GitHub Classroom IA research plan

From prior research and user feedback, we learned that the current onboarding sequence and the site organization didn't match users' workflow or mental models. This led to inefficiencies as they deferred steps they didn't initially need or confusion about where to find things that they *did* need at the time when they needed it.

Prior research and feedback

- Findings from LMS usability study
- Ad hoc interview with a user who requested for search functionality for assignments
- Issue: Improve usability of web interface

Proposed IA redesign

- Figma mockups
- Prototype

Contents

Existing users may not be as familiar with the student roster or LMS integration.

What do we want to learn?

Evaluate the usability of the proposed IA/navigational changes compared to the current IA. Initially, we plan to evaluate the IA with existing users.

- Are users able to intuitively complete the classroom setup?
- Are they able to easily locate the features they need or expected to see in order to set up and maintain their classroom?

What are our hypotheses?

The proposed classroom setup flow is better aligned with teachers' workflow since it follows the common sequence we had observed from users. The revised IA and navigation is more intuitive and allows for easier discoverability of features and functionality they expect to find.

Methodology

There are various research methods for validating at different stages of product development. We plan to use a combination of the following:

- Task-based usability testing used to better understand how intuitive the team's design is, and how well it fulfills user needs.
- User interviews used to gain deeper empathy by learning more about the user's background, their specific context.

Logistics

Schedule

Week of 11/4	Begin recruiting for participants
Week of 11/11	Research interview sessions scheduled
Week of 11/18	Conduct research analysis and synthesize findings

Recruiting

Criteria

We're looking to interview 5-6 GitHub Classroom users with a mix of experience levels.

Invitation email

> Subject: You're invited to participate in GitHub Education research
>
> ---
>
> You had previously indicated that you would be interested in participating in GitHub Education research. We are scheduling interviews with teachers who use GitHub Classroom. If this applies to you, we would love to schedule a time to interview you and get your feedback.
>
> We will be conducting the session over Zoom and will request you to share your screen with us during a portion of the interview. If you don't have Zoom, you will need to install the application prior to our session. We'd be happy to help if needed.
>
> If you're comfortable with the above, please schedule a 30-minute session that's convenient for you: https://www.meetingbird.com/m/ryxmzD1QS
>
> We look forward to hearing from you!
>
> Phoebe
> GitHub: @femmebot

Screener

n/a

Consent

Consent form and responses recorded on Airtable

Confirmation + Reminder

Will be automatically sent to participant at least a day in advance to confirm the research session and to help them prep for the session.

> Subject: Confirm participation in GitHub research
>
> [participant's name]
>
> Thank you for volunteering to participate in our research. To prepare for the session, here are a few quick things to note beforehand:
>
> - **Privacy**: This is to acknowledge that we will keep your personal information private and that any information we gather will not be shared outside of our research purposes.
> - **Screenshare**: We will be conducting the session over Zoom and will request you to share your screen with us. Remember to hide any items on your desktop that you may not want us to see. Please find a place with low noise so we're able to hear each other clearly.
>
> Let me know if you have any questions. I very much appreciate your time!

Thank you

> *Thank you note to come.*
>
> *Also ask if they would be interested in participating in a follow-up interview in the future and if they could recommend someone we should talk to.*

Tools

Calendar

Set up meetingbird.com, a calendaring tool, for scheduling sessions

Research candidate tracker

- In Airtable

Script outline

User interview

Intros/Warm-up

(3-5 mins.)

> [Sample script]
>
> Hi! Thank you so much for volunteering to participate in our research. My name is [name] and I'm a researcher at GitHub. These are my colleagues [names] who are helping with the research.
>
> The purpose of this session is for us to learn more about your experience with GitHub Classroom. I'll ask you a few questions and, later, would like to ask you to walk through a scenario. We'll need to ask you to share your screen then so we can see what you're doing. We also need to ask you to talk aloud so we know what's going on in your head as you're thinking.
>
> Your participation is completely voluntary so please don't feel obligated to answer questions that you don't want to. And please be completely honest with us. You won't hurt our feelings.
>
> We would like to record the session so we can review it later. We will only use this for research purposes and we won't store or share any personal information about you. Do we have your permission to record?

Background and context

(3-5 mins.)

We want to make this somewhat open-ended so we can extract richer data. Probe into their role, needs, and how GitHub Classroom fits into that role. Suggested prompts:

- Tell us about your background as a teacher.
- Tell us about your class.
- How did GitHub Classroom become part of your class? *Dig into what problem(s) it solves for them, and where it falls short.*

Classroom setup

(3-5 mins.)

We want to understand their current and preferred workflow for preparing Classroom for a new semester. Dig into pain points. Suggested prompts:

- Tell us how you usually go about preparing for a new semester.
- Describe how you would set up GitHub Classroom for a new semester.
- If they've taught in the past, probe into how their current workflow compares with how they did things previously.
- What would you change about that process if you could? Why?

Prototype

(10-15 mins.)

I'm going to share a link to a prototype. Click on the link to start the prototype. At this point, we'd like to ask you to share your screen with us.

Suppose spring semester is about to start. You want to set up GitHub Classroom for your new class. This is what you see when you sign in to GitHub Classroom.

- Based on the workflow you described earlier, talk us through how you might go about preparing for a new semester using this prototype. You won't be able to type text but feel free to point or click on things as you would normally.

Assessment

- As you went through this, was there anything that seemed to be missing?
- Did anything feel out of place or unnecessary?
- ~~How would you rate the process of setting up a classroom from 1 (not at all intuitive) to 5 (extremely intuitive)? How does this compare with how you had set up a classroom in the past?~~

Wrap-up

(2-5 mins.)

That's it! I'm now going to open it up to my colleagues to see if they have any questions. And if you have additional feedback for us, we'd love to hear them.

Would you be interested in participating in a follow-up interview in the future?

Notes

Session 1 notes

[intro]

Tell us about your background as a teacher

Well, I am not so much of a teacher. I'm a researcher primarily. I'm working at University of Applied Sciences here in Cologne and it happens that sometimes if you are working as a researcher at university your professor asks you to help so in the past I led some of the tutorial groups that are accompanying the regular classes. Yeah so basically I am more of a teaching assistant. So last year I led the tutorial on data modeling. We started to use GitHub and introduced GitHub Classroom there.

And how many classes are you assisting?

Well it was just this one this semester. In the previous classes it was just one per semester.

Tell us the context for how you got introduced to GitHub Classroom.

I'm not sure if I remember. I must have stumbled upon it some time. I was just wondering how I could use GitHub in our classes to introduce students to the concept of version control. And I just stumbled upon it and I said "Oh great! This might help us organize all these things."

