

Technology Students' Recognition of Algorithmic Data Bias through Role-Play Case Studies

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This talk is about a research implementation on using role-play case studies to engage students in learning about the social implications of developing algorithmic technology. We talk about data bias in this presentation, but the broader impact is having students recognize that developing technology is not an isolated activity. Creating new technology affects everyday life—altering what people can and can't do, and different people have varying levels of access to these services. Fundamentally, students are made aware of the impacts of the work they will be doing after graduation.

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Discussion about Algorithmic Data Bias

- Algorithms and AI support almost every technological system today.
- Algorithmic data bias refers to systematic errors in an algorithmic system that hurt or favor one group of individuals over others.
 - + Can occur at any point of the data pipeline (collection, cleaning, analysis, reporting),
 - + Are difficult to fix depending on the context of the data,
 - + Can have many unrecognized effects!

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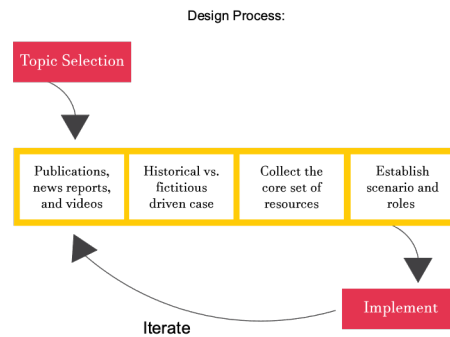
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As algorithms proliferate across domains, their development for analysis, prediction, and generation tasks raises questions about fairness, justice, and inclusion. One primary reason is algorithmic data bias, a common phenomenon across datasets and systems that reflects incomplete or misused data. With the incentive to make generalized systems that can do everything, everywhere, data bias reflects the data makeup and how it leads to systematically unfairly generated decisions or outcomes.

As future engineers, analysts, and scientists, it is fundamental that technology students are made aware early in their careers of how bias can, at a minimum, alter the quality of an algorithmic decision and, at worst, harm people and communities. There are also unique conversations that can only be made by ensuring underrepresented groups and their experiences are highlighted when engaging with technology.

Role-Play Scenarios (RPS)

- We use *Case Studies* to help students to take on different perspectives and talk about Algorithmic Bias.
- Doorn and Kroesen (2013):
 1. teaching communication skills
 2. teaching ethics
 3. broadening students' perspectives.



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We use role-play activities to instruct students on these complex issues. It allows students to engage with the course content but also allows them to talk about it in a more fun and exciting way. Doorn and Kroesen (2013) highlighted that role-playing as a method can help teach communication skills and ethics and broaden students' perspectives. Role-playing can also highlight alternative ways of thinking, centering the lens of discussion away from the dominant discussion to include ways of thinking in engineering and STEM education that are likely not highlighted through other curricula. We have been using these methods for the past three years, and students have expressed appreciation for the activities' interactive nature. They would much rather engage in these topics in this format rather than write another essay (this is also becoming tougher with the commercialization of large language models and XAI tools like ChatGPT and Bard).

We generally use an iterative design process that brings together real-world examples of the topic we want to discuss with students. We include articles, publications, videos, and other resources to establish the roles and build a conversation. Some roles are designed not to agree with each other – the values of different perspectives are set up to foster conversation. Ultimately, we hope to facilitate a conversation and direct students into recognizing the principles at play.

Example of Resources Given

Videos

Crockford - TED Talk - What you need to know about face surveillance
https://www.ted.com/talks/kade_crockford_what_you_need_to_know_about_face_surveillance

Acquisti - TED Talk - A future without secrets
https://www.ted.com/talks/alessandro_acquisti_what_will_a_future_without_secrets_look_like

DeSalvo - TED talk - how tech companies can assist with COVID
https://www.ted.com/talks/karen_desalvo_how_tech_companies_can_help_come_out_of_the_pandemic_and_reshape_public_health

News Reports/Blogs

Mark Lieberman. (2020). Facial Recognition Tech in Schools Prompts Lawsuit, Renewed Racial Bias Concerns. Education Week.
<https://www.edweek.org/technology/facial-recognition-tech-in-schools-prompts-lawsuit-renewed-racial-bias-concerns/2020/06>

