAST Professional Publishing.

Rappolt-Schlichtmann, G., Daley, S. G., Lim, S., Lapinski, S., Robinson, K. H., & Johnson, M. (2013). Universal design for learning and elementary school science: Exploring the efficacy, use, and perceptions of a web-based science notebook. Journal of Educational Psychology, 105(4), 1210-1225.

Daley, S. G., Hillaire, G. and Sutherland, L. M. (2014), Beyond performance data: Improving student help seeking by collecting and displaying influential data in an online middle-school science curriculum. British Journal of Educational Technology. doi: 10.1111/bjet.12221

Vue, G., Hall, T.E., Robinson, K., Ganley, P., Elizalde, E. & Graham, S. (2015). Informing Understanding of Young Students' Writing Challenges and Opportunities: Insights From the Development of a Digital Writing Tool That Supports Students With Learning Disabilities. Learning Disabilities Quarterly

Universal design for learning. Rose, D.H. & Gravel, J.W. (2013). In E. Baker, P. Peterson, & B. McGaw (Eds.).International Encyclopedia of Education, 3rd Ed. Oxford: Elsevier.

Rose, D.H. & Meyer, A. (2002). Teaching every student in the digital age: Universal Design for Learning. Alexandria, VA ASCD.

Rose, D.H., Meyer, A., & Hitchcock, C. (2005). The universally designed classroom: Accessible curriculum and digital technologies. Cambridge, MA: Harvard Education Press.

Dudley-Marling, C. (2004). The social construction of learning disabilities. Journal of Learning Disabilities, 37, 482-490.

Albrecht, G., Seelman, K., & Bury, M. (2001). Handbook of disability studies. Sage Publications.

Okolo, C.M. & Diedrich, J. (2014). Twenty-five Years Later: How is Technology Used in the Education of Students with Disabilities? Results of a Statewide Study. Journal of Special Education Technology, 29(1).

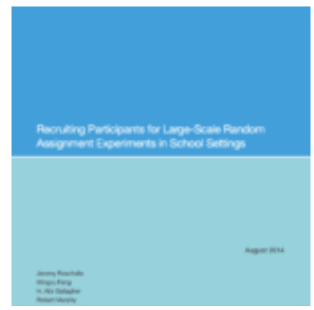
CIRCLS Center for Integrative Research in Computing and Learning Sciences

Recruiting Participants for Large-Scale Random Assignment Experiments in School Settings

CIRCLS features relevant primers found in the literature. We welcome new primers on similar topics, but written more specifically to address the needs of the RETTL community. Have a primer to recommend? Contact CIRCLS.

Title: Recruiting Participants for Large-Scale Random Assignment Experiments in School Settings

Authors: Jeremy Roschelle, Mingyu Feng, H. Alix Gallagher, Robert Murphy, Christopher Harris, Danae Kamdar, Gucci Trinidad



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Abstract

Recruitment is a key challenge for researchers conducting any large school-based study, especially random assignment studies where researchers require certain level of control over experimental conditions and intervention implementation. Such studies often need to have a sample of 30-60 teachers or schools to have sufficient power to detect medium-sized effects of interventions. We report here on our experiences in recruiting participants for random assignment experiments in public primary and secondary schools. Our perspective is based on over twenty current and completed randomized controlled trials (RCT) in K–12 school settings conducted by SRI International, including studies of educational technology, literacy, mathematics, science, instructional materials, teacher professional development, and student behavioral supports, following What Works Clearinghouse standards for RCTs. Considering our experience across these studies, we reflect on how we approached the recruitment problem and what worked during our efforts. Our comments are organized in six topics corresponding to the aspects of an overall recruitment process: 1) Study design; 2) Intervention packaging; 3) Planning a recruitment process; 4) Designing recruitment messages; 5) Running a recruitment campaign; 6) After recruitment.

Citation

Roschelle, J., Feng, M., Gallagher, H., Murphy, R., Harris, C., Kamdar, D., Trinidad, G. (2014). Recruiting Participants for Large-Scale Random Assignment Experiments in School Settings. Menlo Park, CA: SRI International.

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Facial Recognition Technologies in the Wild: A Call for a Federal Office

CIRCLS features relevant primers found in the literature. We welcome new primers on similar topics, but written more specifically to address the needs of the RETTL community. Have a primer to recommend? [Contact CIRCLS](#).