Did you actually set it up or did someone invite you to use it?

No I set it up. I completed this training sessions there…this certificate for Campus Advisors and afterwards I set up this Classroom and I showed my professor how it works but I manage most of it.

You're in the middle of a semester now?

Yes, it started in October. But in this semester I am not doing a tutorial it was just last semester. This course is just in the summer so we will use it in the summer again.

If this were summer again could you walk me through how you would set up GitHub Classroom for your class?

Uh huh so following the recommendation, I would set up another organization because as far as I understand you would use a new organization for each class. Next semester, we want to try this new integration with learning management systems that just came out this summer I guess? We want to try that and connect it to Moodle and see how that works. I don't know yet. [laughs]

Will you tell us?

I will, yeah!

And then I guess I will basically copy the assignments from last semester and maybe tweak it a little bit but I mean it worked quite well

At this point what I'd like to do is share a link with you.

In the chat, I guess?

Uh huh

And what is this?

This is a prototype. It's clickable but it's not functional. We're looking to make some changes with GitHub Classroom and we'd like to test to see whether any of the changes we're thinking of making will be effective or not and we're looking to gain insights first from users like you.

Let's pretend you're preparing for your summer class and you're setting up GitHub Classroom for your summer class. At this point, would you mind if you could share your screen? Do you see icons in the bottom? Do you see one that says "Share" with an arrow?

Ah I have one. I have to select my window. Can you see that?

Yes! Does this look something like what you see currently for your GitHub Classroom?

Yeah, yeah sure.

How might you set up your classroom for the new semester?

Well, I guess I would click new classroom? Ah, but beforehand, I would create this new organization. Ah, maybe…this is new right? (Selects "create a new organization" from the dropdown). Okay, this is nice! Set up a new organization for the class as I said before. Yup. I would do that. (tries to type in organization name) Oh I can't do that. (Clicks on button.)

And that's it? (on the new classroom empty assignment tab)

Yes, normally what else do you do when you set up for a new semester?

Well because I would need to connect to student IDs I guess? As I said before, I would try to use this connection thing that lets you … Moodle, in this case? (Goes into "Setting" and points to the LMS section) And if I do this it syncs with the classroom? That's what I would do.

So you would connect your students first?

Mm hmm from Moodle.

And I think you said earlier you would copy your assignments from the previous semester but tweak them a little bit.

Yes, if I remember correctly you can use a template repository so I can just use the old one for that

What would you expect to see under “Students”

If I connected to Moodle then I would expect to see that all my students are there

Are you the one who manages other teaching assistants and researchers?

I was the first one to find GitHub Classroom and learn about it and i also told my other colleagues about it and showed how it works and one of them also tried it for his class so I basically advertised it because I think it’s a really good teaching tool for working with GitHub.

So you were saying that it helps with teaching. What problems does it solve for you?

Not with teaching as such but with organization. Because if i hadn’t used classroom I would have tell the students that each of them create a repository and then I would have to manage somehow all the URLs, and all the cloning, and the grading, … I don’t know. I haven’t tried it without it actually but this is how I imagine it would be. It would be very complicated.

How large is your class?

They are about 40 students. So it’s a bit too much for individual assignments. To grade 40 assignments is time consuming. But in the middle of the semester we switched to team assignments because it’s just a few repositories. And I think it helps the students learn from each other. I liked that we had both options. This is also something that I think Classroom manages very well—to connect people to teams and abstract away all of this group-building.

Are there any features you wish GitHub Classroom had?

So if you use this classroom assistant software it can download all of the repositories but it’s mostly for archiving as far as I can see that but it would be better if it would have something similar for grading. That you download all the repositories and you are able to push back to them. I’ve been following the forums. I know there are lively discussions in the issues and I’ve just been following them and I know that it’s difficult and not what the Assistant was made for. But some tool to ease giving feedback via issues? I don’t know exactly how to realize that.

How *do* you do it now?

Right now, as I said before, there are too many repositories to go to each one individually. To each script and comment. I know it is possible to give feedback—per line even—but it is just too much work so we decided to just download the repositories and see if it works and we gave out grades outside of any GitHub feedback loop. It’s not ideal but maybe we try other ways in the future.

Also maybe a small obstacle right now is Classroom Assistant doesn’t run very well on Linux. So maybe someone should work on that.

Are there any other script or tools that you use in conjunction with GitHub Classroom to help you manage the class better

I found some guy who developed some scripts. For example, one of them is downloading the timestamps of the latest submission. That was really nice. For example if we had a deadline,

did the students just push 5 minutes before the deadline or did they continually work on the repository? And there was some guy who provided some scripts for that. I don’t know his name or repository but there are scripts out there that ease teaching beyond Classroom.

[wrap up]

Session 1 de-brief

- What surprised you
    - Participant is a teaching assistant who had set up (and continues to manage) GitHub Classroom. The professor doesn't actually use Classroom.
    -
- What was something new you learned that you didn't know before
    - Participant had completed the Classroom training and received a certificate
    - Was interested in trying out the LMS integration with GitHub Classroom this summer
    - Classroom Assistant doesn't run well on Linux
    - Uses a third-party script to add timestamps to Classroom Assistant download so they can get granular information on each assignment related to the deadline
    - Participant was able to successfully find functionality they were looking for.
- What did you find that reinforced what you've already known
    - Plans to reuse assignments from this semester with a few tweaks
    - Needs a way to provide feedback to students
    - Sets up a new organization per classroom (based on recommendation)
- Memorable quote(s)
    - "So following the recommendation, I would set up another organization because as far as I understand you would use a new organization for each class."
    - "They are about 40 students. So it's a bit too much for individual assignments. To grade 40 assignments is time consuming. But in the middle of the semester we switched to team assignments because it's just a few repositories. And I think it helps the students learn from each other."
    - "[needs] some tool to ease giving feedback via issues … Right now, as I said before, there are too many repositories to go to each one individually to each script and comment. I know it is possible to give feedback—per line even—but it is just too much work so we decided to just download the repositories and see if it works and we gave out grades outside of any GitHub feedback loop. It's not ideal but maybe we try other ways in the future."

Additional notes:

- Need to adjust prototype so tabs are clickable from the assignment empty state page.

Session 2 notes

[intro]

Let's get started. You're a teacher, correct?

Yes, I'm a lecturer at a university.

Great! How did that happen? Tell us how you became a teacher.

I've been a software developer actually my whole career. I quit my job for personal reasons trying to figure out what I was going to do next and I had worked with the university on hosting conferences for girls because that was one of my passions and they ended up having an emergency hire two years ago so I've been doing that for the last two years.

Lucky you! Lucky for them!