Research Articles

Patrick Howell O'Neill, Tate Ryan-Mosley and Bobbie Johnson. (2020). "A flood of coronavirus apps are tracking us. Now it's time to keep track of them." MIT Technology Review.
<https://www.technologyreview.com/2020/05/07/1000961/launching-mittr-covid-tracing-tracker/1/18>

laire Galligan, Hannah Rosenfeld, Molly Kleinman, and Shobita Parthasarathy. (2020). "Cameras in the Classroom. Facial Recognition Technology in Schools." University of Michigan.
https://stop.fordschool.umich.edu/sites/stop/files/uploads/file_assets/cameras_in_the_classroom_full_report.pdf

"Snapshot Series: Facial Recognition Technology." (2020). Center for Data Ethics and Innovation.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/905267/Facial_Recognition_Technology_Snapshot_UPD_ATEP.pdf

Thomas Brewster. (2020). "The Wrongful Arrest Of A Black Man Provides More Proof Facial Recognition Is Racist." Forbes.
<https://www.forbes.com/sites/thomasbrewster/2020/06/24/a-wrongful-arrest-of-a-black-man-provides-more-proof-facial-recognition-is-racist>

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For each case, we gave students a specific set of resources that highlighted the broader issues and gave them insights into how some of the roles may interact. The resources included academic papers (research articles, journal papers, conference papers), videos, and news reports that were more friendly toward general audiences. The mix is important to ensure students get a more holistic perspective.

The resources were selected to present a diverse and inclusive perspective to students. Particular attention was given to the sources of information, and students were asked to think about how the power and authority of those reporting on issues (both in the context of news or academic readings) affect what is published and how it is discussed.

Class Schedule

Week	Activity
Week 1	Introduction to module
Week 1	Videos covering module material
Week 1	Readings (scholarly and news articles) covering module material
Week 2	Role-play pre-questions
Week 2	Individual concept map
Week 3	Role-play activity (moderated, semi-scripted)
Week 4	Group concept map
Week 4	Role-play post-questions

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For each topic/case, a 4-week mini session was outlined. Students were introduced to the modules and given videos and reading resources that covered the module material. They then answered a set of pre-questions to help prepare for participating in the scenario and create an individual concept map. Next, the role-play activity, which was moderated and semi-scripted, was conducted. After participating, students created a group concept map and answered additional questions regarding the experience. For this work, we only touch on the transcripts from the role-play activities, but our other work does highlight other assessments and aspects of the work.

Facial Recognition Technology Case

Fictitious campus exploring Facial Recognition Technology to monitor student temperatures, and self-reporting of symptoms

Topics covered:

- Data Bias
- Data Handling Procedures
- Community Privacy
- Equity in public spaces.

Student Roles

- **Role 1** - VP, Information Technology Services
"Although there may be problems, they can be overcome!"
- **Role 2** - UG Student and VP of AHU Student Org.
"Student Wellbeing is fundamental to any solution."
- **Role 3** - History Prof. and Faculty Senate Member
"In its current form FRT is too dangerous."
- **Role 4**: Associate VP, Provost's office at AHU
"We need this technology, but can we afford it?"
- **Role 5**: Senior Director, Office of Equity and Inclusiveness
"Is this tech actually accessible?"
- **Role 6**: Director, non-profit Consulting Firm
"Our application can address the shortcomings of the tech."

BREAKING NEWS

AI NEWS NETWORK

AHU looking to Facial Recognition technology to bring students safely back to campus

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Each case included a real-life inspired scenario encapsulating an algorithm-driven concern or problem within a larger context. The Facial Recognition Technology case follows the following scenario: To bring students back to campus post-COVID, a college is asking for feedback on using facial recognition cameras to monitor the community. The algorithm for this case is a biometrics system that detects and authenticates students and their symptoms. On the right are the student roles and a one-sentence summary that we created for this presentation to give you an idea of the role's opinion or perspective. The actual case study has a significant write-up for students to follow.



Credit Risk Analysis Case

A bank is investigating why results for a lending decision is different for people with similar profiles. Should a model be used to make these kinds of decisions?