Title: Facial Recognition Technologies in the Wild: A Call for a Federal Office

Authors: Erik Learned-Miller, Vicente Ordóñez, Jamie Morgenstern, and Joy Buolamwini

Download PDF

Abstract

In recent years, facial recognition technologies (FRTs) have experienced enormous growth and rapid deployment. The potential benefits of FRTs such as increased efficiency, diagnosis of medical conditions, and the ability to find persons of interest are tempered with risks of mass surveillance, disparate impact on vulnerable groups, algorithmic bias, and lack of affirmative consent.

The passage of city and statewide restrictions and proposed federal legislation show growing public concern. They also demonstrate the need for comprehensive policies to address the wide range of uses across private and public sectors. Current legislative efforts address a patchwork of different applications, jurisdictions, and time periods. They do not cover the full scope and spread of FRTs.

The ubiquitous scenarios that lawmakers have not yet addressed require oversight and guidance for industry practice, research norms, procurement procedures, and categorical bans where deemed appropriate. Depending upon the application, societal, legal, ethical, financial and even physical risks demand a thorough understanding of real-world impacts. How can we manage such a complex set of technologies with such enormous societal implications?

We present our rationale for a new federal office by examining how other complex technologies have been successfully managed at the federal level. Specifically, we draw analogies with regulatory structures for two

other complex industries–the medical device industry and the pharmaceutical industry. We argue that FRT raises similar questions and concerns, and has a similar potential for successful regulation through such mechanisms. Furthermore, without such mechanisms, current problems are likely to persist.

Citation

Learned-Miller, E., Ordóñez, V., Morgenstern, J., & Buolamwini, J. (2020). Facial recognition technologies in the wild: A call for a federal office. Retrieved from https://people.cs.umass.edu/~elm/papers/FRTintheWild.pdf

← The Impact of Artificial Intelligence on Learning, Teaching, and Education

Recruiting Participants for Large-Scale Random Assignment Experiments in School Settings →

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CIRCLS Center for Integrative Research in Computing and Learning Sciences

The Impact of Artificial Intelligence on Learning, Teaching, and Education

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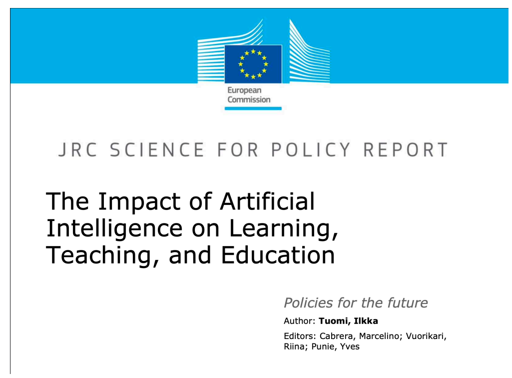
European Commission

JRC SCIENCE FOR POLICY REPORT

The Impact of Artificial Intelligence on Learning, Teaching, and Education

Policies for the future
Author: **Tuomi, Ilkka**
Editors: Cabrera, Marcelino; Vuorikari, Riina; Punie, Yves

Title: The impact of Artificial Intelligence on learning, teaching, and education

Authors: Tuomi, Ilkka; Punie, Yves; Vuorikari, Riina; Cabrera, Marcelino

Abstract

This report describes the current state of the art in artificial intelligence (AI) and its potential impact for learning, teaching, and education. It provides conceptual foundations for well-informed policy-oriented work, research, and forward-looking activities that address the opportunities and challenges created by recent developments in AI. The report is aimed for policy developers, but it also makes contributions that are of interest for AI technology developers and researchers studying the impact of AI on economy, society, and the future of education and learning.

Citation

Tuomi, I. (2020). The impact of Artificial Intelligence on learning, teaching, and education. *Policies for the future, Eds. Cabrera, M., Vuorikari, R & Punie, Y., EUR 29442 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-97257-7, doi:10.2760/12297, JRC113226.*

← Artificial Intelligence in Education: Promises and Implications for Teaching and learning

Facial Recognition Technologies in the Wild: A Call for a Federal Office →

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Artificial Intelligence in Education: Promises and Implications for Teaching and learning

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Title: Artificial Intelligence in Education: Promises and Implications for Teaching and learning