Yes! [laughter] It's one of those things that just kind of worked out.

So, you're a lecturer…it sounds like it's a big class?

I have about 30 per class. It's not a huge university class.

What is it that you teach?

I teach Data Structures and C++. And I teach Assembly programming language in MIPS. And then I've taught Linux in the past. And then sometimes I host teacher online internships to computing class.

Is this just one class?

This semester I have multiple sections of Data Structures and Assembly so four classes.

Wow! That's a full time—*more*—than a full-time job! Now tell me how GitHub Classroom came about. How did you learn about it?

So basically I was asked, because I've been a software developer all this time, our university … we're a computer science department but we were not teaching our students or we were not promoting our students to use GitHub very much. So I was asked to introduce it in my class. So Data Structures would be the first time these software developers—most of them—would have seen GitHub. So I went out looking for … well, I already knew how to use it, but knowing how to use it and knowing how to teach it are different things. So I went out looking for resources to figure out how to teach it and that's how I came across the Campus Advisor training. My intent was I was just going to do the training to be prepared to teach it and then they just said Well, you can do an interview and then you can be this Campus Advisor and then I said, well, okay, sure I'll do that. And then mainly, I learned it to learn to teach GitHub and then I came across GitHub Classroom.

So I had talked to other folks in my department and they … there's a couple of people who use GitHub in their classes, like the Software Engineering class, because it's a group project. And they just had students create repositories like private repositories, and then invite the professor to their private repositories. And that's how they managed their projects.

I had learned about GitHub Classroom during the Campus Advisor training so I posted a question on the forum "Why should I use GitHub Classroom? What's the advantage?" because my colleagues are using just GitHub. And I got several responses saying it was helpful for

particularly cloning repositories down to your machine, that you could look at all the code at once if you want to run it. So I just decided that I would be the explorer and I would go out and just use it. And so far it's been going fine but I don't know if I'm using it right or using all the features but I am using it.

And I've used for … so this class, I waited kind of mid-semester or maybe about a month in before introducing GitHub. I've used for about three projects now so far and I'm going to use it for one more for a group project. I didn't use it initially but probably next semester I will try to introduce it earlier on.

I also have Blackboard so I have not figured out or have not tried to figure out if I can tie GitHub [Classroom] to Blackboard. I know it ties to some LMS systems but I don't know if Blackboard is one of them.

That's very enlightening. Thank you. So you mentioned that you hadn't started using GitHub Classroom until later in the semester…is that because you hadn't introduced Git earlier?

Right, right. So they don't know Git at all. So I had to sacrifice a couple of lectures which I already have. That class is extremely packed with information. It's only the second semester I've taught it so it's a little intimidated by trying to introduce it a little earlier on and getting sidetracked with Git and also have all this other material that's required for them. Now that I've done it one semester, I'm going to handle that differently. I think I'm going to introduce it right at the beginning.

Part of my problem with my university is it's a little embarrassing to admit but my students are visual. They use Visual Studio. And they are so intimidated by the command line that *that* is the struggle. I need a little more time to teach them the command line. I know they can use the GUI but as a software developer, knowing how the GitHub documentation works, it doesn't make sense to teach them the GUI first. I mean learn the command line first and then teach them the GUI. So that's where my challenges all lie. They see a command line and they just freak out. And I was afraid that that was going to sidetrack my entire class. I knew that because when I taught Linux, they saw that and that's how I learned that they have no clue.

[laughter]

No idea how to use it. Which is kind of embarrassing since we're computer scientists.

That's actually very insightful.

Yeah, I'm actually not sure. If I force them to use the command line using a little lab project I had for them to do just something similar like what GitHub has for their training you know like clone a project and then push files to the repository. And that's when I learned that the command line was actually a problem for them. Then I said that after we had done it a couple of times but now that you understand the mechanics and you understand what these commands are then it's your decision if you want to use a GUI. I don't care. It's not like I would know. Then I'm thinking, the other two colleagues I had that require GitHub in their class, they allow the class to just use the GUI. So one uses Eclipse and they just use plugins for Eclipse.

Umm, actually maybe both of them use Eclipse. So they never touch the command line. But wanting a little bit to force them to learn how to do that but it's just a matter of which should go first: command line or GUI? Also, different people have different platforms. So even though our department is a Microsoft department, we use Visual Studio products, there are some people who have Macs, right? So it's completely different if they're using Xcode on a Mac. So I don't want to be tied to feeling responsible for teaching them all the different GUIs so if it's command line, it's the same for everyone.

Yup.

You feel the pain, right? I tell them at the beginning of the semester that the most important trait of a computer programmer is persistence.

[laughter]

Okay, so let's talk about how you've set up GitHub Classroom for this semester. Hopefully you do still remember since it's fairly recent. Can you walk me through the steps of how you set it up for your class?

Yeah. I mean I didn't really do anything sophisticated. I set up a classroom for each section and then I just put the three assignments in there. Maybe it's four … no there's 3 assignments and then there's a test assignment—the lab I told you about. It's just a "learn Git" assignment, not a programming assignment. So I just created those different assignments and then I got the link that GitHub Classroom provides and then I put that on Blackboard and I say "click that link and make sure you accept that assignment". And then from there they can go to their repository and do what they need to do. And then … I guess on this last one I put the due date in. I didn't really think it does much but I did put it in. There's no warning, there's no way to cut them off … those kinds of things. But then I use the Classroom tool to download the repositories. Then I could run the code if I needed to and grade it that way. And then I go to Blackboard and put the grades in. I think that's it. Obviously they would use Git to push to their repositories. I gave them some starter code even if there wasn't much to it. I gave them some anyway. And then obviously they would have to clone their repository and then push all their changes by the due date. And I didn't ask them to use branches or anything like that because I thought they were confused enough.

[laughter]

Now I'm going to encourage them to use branches for their group project because I think it would be useful for them to know that.

They're going to love merge conflicts!

Yeah, they're going to hit merge conflicts.

Anything that you think could be improved about the process of setting things up?

Well, probably my biggest challenge is if I could figure out how to tie to Blackboard. Because I'm having to make that time myself. Maybe something with the due dates? I don't even know

if you could shut those repositories down or that even makes sense. Something like a warning? I don't know. Something to let them know that the due date has passed.

The only other thing is that I would recommend is … it's slightly off-topic but it's something that caused me problems. There was maintenance in the middle of the day. I didn't know what was happening. I didn't get an email. Nothing. This is all free, I know, and I'm not trying to complain but it would have been nice to know in advance because this was in the middle of the day right as I was actually trying to grade. Luckily, I already had downloaded the repositories.