Topics covered:

- Data Bias
- Decision-Making
- Public Data
- Inclusiveness

Student Roles

- **Role 1** - Data Analyst, EDK Bank
"It's not data but good data that matters!"
- **Role 2** - Underwriting Specialist, Consulting Services
"We can be more inclusive in the way we review apps."
- **Role 3** - Chief Credit Innovation Officer, EDK Bank
"We should be most profitable with least risk!"
- **Role 4:** Research Analyst, AI Startup
"We can use and be more transparent at the same time."
- **Role 5:** Loan Process Regulatory Officer, Regulatory Authority
"Systems are getting more complex and less understandable."
- **Role 6:** Director of AI in Finance at Institute of AI Ethics
"Lack of credit affects many of our applicants - we can do better."

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For the Credit Risk Analysis case, students are encouraged to think about what factors or descriptive items about a person are good measures of defining re-payability. Is the zip code of a borrower important? Is the amount of money they make? How many social media accounts do they have, or how often do they post? In this case, a bank wants to use data models to decide who should be awarded loans. The algorithm is a classification model using demographic and past financial data to define creditworthiness.



AI in Agriculture Case

Farming Collective is revolutionizing farming by empowering and automating Agricultural processes through AI and Technology!

Topics and Principles covered:

- Fairness, Responsibility, Privacy, Trust, Solidarity, and Dignity.

Student Roles

- **Role 1** - CTO of a start-up called Self-Running Farms (SRF)
"Once farmers see how the tech can help, they'll be onboard."
- **Role 2** - Ag. Extension Coordinator at Soybean Farmers Group.
"We help farmers through training. I'm not sure about the tech."
- **Role 3** - Director of Civic Engagement at a tech company vowing to help rural US regions with economic growth and job creation
"Whether with or without tech, we need farmers in the loop."
- **Role 4:** Technology Evangelist for Agricell, a large global conglomerate operating across agriculture-related businesses
"Let's talk: what can we help you with?"
- **Role 5:** A concerned farmer worried about limited profits and lack of legal training.
"We're stretched thin as is, but now the data boogiemer wants in."
- **Role 6:** Illinois Pecan farmer and representative for a Black Farmer's non-profit group.
"The tech is useful, but what about farmers who can't afford relearning?"

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For the AI in Agriculture case, students are guided through an example of innovative technology that has the potential to affect everyday people both as consumers and because of changes in the availability of jobs in the agriculture industry. A rural farming community discusses the impact of larger technology organizations "revolutionizing agriculture." The algorithm for this case is around the automation of farming procedures, software (ML models), and hardware (drones).

Methods, Data Collection and Analysis

Participants

- 3 sections of an Undergraduate “Technology and Society” course.
- Spring 2021 - 40 students, 7 Groups.
- Fall 2022 - 73 students, 12 Groups.
- College of Engineering and Computing.

RPS Activity

- 30-45mins semi-structured conversation.
- Groups of 5-7 participants and a moderator.
- Asked to reach a group consensus on the topic at hand.

Mixed-Methods Approach

Data corpus includes:

- Transcripts from role-plays.

Transcript Analysis

- Directed Transcript Analysis approach.
- Authors first sat in the role-play sessions, took notes and read through the transcripts.
- Authors then did initially coded the transcripts and then came together to discuss codes and findings.
- Generated a set of themes based on codes with examples of each.

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For this work, we collected role-playing transcript data from 113 students (40 in spring 21 and 73 in fall 22). All the participants were broadly technology students, representing majors such as cyber security, data analytics, information science, computer science, and some engineering courses. The course where this was implemented fulfills the ethics requirements set forth by ABET.

The role-play activity was run and transcribed through Zoom, lasting about 30-45 minutes. We gave students some structure to the discussion by giving them opening and guiding questions. At the end of the discussion, students were instructed to come up with a group consensus – accept the use of the technology, offer changes, or reject it in totality. Everyone should have buy-in to the response, even if they are not completely in agreement.

We analyzed the transcripts by following the role-play sessions. We then

read through all the transcripts and noted initial codes before coming together to discuss the codes and generate the themes. The themes were broad, and we looked for themes representative across a significant number of the conversations or in a significant level of depth.