Authors: Holmes, Wayne; Bialik, Maya; Fadel, Charles

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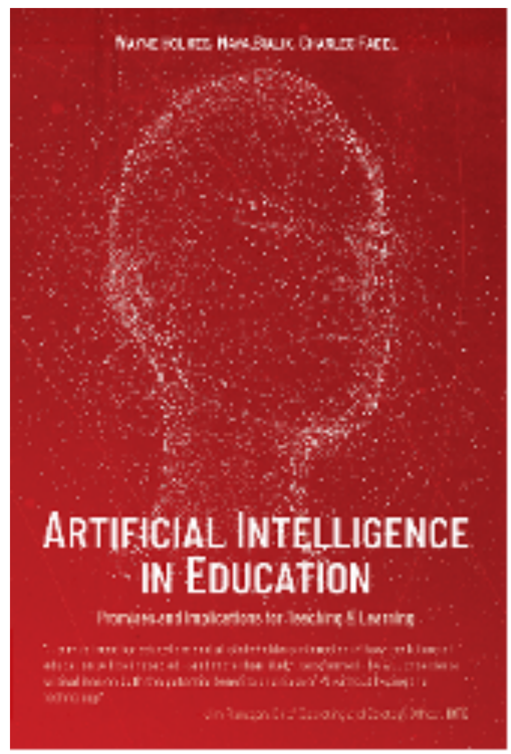

Abstract

This book by the Center for Curriculum Redesign immerses the reader in a discussion on what to teach students in the era of AI and examines how AI is already demanding much needed updates to the school curriculum. The second part of the book dives into the How: the history, techniques, and applications of AI in education –including the way AI can help teachers be more effective, and ends on a reflection about social aspects of AI.

Citation

Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial Intelligence in Education: Promises and Implications for Teaching and learning. Center for Curriculum Redesign.

← The Pedagogical Agent in Online Learning

The Impact of Artificial Intelligence on Learning, Teaching, and Education →

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The Pedagogical Agent in Online Learning

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Title: The Pedagogical Agent in Online Learning: Effects of the Degree of Realism on Achievement in Terms of Gender

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Authors: Saidatul Maizura Sahimi; Farah M. Zain; Nabila A. N. Kamar; Noorizdayantie Samar; Zuraidah A. Rahman; Omar Majid; Hanafi Atan; Fong Soon Fook; Wong Su Luan

Abstract

This paper describes the impact of the degrees of realism (unrealistic, moderately realistic and highly realistic) of the pedagogical agent on student's achievement during online learning in terms of gender. Three modes of the e-learning portal with appropriate degrees of realism, namely, Online Learning with a Cartoon Pedagogical Agent (OLCPA), Online Learning with a Moderately Realistic Pedagogical Agent (OLMRPA) and Online Learning with a Highly Realistic Pedagogical Agent (OLHRPA) were developed and implemented. A quasi-experimental 3×2 factorial design was employed; independent variables were three degrees of realism, the dependent variable was achievement scores, and the moderator variable was gender of students. The subjects were 130 Form Four students (16 years old) from Malaysian secondary schools who were randomly assigned to groups. Analysis of variance (ANOVA) was employed to analyze data. The findings of the study suggest that there was no significant difference in the students' achievement among the three degrees of realism in terms of their genders; both genders achieved almost the same across different degrees of realism. The reasons for the observed results are discussed and elaborated.

Citation

Maizura Sahimi, S., Zain, F. M., Kamar, N. A., Samar, N., Rahman, Z. A., Majid, O.,Atan, H., Fook, F.S. & Luan, W. S. (2010).The Pedagogical Agent in Online Learning: Effects of the Degree of Realism on Achievement in Terms of Gender. Contemporary Educational Technology, 1(2).

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Facial Recognition Technologies: A Primer

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Title: Facial Recognition Technologies: A Primer

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Authors: Joy Buolamwini, Vicente Ordóñez, Jamie Morgenstern, and Erik Learned-Miller

Abstract

This primer is meant to accompany our white paper, Facial Recognition Technologies in the Wild: A Call for a Federal Office, as a supporting document. It presents background on Facial Recognition Technologies (FRTs) and provides important context for material in the main document of the white paper. The primer is written for a non-technical audience to increase understanding of the terminology, applications, and difficulties of evaluating this complex set of technologies. In Section 1, we provide basic definitions of common terms like face detection and face verification. Such definitions are needed to clarify the precise meaning of subsequent discussions. In Section 2, we present some common and lesser known uses of FRTs. Section 3 introduces some of the fundamental technical concepts used in the process of recognizing a face, from the capture of the face by a camera, to the digital representation of faces in a computer, and finally to the evaluation of results and the categorization of errors. Section 4 highlights challenges with characterizing and measuring the accuracy of FRTs. This primer is a basic tutorial and does not provide guidance on if, how, or when specific FRTs should be used.