Oh here's another problem I had. Their GitHub ID is whatever they want it to be and there's a classroom ID that's separate. Sometimes I have trouble seeing the tie between those two. Using GitHub Classroom, I could view the repository, that's the only way I could find out which repository ties to which GitHub ID. Which student ties to which GitHub ID. It might be nice if when I download it if there's something that told me. I don't have an answer off the top of my head but that has caused me confusion.

That makes sense. It would make grading a lot easier if you could correlate.

Right! If I knew who was @blacklabcoder then I could put the right grade in.

Great! Now I'm going to share a prototype with you. I'm going to share a link in the chat. This is just a prototype, it's not fully functional. You can click on it but you can't type anything into it. And the idea here is let's say you are preparing GitHub Classroom for an upcoming semester. And you are going to be setting it up again for the similar class for different sections. And when you log in, this is what you see.

Okay.

If you don't mind actually at this point, could you hit the "Share" button at the bottom of the screen.

[looks for the Share button] Okay.

Great. Again, let's pretend this is your classroom although I guess in your case you would have four of these because you have four sections?

Yeah I'm only doing it one class though so two right now.

Ah, okay. So let's say you are setting up your classroom for the new semester. Walk me through how you might do that.

Set up a new classroom? Is this going to work? [points to the dropdown options] Will I find my organization? [Participant tries to find their existing organization]

Sort of. You're not able to type…

[laughs] I don't think it's letting me type. So just create a new classroom? [Clicks button] Okay.

Alright now create your first individual assignment. I probably won't set up my students until the class is just about to get started. So I would create my assignment. Umm I don't type

anything in here. Create an individual assignment. Then I would copy that invitation link and put that in Blackboard. And that'd be it, I guess, right?

Let's see what else do we have? What else is in here. I might add a deadline. But I can't click. Yeah! Looks pretty straightforward. Then at some point, I'd have to go and put the students in for the class. And I don't see where that is now. [clicks on the breadcrumb] Go back here. [clicks on Students tab and clicks on button to add students.] I don't think my LMS is supported. Blackboard. [Doesn't see Blackboard listed among LMS options.] So what I normally do is get a csv for Blackboard and put it here. And that's it. Right?

I think so. Is there anything else that you do with do with your classroom that you're not able to find here?

Umm…I don't so. I think I usually just write the assignments. I usually just import from a repository, right? And I'm assuming that was an option in there. I couldn't type in. I always use a starter repository. And I haven't used a template repository so I don't actually know what that is. I just work from a repository that I already have. Then set up the link in Blackboard. And that's pretty much what I do. [wrap up]

Session 2 de-brief

- What surprised you
    - Participant set up GitHub Classroom mid-semester. (Didn't introduce Git to the class until a few weeks into the semester.)
    - Despite undergoing the Campus Advisors program after searching for resources on how to teach GitHub, still "don't know if I'm using it right or using all the features but I am using it".
    -
- What was something new you learned that you didn't know before
    - Has colleagues who use GitHub alone without GitHub Classroom for their class.
    - Still determining which class and when to introduce students to Git/version control/command-line during the semester
    - Still uses non-template repos for starter code
    - Participant was able to walk through their typical classroom setup and navigate using the IA presented in the prototype.
- What did you find that reinforced what you've already known
    - Teach git via command line vs GUI
    - Sets up classroom curriculum/assignments weeks in advance but waits until closer to the beginning of the semester to add students
    -
- Memorable quote(s)
    - "Why should I use GitHub Classroom? What's the advantage?" because my colleagues are using just GitHub."

- “The only other thing is that I would recommend is … it’s slightly off-topic but it’s something that caused me problems. There was maintenance in the middle of the day. I didn’t know what was happening. I didn’t get an email. Nothing.”
- “Their GitHub ID is whatever they want it to be and there’s a classroom ID that’s separate. Sometimes I have trouble seeing the tie between those two. Using GitHub Classroom, I could view the repository, that’s the only way I could find out which repository ties to which GitHub ID. Which student ties to which GitHub ID. It might be nice if when I download it if there’s something that told me.”
- “Alright now create your first individual assignment. I probably won’t set up my students until the class is just about to get started.”

Additional notes:

Session 3 notes

[intro]

Tell me a little bit about how you got started teaching?

Oh, so I started teaching in 2012. I got my Master’s in 2009 and that kind of segwayed and opened the door. I started teaching at—well, the school’s not open anymore—but it’s called ITT Tech. And I transitioned from there. Well, it was a part-time opportunity for me because I had a full-time IT job. I taught at ITT Tech and then I developed my style. And from there I moved to Durham Technical College where I got more feelings. And then, I went back to school again and got my PhD and then taught at E-line (?) University and also taught at UNCG and now also teach at North Carolina Central. So, it wasn’t all at one time but this is all over a time span teaching. I began to use GitHub [starts coughing…unintelligible]

Excuse me. I’m going to go get some water.

Go ahead! I’ll do the same.

Teaching different technical courses. Because ITT Tech wasn’t specifically just CS, it was information technology and also teaching at a community college was more like introducing users to the Microsoft Suite. But each opportunity led to a different type of interaction with technology of course which I got to E-line … the four-year institutions it was pure CS courses but it was a good gauge and eye-opener of where we are as a society and the needs. Because even though Computer Science is booming, there are still some people who aren’t sure how to use the Microsoft Suite. That’s a thing as well. It’s been over a time period but what I realized while teaching part-time was that I really enjoyed it. So I knew that when I went to get my PhD I wanted it to be a full time thing because it just merged both of my passions. I love tech and I also love people. And so I feel that I get to engage in both of those passions. And I also do

research which I love—like what you're doing. See what's working, what's not working. Write a paper about it to help other people learn from your mistakes. Or also empower them from the things that you're doing right. It's the best of both worlds, I feel.

I feel you! Fantastic. So you're not a stranger to what I'm doing. You mentioned that you also started picking up GitHub. Was that while you were teaching or while you were doing software development?

So how I got started with GitHub is while I was a PhD student, we were lucky enough to have one of the GitHub Campus Experts. And so I had started on the Campus Expert Program. However, being a PhD student, I didn't really have time to finish it unfortunately so I kind of left it there for a little bit. Then when I began teaching Data Structures, I saw that as an opportunity to "Hey, maybe I can introduce GitHub to my classroom" and get the students acclimated. And that's when I found out that there was a Campus Advisor Program. I didn't even know that there was a program for faculty or teachers. But I reached back out to the gentleman whose name was Chris ---, he's graduated since then, but I reached out to him. Like I said, he was a Campus Expert. There was two in the state of North Carolina—one in NC State and one in North Carolina A&T State University. I reached out to him and he was a TA for like an introduction to programming. So I reached out to him and like "Hey, how can I make this impactful and useful in my classroom?" So number one, engage my students and also give them an opportunity to show their portfolio to employers so, you know, maximize the opportunity for both my students and myself. And the thing about it is I kind of got into this like the second or third week of class. So I was new to all this. I was like "How can I do this without like—what's the word I want to use here—just kind of upsetting them because students get used to a certain structure. I wish I had known about the Campus Advisor Program prior to the semester starting. But I felt that they were still early enough where I could implement it.

