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Annotators Increased Research Career Interest After Participating in Human Labeling Tasks for AI/ML Research

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This work in progress paper will explore how participation as a human labeler in an AI/ML pilot study contributes to graduate students' self-efficacy and interest in AI/ML research.

Introduction

Participatory research emphasizes advancing scientific knowledge through direct collaborations and partnerships between researchers and community members. *Citizen*, or more recently, *community science* (CS) is a form of participatory research involving community members, stakeholders, or other volunteers working together with researchers throughout the research process [1],[2]. CS can be classified into three distinct types of projects: contributory, collaborative, and co-created [3]. In contributory projects, participants contribute to data collection, occasionally helping with data analysis and dissemination. In collaborative projects, participants help with analysis, sometimes helping with the study design, drawing conclusions, and dissemination. Lastly, participants in co-created projects are involved in every stage of the project from developing research questions and hypotheses through analyzing and discussing results. In recent years, participatory science (PS) was coined as an umbrella term to more accurately represent the engagement of those involved in community science, community-based monitoring, and volunteering to engage in research [1],[4]. Research has shown that engagement in even less-collaborative CS can improve participants' understanding of the scientific process and increase self-efficacy, agency, and interest in STEM, especially in youth and emerging adults [5], [6].

The effects of CS/PS on graduate student outcomes remain underexplored, potentially due to students' existing engagement in STEM research. Graduate students may be seen as emerging experts, existing somewhere within the novice-to-expert continuum, and this variability in research experience is worth deeper exploration in PS. Existing research indicates that co-created PS may increase self-efficacy, a factor in reducing the isolation and estrangement that many graduate student researchers experience in their programs [7], [8], [9]. While previous research suggested increased confidence in labeling and increased interest in AI/ML research after participating in an ML pilot study, more studies are needed to determine if PS can increase graduate students' self-efficacy [Redacted for Review].

Our current work is situated within a broader study addressing how to design ML/AI tools for both non-experts (particularly high school, undergraduate, and graduate students) and experts in plant root labeling. While typically implemented separately, researchers have also explored the integration of machine learning (ML) and PS to develop new tools, for data collection, and processing. The benefits of combining ML and PS include increasing the volume of training data for ML algorithms, accelerating large data validation processes, and improving data quality [10]. Additionally, research suggests that the integration of ML and participatory research can promote interdisciplinary collaborations between researchers and volunteers [10]. Our work supports this through seeking to understand how youth input in ML experiments compare to input from plant and computer scientists.

The purpose of this post-reflective study was to investigate how graduate students who completed a pilot study assessing how non-experts in plant science utilize labeling tools as human labelers, engaged in AI/ML research following their participation. Specifically, this work highlights how contributory projects can affect graduate student self-efficacy when engaging in AI/ML research experiences. Our central question was: how does engagement in an AI/ML research study as a human labeler affect graduate student self-efficacy, behaviors with, and interest in AI/ML?

Experimental Methods

Research Design

In the initial pilot study, a multidisciplinary team of researchers from computer science, computer engineering, human-centered computing, plant science, agriscience education, and engineering education conducted a pilot study with ten participants tasked with labeling images of plant roots for ML model training in two 30-minute sessions [Redacted for Review]. Following these sessions, participants were asked to complete a survey with quantitative and qualitative examining their ML self-efficacy and interest in AI/ML research before and after participating in the study. These data provided some context into student engagement in AI/ML research, but no data was available to indicate students' intent to persist in AI/ML related research activities. The current study aims to address this gap in initial data collection by understanding student intentions before and after engagement in our labeling research project.

For the work reported here, approximately one year later, we contacted those same 10 participants for follow-up interviews to reflect and expand upon the results of Likert style scale STEM self-efficacy and STEM interest questions asked in the pilot study, and to further explore participant experiences with CS, AI and ML. Three participants responded to date.

Data Collection

We designed a semi-structured interview protocol to gather in depth qualitative responses to the quantitative self-efficacy questions from the pilot study, in addition to examining participant actions in the year following. Using self-efficacy theory as a framework, questions aimed at addressing mastery and vicarious experiences were crafted. Additional questions about student interest in AI/ML use and careers focused on understanding how participation in research may impact future decision making. We conducted 30-minute interviews virtually via Microsoft Teams, after obtaining informed consent. The interview script contained eight questions, excluding clarifying and probing questions to allow for deeper understanding and elaboration.