Citation

Buolamwini, J., Ordonez, V., Morgenstern, J., & Learned-Miller, E. (2020). Facial Recognition Technologies: A Primer. Retrieved from https://people.cs.umass.edu/~elm/papers/FRTprimer.pdf

A Review of Fundamentals and Influential Factors of Artificial Intelligence

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Title: A Review of Fundamentals and Influential Factors of Artificial Intelligence

Authors: Alexander Richter, Tamara Gačić, Bernhard Kölmel, Lukas Waidelich, and Patrice Glaser

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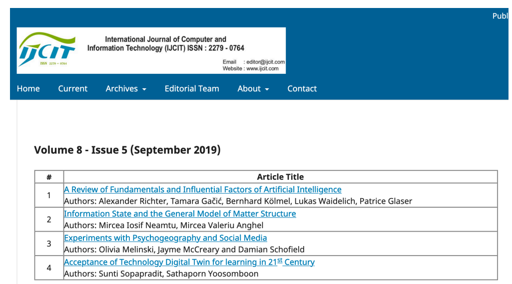

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Volume 8 - Issue 5 (September 2019)

#	Article Title
1	A Review of Fundamentals and Influential Factors of Artificial Intelligence Authors: Alexander Richter, Tamara Gačić, Bernhard Kölmel, Lukas Waidelich, Patrice Glaser
2	Information State and the General Model of Matter Structure Authors: Mircea Iosif Neamtu, Mircea Valeriu Anghel
3	Experiments with Psychogeography and Social Media Authors: Olivia Melinski, Jayme McCreary and Damian Schofield
4	Acceptance of Technology Digital Twin for learning in 21st Century Authors: Sunti Sopapradit, Sathaporn Yoosomboon

Abstract

Artificial intelligence (AI) is a trend that is currently leading to controversial discussions. On the one hand, it is a hyped technology with great potential to change the way people live and work.On the other hand, humans fear the possible consequences of misguided superintelligence based on the example of well-known movies. There are also numerous prominent scientists and technology pioneers who have very different opinions on this topic. In order to contribute to that discussion, this paper presents the drivers, advantages, disadvantages and challenges for the use of AI applications based on a literature search. In addition, historical developments, common definitions, types and functionalities of AI are described.

Citation

Richter, A., Gačić, T., Kölmel, B., Waidelich, L., & Glaser, P. (2019). Algorithmic Fairness in Education. *International Journal of Computer and Information Technology*, 8(5), 142-156.

← Algorithmic Fairness in Education

Practicing Connections: A Framework to Guide Instructional Design for Developing Understanding in Complex Domains →

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Educating Critical Thinkers: The Role of Epistemic Cognition

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Title: Educating Critical Thinkers: The Role of Epistemic Cognition

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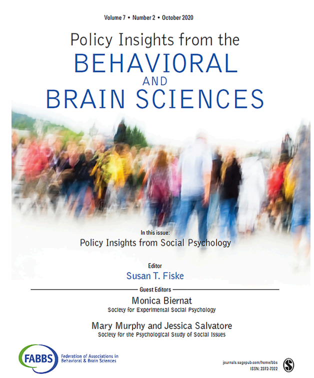
Authors: Jeffrey A. Greene, Seung B. Yu



Abstract

Proliferating information and viewpoints in the 21st century require an educated citizenry with the ability to think critically about complex, controversial issues. Critical thinking requires epistemic cognition: the ability to construct, evaluate, and use knowledge. Epistemic dispositions and beliefs predict many academic outcomes, as well as whether people use their epistemic cognition skills, for example, scrutinizing methods in science and evaluating sources in history. The evidence supporting the importance of epistemic cognition, inside and outside of the classroom, has led to a growing body of intervention research. However, more research can reveal how to best position teachers and students to develop and enact productive epistemic cognition. Promising directions for future research and policy include developing learning environments that promote students' epistemic cognition and subsequent critical thinking, as well as incorporating this work into educator preparation programs.