So I talked to them about that and I went home over the weekend and did the Campus Advisor Program umm [laughs] because it doesn't take that long to do—at least for someone who is technical, it doesn't take that long at all. I applied for the swag for the students. I started with something really simple. I know they thought it was elementary but many of them still had trouble doing it. My first assignment with them was I wanted them to make their own octocat. And I wanted them to create their own repository. Create their own octocat. And basically create their own README file. And send me a message through there.

That was the first. And I know that sounds very elementary but many of them could not do it to be honest with you. Because, to be honest with you, if you don't spell every single thing out … one thing that I learned with my students—the difference between myself and my students—I'm the kind of learner, I'm a true nerd. If someone gives me something, even if they don't give me all the steps, I have a natural inclination and inquisitiveness where I'm going to go out and figure it out. Because I view it as a challenge.

But as I'm learning, everyone doesn't learn that way. Sometimes it makes students feel defeated. You have to give a happy medium. You don't want to spoon feed students. But you also want them to…you want them to have their own interests, especially if it's their major. Have their own interests and researching and solving problems whether they're a software engineer or if they choose information technology, someone's not always going to have the

answers outlined for them. And they will have to do a little bit of self research and that's a normal process that each one of us do in our daily lives. We don't know everything so we go to Google and figure it out. I know I'm preaching to the choir but just to give you some context.

No, no I hear you. I do hear different stories although you are the second one who's told me that they introduced GitHub as part of Data Structures so there seems to be a pattern there.

Now that totally makes sense for GitHub, how did GitHub Classroom enter the picture?

Oh so what I did was I was teaching at two different universities at the time UNCG and North Carolina State and both of them use different learning management systems. UNC uses Canvas and A&T uses Blackboard. And I want to put a plug out there, it would be great if there was integration between GitHub and the learning management tool. So what I did was like in Canvas and Blackboard when I created the assignment, in GitHub Classroom they give you a link and basically when I create the assignment, I put the link in there. From there, the students can go and click on the link and then they would have to accept the assignment.

One negative thing that I have to say is that sometimes when a student would go to accept the assignment what happens is GitHub automatically creates a repository for them to begin their work but a lot of times that screen would get stalled. It wouldn't completely process like it's supposed to so many of them just sat there on the screen. They were like "Dr. D--, it doesn't work. Why did you ask me to do this?" And I had to tell them "It actually did work. Check your email". Sometimes the email would be there "we finished your repo" but the screen itself was stalled.

I think one negative feedback that I got from doing it that way was again if there could be an integration piece because I am using two different systems to basically capture number one their grades in one system and they would have their assignment in another system. So I think that was a little frustrating to the students.

And I understand that. I wanted them to see this more of … If you would like to be a software engineer and if you're working on teams this is kind of the process of how you'd collaborate and work with other people but I respect their need to know their grade and also many of them never got used to it like "Did you see my assignment?". That was interesting because my thing was "Did *you* see it?". If you get in your repo that means that *I* can see it. So, umm, that was also a thing too. It was a lot of, I guess, misunderstanding. It wasn't for all of the students. It was just for a small few. They would ask me the same questions each time "Can you see my assignment? Did it show up for you?" But I kept explaining to them actually you can see the running log. GitHub is a system like any other technical system where it logs every single thing that was done. Every time you push, pull, whatever you do, it is documented. So I can see everything that you're doing. I felt that it was a security measure for me. I could stop some of them from saying "Oh, I submitted the wrong file." Everybody is guilty of turning in something late or whatever the case might be.

And then another thing, although I think this was a boo boo on my end, sometimes when I would select the time, I think it was done in military time? The assignments, I think, I was just trying to set it at midnight and so when the students would submit something and I would pull

it up in the Classroom there was no checkmark beside my assignment but I turned it in. So that was something that was like "Oh ok, I just need to select the next day." So those are just small tweaks. No biggie.

I see. This is fantastic. Now, how long have you been using GitHub Classroom?

So I started to use it in January of this year. I used it for a Data Structures course and I also used it for a Web Programming course. And I also tried to create group work for them so they could work together collaboratively to truly see the power basically that GitHub has in working with other people. I think that for myself my expectations were just a little bit too high. I think that what I should have done in hindsight was just introduce them to GitHub and get them in the habit of using it. Get them in the flow. And then if I had them for a second course, if I had them for Advanced Data Structures, then I could introduce how to collaborate with other people.

I think that my expectations were too high because there's such a learning curve in the classroom. You have students who are ready for that and then you have students who are still new to CS and I respect that. So in hindsight, I should have been more [audio drops] and since then again I'm learning too as an instructor. This is my first time teaching this particular course and you know I just made a bad assumption. I just assumed everybody was excited like me and I forgot the undergraduate experience. It is not only the time for them to become scholars, it is also a time for them to develop as individuals. And I recognize there's a lot going on on campus. So I think if I can do that again, I would break it up in parts to get people—especially newbies—a foot in the door and kind of slowly build them up to it.

And I think it would be even better honestly you can't make this doable per se but like in my department, if I stayed at UNCG or A&T, what I would have done was to try and get all the other instructors who were teaching all the programming classes to get on the same page. So then it could be universally used in each classroom and then it's not like I'm making them do extra work or that they're feeling like it's extra work because then everybody is using the same system. I think that would have also helped because again some of the students saw it as "you're making me do extra work".

But the university I'm in now, I'll be here for a while so I'll definitely will pitch that to say "hey for all the programming classes I think this is a great way we can do it" and I'll teach all the other instructors the process and we can cultivate that together. I think that's one thing that can make the process seamless. I don't know if that makes sense.

It does. It completely makes sense. Now since you had fairly recently started using GitHub Classroom, do you remember how you set it up for the semester? I'm mostly curious because you are teaching a couple of classes. Is it just one section?

No, it's multiple sections. And then there's one thing that I didn't do but I wanted to but I felt like I didn't have enough time especially because the semester already started and things were moving very quickly. I saw that some instructors were able to have students' code for it to automatically be graded and I just didn't have the time. And students don't recognize this but we're constantly teaching ourselves too. The software was called Travis and I didn't have time to sit down and look at it.