Recognition of Data Bias

- **Guided through the Role-play:** “To be honest, I never really had a perspective or opinion on a situation like this. I wasn't knowledgeable or ever really thought about the different biases or steps that go into accepting loan applications, so the role-play for me thinking about that. It was nice to learn about the ways that people are trying to take steps to fix some of these issues. – Student 1, Credit Risk Case
- **Other Perspectives:** “My role seemed more focused on profit than anything. So, I see why my role would think that the biases in AI, privacy etc. are not really important. I see that view, but for me, my opinion did not align with his at the start of the discussion and even better arguing for it, it still does not align with it at all.” – Student 2, Credit Risk Case

There were five overall themes that we highlighted through our analysis. The first is simply the recognition of data bias – both in the data itself or the bias of perspectives and how they engage with data.

Student 1 highlighted the use of the role-play activity as a way to guide students through exploring other perspectives. The student mentions not having considered the steps in the process nor the biases that could be found at each.

Student 2 emphasized the learning aspect of taking on another person's perspective. Being empathetic and able to listen to the concerns of others, even if they are biasing a process, is important. Making choices that serve rather than harm is still up to each person.

Connecting the Case to the Real World

- **Outside Research:** “As far as facial recognition technology is concerned, I’m a bit skeptical as it seems quite intrusive into a person’s life and privacy, but even more so knowing that it is not perfect. There have been plenty of reports and instances where the technology is biased and has even led to wrongful arrests. For example, NIST found specific recognition issues with Asian and African faces. They had more false positives up to 100 times more often than white faces. This is because, generally, face recognition systems are trained on faces of lighter-skinned people and as a result are skewed to detect light-skinned people.” – Student 3, Facial Recognition Case

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The second theme was that many students were able to connect the elements of the case to the broader societal issues at play. Student 3 mentions and compares the case details to a NIST survey, which was not part of their readings. In preparing for the role, many of the students did their own outside research to be better equipped to talk from the perspective of a person in one of those roles. The concern for data biasing here was that the technology has yet to get to the point where it is good enough to work on a broad audience. They argued that there are far too many false predictions with facial recognition to apply it to a civilian population then.

Early Ideas about Early Measures...

- **Transparency in Algorithmic Models:** "I think it's sometimes hard to go against the statistics. So maybe the bank should use the age, gender, the type of car you drive... but it's important that they ultimately know what the factors are that go into the model and how they weigh the risk of each." - Student 4, Credit Risk Case
- **Fairness and Justice for all:** "Ethical principles of AI should be applied to agriculture to ensure that technology is used in a way that is fair and justice. This include ensuring that farmers have access to the same information in the resource that technology used to benefit all community members, and that any risk must be minimized." - Student 5, Agriculture Case

The third theme was the progression of ideas from early measures to more nuanced conversations. Students 4 and 5 highlight two broad concepts introduced through the course – transparency, fairness, and justice. These concepts were brought up directly through the case readings and lectures, so they were mostly observed across much of our data.

Student 4 describes that whatever the inputs in the system, for the fair application of the algorithm, there needs to be some disclosure of what is being used to make decisions. Student 5 focused on the inclusivity aspect of access to new technology, highlighting that farmers might be disadvantaged if regulations and financial power aren't considered holistically.

... Became More Nuanced Ideas

- **Complexity:** "With the rising use of automation in farming, a wealth gap between farmers, which is already extremely prominent, could widen itself even further as smaller, independent farmers are left behind with confusing, new technology. Ensuring inclusivity would be essential, and thus, a collective of farmers should join and have a say on what goes on their farms." - Student 6, Agriculture Case
- **Who Benefits:** "If AI is only deployed on rich, large monoculture farms, there is a limitation to the uptake of AI by smaller farmers. A major concern is that this use of AI will bring economic benefit to grow businesses and take companies, but not to the farmer themselves, and the other is transparency." - Student 7, Agriculture Case

As the discussion went on, we found that though students initially focused on data acquisition and testing any algorithmic models as ways to overcome data bias, through the discussion, they highlighted the need to question and meta-reason the need for a highly complex system in the first place.