Citation

Greene, J. A., & Yu, S. B., (2016). Educating critical thinkers: The role of epistemic cognition. Policy Insights from the Behavioral and Brain Sciences 3(1), 45-53.

← Practicing Connections: A Framework to Guide Instructional Design for Developing Understanding in

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Practicing Connections: A Framework to Guide Instructional Design for Developing Understanding in Complex Domains

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Title: Practicing Connections: A Framework to Guide Instructional Design for Developing Understanding in Complex Domains

Authors: Laura Fries, Ji Y. Son, Karen B. Givvin, and James W. Stigler

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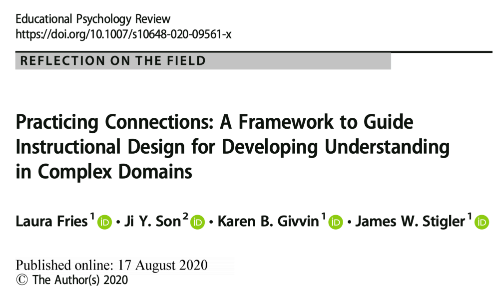
Educational Psychology Review
https://doi.org/10.1007/s10648-020-09561-x

REFLECTION ON THE FIELD

Practicing Connections: A Framework to Guide Instructional Design for Developing Understanding in Complex Domains

Laura Fries[1] · Ji Y. Son[2] · Karen B. Givvin[1] · James W. Stigler[1]

Published online: 17 August 2020
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Abstract

Research suggests that expert understanding is characterized by coherent mental representations featuring a high level of connectedness. This paper advances the idea that educators can facilitate this level of understanding in students through the practicing connections framework: a practical framework to guide instructional design for developing deep understanding and transferable knowledge in complex academic domains. We start by reviewing what we know from learning sciences about the nature and development of transferable knowledge, arguing that connectedness is key to the coherent mental schemas that underlie deep understanding and transferable skills. We then propose features of instruction that might uniquely facilitate deep understanding and suggest that the connections between a domain's core concepts, key representations, and contexts and practices of the world must be made explicit and practiced, over time, in order for students to develop coherent understanding. We illustrate the practicing connections approach to instructional design in the context of a new online interactive introductory statistics textbook developed by the authors.

Citation

Fries, L., Son, J. Y., Givvin, K. B., & Stigler, J. W. (2020). Practicing Connections: A Framework to Guide Instructional Design for Developing Understanding in Complex Domains. *Educational Psychology Review. https://doi.org/10.1007/s10648-020-09561-x*

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Mining Big Data in Education: Affordances and Challenges

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Title: Mining Big Data in Education: Affordances and Challenges

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Authors: Christian Fischer, Zachary A. Pardos, Ryan Shaun Baker, Joseph Jay Williams, Padhraic Smyth, Renzhe Yu, Stefan Slater, Rachel Baker, Mark Warschauer

Abstract

The emergence of big data in educational contexts has led to new data-driven approaches to support informed decision making and efforts to improve educational effectiveness. Digital traces of student behavior promise more scalable and finer-grained understanding and support of learning processes, which were previously too costly to obtain with traditional data sources and methodologies. This synthetic review describes the affordances and applications of microlevel (e.g., clickstream data), mesolevel (e.g., text data), and macrolevel (e.g., institutional data) big data. For instance, clickstream data are often used to operationalize and understand knowledge, cognitive strategies, and behavioral processes in order to personalize and enhance instruction and learning. Corpora of student writing are often analyzed with natural language processing techniques to relate linguistic features to cognitive, social, behavioral, and affective processes. Institutional data are often used to improve student and administrational decision making through course guidance systems and early-warning systems. Furthermore, this chapter outlines current challenges of accessing, analyzing, and using big data. Such challenges include balancing data privacy and protection with data sharing and research, training researchers in educational data science methodologies, and navigating the tensions between explanation and prediction. We argue that addressing these challenges is worthwhile given the potential benefits of mining big data in education.

Citation

Fischer, C., Pardos, Z. A., Baker, R. S., Williams, J. J., Smyth, P., Yu, R., … Warschauer, M. (2020). Mining Big Data in Education: Affordances and Challenges. Review of Research in Education, 44(1), 130–160. https://doi.org/10.3102/0091732X20903304

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Responsible AI: Bridging From Ethics to Practice

By Ben Shneiderman

Communications of the ACM, August 2021, Vol. 64 No. 8, Pages 32-35, 10.1145/3445973

Read the full text.