If I could have incorporated that. I also had a TA by the way who graded all the assignments and that was the reason why I wasn't so stressed out because I had this TA but in the future automation is where it's at. So if I can figure that piece out—how to automate things. And I know that takes a lot on the front end right like knowing all the assignments and finding all of that out that can also help.

But how I set up the courses was, I had multiple sections, I would set it up by section. So if it's Data Structures, I think the university would have 01 or 02 and I would name the course by the semester, by the course name, and by the section to help me keep it separate. You guys later on created a different color code so each class would have a different color code.

One other cool feature would have been—if you're teaching the same class—if there were a copy situation where you can copy a course or merge them into one somehow. I don't know you would do that because you can do that in learning management systems. If you're teaching the same class, you can just copy over the course. That would have been helpful because I was creating the same assignment in each course and I was teaching four courses. Teaching two Data Structures courses, one Web Programming, and then I was teaching another class but I didn't use it in that class. They created GitHub but it was more of a logic course but they still wanted to learn about GitHub. If I could have copied stuff over, that would have made life easier versus creating it manually.

That totally makes. Now do you just have a single organization account for each class or…

Wait a minute, how did I do that? I think I had it by university. Yup. And then under the university, that's the different courses. That's how I structured it. I think that's how I did it. Let me see. I have two UNCGs.

At this point, let me share something really quickly with you. Let's pretend we're at the start of a new semester again. I'm going to share a link. It should appear in the chat. What I'd also love to is if you look at the bottom of your screen, there should be a "Share" button at the bottom of your screen. If you click that that will allow me to see your screen.

Sure.

This is a prototype basically [starts screen sharing but the prototype is rendering very slowly]. There are a lot of visual assets. It's not fully functional but there are some things that are clickable. Let's pretend that—well I already know that your Classroom looks different from this because you have several classrooms—but let's pretend it looks like this and you were preparing to set up your classroom for the next semester. How might you do that? Talk me through it.

Okay. Of course it's been a while. Let me see if I can figure this out. I think I went through this process. If I already have my organization then [points to existing organization] at the time, I was teaching at two different universities so I set it up by which university. But now, moving forward, I would just be at one so I would probably just choose the existing organization. So I

guess I would just choose “existing organization” here. And then, again, I would name the course by the semester because it would be helpful to know, especially if you teach the same class over and over again.

Okay is it going to let me do this?

[tries to type]

Oh, yeah, it doesn’t. The text entry doesn’t work. Only clicking. Sorry! It’s one of the downsides of a prototype.

[clicks button]

I see here that you have the same naming conventions. I did mine the same way. So whatever the course name was, whatever the semester, the only difference here is that I separated it by section. I think that’s helpful only because when you do group pairings, these students can see who is in their class and then also sometimes—you try not to—but sometimes, you might be a little ahead in one class. Again, it’s so vast—the classroom—not everybody is on the same page. But I would have done it this way. I love that you could see students. And add my TA in there. And here, I would create my assignment. It’s not going to let me do that [prototype doesn’t accept text entry—ed.]

Now this is a choice, when I met with my Campus Expert about it, public or private, I chose to make them private because I didn’t want… I can’t always stop cheating however, it happens. But for the assignment itself, I think I may have made the assignments public. But that could be an issue too because unfortunately a lot of professors recycle their assignments which is good for the teacher [audio choppy] but students also recycle the solutions. But I think it’s best to make them private if you can. You want them to be honest with you.

I didn’t usually add any starter code. Only a README file in there. And of course with the deadline and all that. And then “Create the assignment”. [clicks button]

From here, this is the link that I would put in the learning management system for the assignment and tell them they could go ahead and get started. But it didn’t have a nice welcome message like that. So I copy that. Put that into the learning management system. But before that, I could also view it and see if the students have accepted the assignment or not which I love. And also I love this too. Everytime the repo was created, I get an email so i would actually know who’s doing stuff at the last minute and one thing I got a lot of was—because they didn’t know that—and so sometimes they would, I but I have been working on it and I would say, “I don’t think you have” because a few hours before the assignment is due, you created your repository. And they would be like “No, no, no but I could see the assignment. I was working on it on my machine.” But really, what I was getting them in the habit of was because there are so many plugins with the IDEs, they could have been working and pushing and pulling or using the GitHub desktop application, using the terminal. Whatever method to continuously work on their project and pushing.

I’m trying to get them to understand again, in software engineering, people want to know that you’re working on that stuff. Just push it up, you can always go back and change it. And some students did very, very well at that. Other students did not. It just takes time. I sat down in

multiple class sessions but some people just were totally against it because it wasn't happening in their other classes. They saw me as a barrier versus seeing me as someone who was investing in their success.

One thing I did do at the end was to give them extra credit. It seems that the students who don't need the extra credit are the ones who do the extra credit. But for extra credit at the end, I encouraged everybody to build their own GitHub website to basically showcase their skills as a computer scientist and show what they can do. I talked to them about the markup language and that they can just use the templates that are provided and some HTML and CSS. I gave that as extra credit in the end.

I wanted them to basically show some of their repos there so they can showcase their expertise. And that was really exciting because that gave me an opportunity to see more of their personalities. And the website you can really tell who spent a lot of time and kind of sat down and thought about it versus those who were like I just gotta get something turned in.

It's good to see that I still see some of my students still using GitHub. So that makes me very happy because we follow each other on GitHub so I can see their activity. I can see that some of my students are still really invested in it. That warms my heart. As long as there's at least there's one person who saw the value, then I think that's okay.

[wrap up]

Session 3 de-brief

- What surprised you
    - Teaches several classes full-time at two different schools. Used the same curriculum/assignments for Data Structures at two schools.
    - Had taken both the Campus Expert and Campus Advisory programs.
    -
- What was something new you learned that you didn't know before
    - For the community college, the technology track would start with something as fundamental as learning the Microsoft suite
    -
- What did you find that reinforced what you've already known
    - Teachers often teach several sections of the same class with the same curriculum, assignments.
    - Context switching when using a learning management system and GitHub can be confusing for students and a chore for the teacher.
    - Uses the naming pattern coursename (Data Structures, Web Programming) + semester (i.e., Fa19, Su20) + section number (01, 02…)
    - A number of students didn't see the value of Git/GitHub especially when it wasn't required in their other classes and if they're mostly working alone on their own assignments.
    - TAs handle the grading (transfers the pain point)
    -
- Memorable quote(s)
    - "I sat down in multiple class sessions but some people just were totally against it [Git/GitHub] because it wasn't happening in their other classes. They saw me as a barrier versus weeing me as someone who was investing in their success."
    - "It's good to see that I still see some of my students still using GitHub. So that makes me very happy because we follow each other on GitHub so I can see their activity. I can see that some of my students are still really invested in it."
    -

Additional notes:

Session 4 notes

Participant does not use GitHub Classroom and, as such, does not meet our participant criteria. Moderator opted instead to talk about their use of GitHub in the classroom.