We recorded and transcribed interviews using Microsoft Teams, manually reviewing and editing each transcript to ensure accuracy to the original interview. These analyses were performed by a graduate and undergraduate researcher in engineering education and computer science, respectively, under the supervision of a research associate professor in the Agricultural Education and Communication Department and an assistant professor in the Engineering

Education Department at [redacted]. Both supervisors have extensive backgrounds in qualitative research.

Participants

The three participants in this study were graduate students at [redacted] in the Department of Electrical and Computer Engineering. After IRB approval through [redacted], we contacted the participants via email. Each participant was given an alias to maintain anonymity throughout the research process. More details about each participant are indicated in Table 1.

TABLE I
Participant Demographic Information

Participant	Gender	Degree Program	Research Area
Ethan	Male	PhD (completed Fall 2025)	Signals and Systems
Tracy	Female	MS (non-thesis)	N/A (Non-thesis)
Rory	Male	PhD	Signals and Systems

Results

After coding the new interview data, we developed a case study for each participant. Using comparative case study methodology [11], we first analyzed each participants' response to create individual vignettes and compared them to each other [12]. See supplemental table for each participant's experiences and interests. The results presented below offer insight into each participant's experience during the pilot study, as they reflect on how their participation influenced them. Each vignette begins with a summary of who they are, and what their AI experiences were prior to participation in the pilot. The vignettes then address their graduate research experience and conclude with a discussion of their future intentions with AI/ML research.

Ethan—High AI/ML Experience, High AI/ML Research Alignment

Ethan is a recent PhD graduate (December 2025) with AI/ML research interests including simple interpretable models and deep learning models. He was first introduced to AI/ML during his undergraduate studies via a project involving using AI to detect disease on citrus leaves. Ethan was interested in continuing research in applied ML in industry or a national lab. When discussing his thoughts on serving as a human labeler in the pilot study, Ethan noted that the study introduced him to a new process for labeling. He described his previous understanding of labeling as binary, stating, "it just falls into bins". In contrast, he compared the process of labeling plant roots to MS Paint, needing to classify the entire outline of a shape to label it. "It's not just a binary sort of like this image has a cat or a dog. You have to outline where the cat is, where the dog is. You can't just broadly state it's just one. Like it has plant roots, OK, but how

[do] you know where exactly are the plant roots? So it was that type of labeling that I wasn't exposed to."

Ethan also described his limited exposure to AI/ML applications outside of his graduate research, noting that "being a graduate student, I had one problem that I set out to solve, and I used the ML for that... I mean, I hear that ML is used everywhere, but here I'm only using it for this one specific thing". He expressed that the pilot study reminded him of the breadth of AI/ML applications and its different users in various industries, emphasizing its use in agriculture specifically. The study itself had little effect on Ethan pursuing different research interests in the time between the pilot study and the follow-up interview, as Ethan had already expressed a solid understanding of what he wanted to pursue following graduation. While not currently intending to pursue a career in academia, Ethan did comment that "learning about these new tools how other labs and other people are applying ML, it always gives me a bit of curiosity towards what academia would be like".

Although there was little effect on current or future research interests, Ethan described an increased interest in leveraging AI tools and predictions for uses outside of his current research area. For example, he described an interest in exploring how AI can be used for personalized teaching: "So, by leveraging these AI tools and with the amount of personalization that comes with these LLMs like ChatGPT...I think there's room to analyze how we can tailor these tools to better education."

Tracy—Low AI/ML Experience, Low AI/ML Research Alignment

Tracy is a master's student with plans to pursue a PhD. She is interested in the hardware portion of electrical and computer engineering, and her current research focuses on infrared metamaterial absorbers. The semester she participated in the pilot study is also the semester she was introduced to ML through an introductory course. Tracy had no previous experience with labeling or AI/ML prior to this course and participating in the pilot study. Tracy has not yet decided whether to pursue industry or academia following graduation.

Tracy expressed that participating in the pilot study was a straightforward way to learn how machine learning is applied and used "because in electrical engineering it is not very straightforward to understand the actual purpose of AI and machine learning." When sharing what she learned, she shared that she found "it helped me make connections to what I learned and how it is applied in real world situations because what I learned was very fundamental and basic equations and theories and when I was actually learning those, I was able to solve problems and I was able to code some things to make the results I wanted but I couldn't really connect to...in what ways could these things be used."