Student 6 brought the complexity of the systems to attention. It's not simply a matter of losing jobs, money, or the ability to adopt new technology. It is instead a culmination of all the factors that lead back to the freedom of choice for the farmers regarding what they want to do and what they have to do. There is a level of choice that, though is difficult to maintain, should be maintained.

Student 7 questioned who benefits from the increased dependence on technology. Smaller farms will need more ability to adopt the technology. Businesses will benefit, but the people will be hurt.

Connecting Micro to Macro Ethics

- **Using the Tech beyond its purpose:** “Facial recognition is not exempt from function creep. This technology meant to protect students can also be used to discipline students. They may be tracked far beyond necessary because of technology that is not perfect. Issues of privacy and surveillance are bad enough regarding facial recognition technology, but it will disproportionately affect people of color as is always the case in our legal system. This biased and imperfect technology, on top of an already broken and racist legal system will produce severe consequences for our students of color.” - *Student 8, Facial Recognition Case*

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Students recognized the ethical discussion at different levels of ethics. Micro ethics refers to localized ethical choices, usually on an individual basis. In comparison, macro ethics refers to the choices society should make for the betterment of a larger audience.

Student 8 connected these concepts well through the context of the case. The college campus might be a single entity attempting to do its best for its community, but where does this lead to the future of technology? What is stopping the technology from being used to track students beyond the purview of COVID? Additionally, all the same issues of biased models and data return again in this case.

Making Tough Decisions

- **Weighing the Benefits and Costs:** “Not using facial recognition technology is the best approach, because in debating whether or not we should use this technology, our main goal should always be to keep students safe. The technology may help prevent the spread of COVID on campus, but it will not ultimately keep students safe, nor protect their privacy, and has the potential of misidentifying them.” - *Student 9, Facial Recognition Case*

The final theme was of making “tough” decisions. Each case asked students to collaborate with the rest of the roles and develop a consensus response. After hearing about all the benefits or costs of accepting or not accepting the technology, they were required to compromise on a path forward. This is described as a compromise because the technology has the potential to do well and help people. But the potential is often not enough; if significant issues come from using the technology, these are perhaps more important than simply a benefit.

Student 9 gives an interesting outlook into how students took points from across the information to create a summative statement on why or why not the technology should be used. In doing so, they acknowledge and bring to the forefront the latent principles the technology tries to serve. In facial recognition, the technology should be aligned to keep students safe. But is it doing so?

Final Thoughts

- RPS + Case Studies are an exciting way to talk about nuanced topics!
 - + Many students had never done role-plays before.
- Students want to talk about technology that effects their everyday.
 - + Talking through an example of Agriculture can expose students to conversations they would not have otherwise.

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Some final thoughts through running the case studies: These are a great way to have more nuanced conversations on topics surrounding the societal impacts of using technology, ethics, or DEI topics. Curating your case studies allows the instructor to bring subjects they want and customize the course offerings to match student interests.

Ultimately, we found, to no surprise, that students are interested in these topics. Still, if we only talk about them using examples of disasters or catastrophes, students will associate only the negatives with these conversations. Suppose students are told of and can experience through their discussions the benefits of being ethical engineers, scientists, students, and people in general by using ideas that affect them more closely. In that case, they are more interested in the conversation.

Related Publications

1. [Using the Boeing Max Air Disaster as A Role-play Scenario for Teaching Ethical Thinking](#)
2. [Using Role-Plays to Improve Ethical Understanding of Algorithms Among Computing Students](#)
3. [Assessing Engineering Student's Representation and Identification of Ethical Dilemmas through Concept Maps and Role-Plays](#)
4. [Learning to Link Micro, Meso, and Macro Ethical Concerns Through Role-Play Discussions](#)
5. [Recognizing Principles of AI Ethics through a Role-Play Case Study on Agriculture](#)
6. [Instructing First-Year Engineering Students on the Ethics of Algorithms through a Role-Play](#)

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We have been working with role-play case studies for about 3 years and have implemented them in a variety of contexts for a variety of courses. Here are a few of our other related publications on using these activities.

Thank you!

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Thank you!