The session was recorded and will be transcribed soon.

Session 4 de-brief

- What surprised you
    - Text goes here
    - Text goes here
    -
- What was something new you learned that you didn't know before
    - Text goes here
    - Text goes here
    -
- What did you find that reinforced what you've already known
    - Text goes here
    - Text goes here
    -
- Memorable quote(s)
    - Text goes here
    - Text goes here
    -

Additional notes:

Session 5 notes

You're a teacher currently?

Yes

Can you give us a brief history of that?

I've been lecturing for 4-5 years at this point. Started as a grad lecturer during grad school because of a huge need in an expanding university. There wasn't enough people, they asked if I could cover software construction. I taught for 4 years, then finished writing my thesis. Because I'd already been teaching, I upped my allocation of teaching. For the last year I've been FT lecturer, but also a researcher.

Tell us a bit about the class you teach.

I've taught three dif courses, but only one uses GH Classroom. Software construction, a combination of soft arch and soft development methods. Tooling, unit testing, flows. Python course doesn't use GitHub. Unit/Linux sysadmin, they write scripts but not a lot of artifacts to be logged.

How did you find GitHub Classroom?

We tried using GitHub for a while before Classroom was GA. We ran into issues with auth boundaries. We want private repos so they don't copy, but when students create their own repos, they have to remember to add the TAs and graders to the repo. Back in the day, they had to have the SDP to get private repos.

You talked about having to add graders. Is that separate from TAs?

We have difference between TAs and graders. Some courses have too much grading for just TAs.

It sounds like you have graders because there's a burden on grading, can you expand?

Graders fill a couple of positions. In CS, we use them in courses that have a lot of courses and a lot of quizzes, often paper quizzes. May have 600-1000 students across 3 classes, and we need at least a few graders to get through that. I have TAs watch labs and exams, and graders look over a large code project. They download the project from GH Classroom, runs the program through a grader. Because I have 200 students submitting 100 projects 3 times in a quarter, there's a number of steps needed to process including pulling out ones that don't compile, one's that have an infinite loop etc. You can either get midterms back in a reasonable time, or assignments, but not both with the # of TAs we have. + We normally have graders who are undergrads.

Are you the one who sets up the class at the beginning of the class?

Yes

How do you do it?

I delete my previous classroom. Well, first I download all the final submissions for the classroom. We do MOSS validation since plagiarism is becoming a bit of an issue. We download to add to MOSS. After that, I delete the Classroom and build a new one attached to the org. I rebuild the labs based on previous issues found. I have noticed one issue with templates, they don't clone recursively. They're supposed to be faster, but it doesn't pull submodules. It's just missing.

Anything else, any other problems?

I've had a lot of students complaining about the process failing. It's hard to recreate since it's not consistent. The other thing I've noticed is that students can enter non URL encoded characters in the team name, and it'll show up in the team listing, but it won't match with the url for cloning, since some characters get stripped. I know there's a new roster feature but I haven't used it.

You said you have a large class, do you know roughly how many?

200 in fall, 100 in spring. I don't differentiate my sections in GH Classroom.

When you set up GH Classroom for a new semester, you delete the classroom, make a new one, walk me through the rest of your steps.

I send out an invitation link as part of the first lab, it's an intro to Git. They create a GitHub account, accept the link, then perform the lab. It just uses their commit, but we have another one using PRs. For the other assignments, I have templates already. Some individual, some group assignment. Because we have them develop continuously on the repo, we use annotated tags to pull the right version for grading. There's no checkpointing but tags so we use that so students can continue after submission.

Let me pause, I'd love to hoping to release some improvements to Classroom. I will be sharing. This is a clickable non-functional prototype. There are some parts where some things aren't actionable. But let me set the stage here. Let's pretend you're starting to prepare for your winter class, so it sounds like you'll probably start by going back to your GH Classroom, let's say you just finished deleting your former classroom, and you signed in. Pretend the prototype is what the dashboard looks like. Would you mind sharing your screen?

<Screen share didn't work D: D: D:>

Maybe you can describe what you're doing? How you would set up your new classroom, pretending the prototype is the new classroom

We have a cs100 org where all the re-used repos are tied to. You can only have one Classroom per org. Once I've deleted the old one, I'd make a new one. I'd select my organization. Which I guess would be an existing one. I'd enter a Classroom name. Then go into assignments, and create an assignment. There's only individual for some reason. Give it a title for lab-1, now

there's prefix which is kind of nice, I'd set it to private, and for starter code, we have template repositories which we use. I'd set that as the starter code. I'd add instructions to the README. I don't use deadlines, we have TAs do validation for that. I do not, ever, grant admin access to students! Which has pros and cons. This would make the new assignment, and then I think I can enable the assignment invitation url, and then send out that URL as assignment one. I think when they accept the assignment, they're added to the org which is how we add the students. Then I do the same thing for the rest of labs and assignments, I do it a week before usually, no specific reason.

Is there anything based on what you see here that you feel seems to be missing?

I'm clicking around… Nothing that's missing that I use currently… I notice they're an archive classroom thing which seems interesting, we have our own version of archive where we save all the old assignments in another GitHub account actually. I use relatively basic features, the features that I would be interested in adding are not necessarily Classroom based. We connect to LMS, I've never played with it, we use Blackboard, but we do our grading outside of Blackboard anyways. We just have a Google Sheet which makes collaborating easy. It's easy to do formulas. We use gradescope. The TAs check them off. There's a couple of assignments and homework, the graders grade, I push them out when they're done. We would love to get autograding for the assignment, and there's now a few options, but a lot of them are expensive and/or hard to build and/or hard to maintain. GitHub Actions is one thing that might actually make it reasonable, we can keep it on GitHub, grade based on submissions, we want people to learn VCS, since everyone uses Git, we should use it. And we do testing, so if we can bundle it all together with CI. I'd love to build full autograding. We have an autograder, but I don't feel comfortable giving it full control over student grades. Since they don't have access, I feel uncomfortable letting it have full control. But if we could have it run every time they pushed, they could iterate and solve their issues and figure out how to fix them.

Anything else on your wishlist?

One thing that'd make me use LMS integration, if I could have students put in their own course information. If they could put in their name and student ID, I wouldn't have to deal with it. The roster is new and I haven't used it, but I'd guess it sends an email out, or I'd have to know their GitHub username. We used to send out a Google form to associate logins to names, but it was a lot of information to deal with. We use a names.txt file in the submissions, and the autograder figures out who the repo belongs to. One issue with gradescope, my course has a lot of transfers and international students. The email they're given on the roster is typically not one they have access to. I have to go in manually and fix it. If they could manually enter their email, that'd be great.