Responsible AI

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This material is based upon work supported by the National Science Foundation under grant 2021159. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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Algorithmic Fairness in Education

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Title: Algorithmic Fairness in Education

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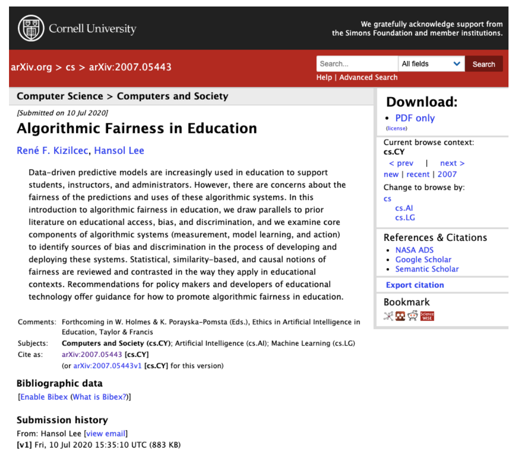
Authors: René F. Kizilcec and Hansol Lee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We gratefully acknowledge support from the Simons Foundation and member institutions.

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[Submitted on 10 Jul 2020]

Algorithmic Fairness in Education

René F. Kizilcec, Hansol Lee

Data-driven predictive models are increasingly used in education to support students, instructors, and administrators. However, there are concerns about the fairness of the predictions and uses of these algorithmic systems. In this introduction to algorithmic fairness in education, we draw parallels to prior literature on educational access, bias, and discrimination, and we examine core components of algorithmic systems (measurement, model learning, and action) to identify sources of bias and discrimination in the process of developing and deploying these systems. Statistical, similarity-based, and causal notions of fairness are reviewed and contrasted in the way they apply in educational contexts. Recommendations for policy makers and developers of educational technology offer guidance for how to promote algorithmic fairness in education.

Comments: Forthcoming in W. Holmes & K. Porayska-Pomsta (Eds.), Ethics in Artificial Intelligence in Education, Taylor & Francis

Subjects: Computers and Society (cs.CY); Artificial Intelligence (cs.AI); Machine Learning (cs.LG)

Cite as: arXiv:2007.05443 [cs.CY]

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Abstract

Data-driven predictive models are increasingly used in education to support students, instructors, and administrators. However, there are concerns about the fairness of the predictions and uses of these algorithmic systems. In this introduction to algorithmic fairness in education, we draw parallels to prior literature on educational access, bias, and discrimination, and we examine core components of algorithmic systems (measurement, model learning, and action) to identify sources of bias and discrimination in the process of developing and deploying these systems. Statistical, similarity-based, and causal notions of fairness are reviewed and contrasted in the way they apply in educational contexts. Recommendations for policy makers and developers of educational technology offer guidance for how to promote algorithmic fairness in education.

Citation

Kizilcec, R. F., Lee, H. (Forthcoming). Algorithmic Fairness in Education In W. Holmes & K. Porayska-Pomsta (Eds.), Ethics in Artificial Intelligence in Education, Taylor & Francis.

← Mining Big Data in Education: Affordances and Challenges

A Review of Fundamentals and Influential Factors of Artificial Intelligence →

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Encourage Self Regulated Learning in the Classroom

Sharon Zumbrunn
Virginia Commonwealth University, skzumbrunn@vcu.edu

Joseph Tadlock
Virginia Commonwealth University, tadlockja@vcu.edu

Elizabeth Danielle Roberts
Virginia Commonwealth Univeristy

Self-regulated learning (SLR) is recognized as an important predictor of student academic motivation and achievement. This process requires students to independently plan, monitor, and assess their learning. However, few students naturally do this well. This paper provides a review of the literature including: the definition of SRL; an explanation of the relationship between SRL and motivation in the classroom; specific SRL strategies for student use; approaches for encouraging student SRL; and a discussion of some of the challenges educators might encounter while teaching students to be self-regulated, life-long learners.

Read the literature review by Sharon Zumbrunn, Joseph Tadlock, and Elizabeth Danielle Roberts.

Mining Big Data in Education: Affordances and Challenges →

This material is based upon work supported by the National Science Foundation under grant 2021159. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.