When asked about her current understanding of the purpose of ML, Tracy also commented on the necessity of labeling, and the effectiveness of AI/ML in different areas. She highlighted the market potential of AI/ML in agriculture specifically, suggesting alternative uses beyond labeling plant roots: “It doesn't have to be roots. It can be bugs, insects or some defected leaves.” Describing her confidence using the ML tools after watching a demonstration, Tracy noted increased confidence in exploring every functionality of the program. She also reflected on her confidence in trying out new AI/ML tools saying that “if I was reluctant to try the tools that I haven't used, I think I was more confident in exploring unused tools or some unfamiliar functionalities.”

Rory—High AI/ML Experience, High AI/ML Research Alignment

Rory is a PhD student with research interests in wireless communication. Before the events of the pilot study, Rory’s work involved reinforcement learning, an AI technique. Rory was interested in industry jobs in software and AI engineering. When asked about learning experiences during the study, Rory emphasized a new understanding of the time intensity and precision involved in machine learning labeling, explaining that his experience with labeling was limited to labeling handwritten data in Python. Rory also shared a broadened knowledge of the use of AI in agriculture, a field that he previously described as new to him. Most notably, Rory recounted the impact the pilot study had on his daily life, explaining that he had gained a new eye for the potential applications of AI in other fields. “It’s given me an extra sense or an extra eye, I guess, to look out for different applications of artificial intelligence just in things I encounter daily."

Rory outlined an anecdote about a trip to a hazelnut farm, sharing the following thoughts he had at the farm: “There's a lot of data I could potentially collect out here and label, and maybe, like, analyze the soil quality in some way or the health of the hazelnut trees.” Though Rory’s research has mostly, in his words, remained the same, he has embarked on new ventures in autonomous data collection with mobile agents and expresses interest in continuing this research.

Discussion

While all participants had different levels of experience with AI/ML research, all three participants shared how engagement in the pilot study broadened their understanding of the different applications of AI/ML tools, particularly in agriculture. All participants noted that labeling plant roots was a new application of ML that they were previously unaware of. Despite all having prior exposure to AI/ML from a technical standpoint within their required coursework, the applications of AI/ML were not emphasized in their curriculum. This was an interesting finding because these students are in a discipline where one might expect students to know how these technologies are being implemented, especially within the context of STEM-related applications of AI/ML.

Even with this limited curricular exposure to applications of labeling, they all indicated that because of their participation in the pilot study, their confidence remained the same (Ethan) or increased (Rory and Tracy) in their ability to use labeling tools and/or new AI/ML technologies. Interestingly, Rory and Tracy had vastly different levels of prior experience, with Rory having some prior labeling experience and Tracy having none. Regardless, all three intend to continue to engage with AL/ML in the future, especially if it is related to their future employment. Our novice participant, Tracy, felt more confident in her ability to use other labeling tools in the future, which is an outcome she would not have from her curricular experience. Graduate student research and coursework do not always make connections to real-world applications, or provide practical experiences, which highlights how impactful CS/PS can be for students as they are exploring career pathways.

Conclusion

In this study we examined how participating in an AI/ML research study as a human labeler affected graduate student self-efficacy, as well as their interest and behaviors in AI/ML. Through semi-structured interviews, we found that engagement in a community science project, an ML labeling study, introduced three Electrical and Computer Engineering graduate students to new applications of AI, particularly in agriculture. Participants also outlined potential applications of AI in agriculture separate from the application in the pilot study, indicating that the labeling experience stimulated thoughts about using ML in a new field. Participants explained that these experiences were not present in their undergraduate or graduate curriculums, and this finding indicates that incorporating relevant CS into higher education curriculums may provide useful learning experiences for students. Additionally, we found that the CS experience increased confidence in using new AI/ML technologies in two out of three participants, indicating a positive change in self-efficacy. These findings emphasize that even in higher education, CS experiences may increase self-efficacy in a student's area of study. More research is necessary to examine the unique effects of CS participation in graduate students, with the addition of a larger sample size to verify the significance of changes throughout the experience.

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