It'd be really nice to be able to associate grades with assignment submissions.

[wrap-up]

Session 5 de-brief

- What surprised you
    - There are graders who fill a specific role in addition to TAs
    - Was under the impression that you could only have one classroom associated with an organization.
    - The student roster function isn't known / well understood
- What was something new you learned that you didn't know before
    - Does a manual "archiving" of past classroom by downloading all the repos and moving the past semester's classroom to another organization, then deletes the the classroom before creating a new one.
    - Doesn't separate sections in GitHub Classroom
    -
- What did you find that reinforced what you've already known
    - Need better cross-promotion of benefits and services available to faculty
    - Grading for large classes is hard to manage
    -
- Memorable quote(s)
    - "Graders fill a couple of positions. In CS, we use them in courses that have a lot of courses and a lot of quizzes, often paper quizzes. May have 600-1000 students across 3 classes, and we need at least a few graders to get through that. I have TAs watch labs and exams, and graders look over a large code project."
    - "I delete my previous classroom. Well, first I download all the final submissions for the classroom. We do MOSS validation since plagiarism is becoming a bit of an issue. We download to add to MOSS. After that, I delete the Classroom and build a new one attached to the org. I rebuild the labs based on previous issues found. I have noticed one issue with templates, they don't clone recursively. They're supposed to be faster, but it doesn't pull submodules. It's just missing."
    - "One thing that'd make me use LMS integration, if I could have students put in their own course information. If they could put in their name and student ID, I wouldn't have to deal with it. The roster is new and I haven't used it, but I'd guess it sends an email out, or I'd have to know their GitHub username … It'd be really nice to be able to associate grades with assignment submissions."
    - Text goes here

Additional notes:

Appendix

Video recording

Recordings for research sessions are automatically deleted 30 days after the creation date.

1. Session 1
2. Session 2
3. Session 3
4. Session 4
5. Session 5

Analysis

Methodology

- Recruited through @ericdrosado where most respondents had completed the GitHub Campus Advisors program
- Conducted remote usability sessions
- Approach was a mix of open-ended interviews and task-based usability testing with a clickable prototype
- User task: How might you set up your classroom for a new semester

Recruiting participants

- Participants had varying experience levels with GitHub Classroom:
    - 1: no experience
    - 2: < 1 year
    - 2: > 1 year
- Taught high school, college, graduate
- Course loads:
    - One class with 40 students
    - Two classes, one with 3 sections and 30 students in each section
    - Teaches several sections of one class at two different universities
    - Teaches 2 courses; 100-200 students per course
- Based on their past behaviors, two of the participants tend to align with the persona of Lisa, one with Eric, and one who was part Eric, part Lisa
- Sample bias due to Campus Advisor training

Findings

Information architecture (IA)

Current users had no problems re-orienting and setting up their classroom with the new IA.

All current users were able to replicate their workflow for setting up a new class. None of the participants we observed were stalled or sidetracked by steps they didn't need or had to defer. Those who considered setting up additional tasks were able to find and navigate to them intuitively.

- "Well, I guess I would click new classroom? Ah, but beforehand, I would create this new organization. Ah, maybe…this is new right? [Selects 'create a new organization' from

the dropdown]. Okay, this is nice! Set up a new organization for the class as I said before."
- "Alright now create your first individual assignment. I probably won't set up my students until the class is just about to get started. So I would create my assignment … Create an individual assignment. Then I would copy that invitation link and put that in Blackboard. And that'd be it, I guess, right? Let's see what else do we have? What else is in here. I might add a deadline … Looks pretty straightforward."

One even discovered a feature on the prototype that is currently available but hadn't noticed with the existing UI.

- "I'm clicking around … Nothing that's missing that I use currently … I notice they're an archive classroom thing which seems interesting, we have our own version of archive where we save all the old assignments in another GitHub account actually."

Insights on grading

Fundamentally, grading code has two tightly-coupled parts: (1) Whether it runs as expected and how many points it's worth (2) Providing a timely, tight feedback loop to help students learn and improve.

- "There are too many repositories to go to each one individually. [Note: class size is 40] To each script and comment. I know it is possible to give feedback—per line even—but it is just too much work so we decided to just download the repositories and see if it works and we gave out grades outside of any GitHub feedback loop."
- "We have an autograder, but I don't feel comfortable giving it full control over student grades … But if we could have it run every time they pushed, they could iterate and solve their issues and figure out how to fix them."

Several actors and tools are likely involved in grading and providing feedback.

- It's fairly common for grading to be relegated to TAs.
- Managing assignments is especially burdensome for those who have very large class sizes.
    - **One university has graders (in addition to TAs) who manage the task of grading. They also use grading software, Gradescope, which uses ML to analyze the assignments, identify clusters for easier bulk-grading, provide student feedback, and surface insights through analytics.**
      "Some courses have too much grading for just TAs. Graders fill a couple of positions. In CS, we use them in courses that have a lot of courses and a lot of quizzes, often paper quizzes. May have 600-1000 students across 3 classes, and we need at least a few graders to get through that. I have TAs watch labs and exams, and graders look over a large code project. They download the project from GH Classroom, runs the program through a grader. Because I have

200 students submitting 100 projects 3 times in a quarter, there's a number of steps needed to process including pulling out ones that don't compile, one's that have an infinite loop etc. You can either get midterms back in a reasonable time, or assignments, but not both with the # of TAs we have. + We normally have graders who are undergrads."

- Grading involves a patchwork of several tools and processes
    - "We use Blackboard, but we do our grading outside of Blackboard anyways. We just have a Google Sheet which makes collaborating easy. It's easy to do formulas. We use Gradescope. The TAs check them off. There's a couple of assignments and homework, the graders grade, I push them out when they're done. We would love to get autograding for the assignment, and there's now a few options, but a lot of them are expensive and/or hard to build and/or hard to maintain."
    - "Because we have them develop continuously on the repo, we use annotated tags to pull the right version for grading. There's no checkpointing but we use tags so that students can continue after submission."
    - "I think one negative feedback that I got from doing it that way was again if there could be an integration piece because I am using two different systems to basically capture number one their grades in one system and they would have their assignment in another system. So I think that was a little frustrating to the students. "

Many rely on Classroom Assistant for grading but it has problems.

- "Their GitHub ID is whatever they want it to be and there's a classroom ID that's separate. Sometimes I have trouble seeing the tie between those two. Using GitHub Classroom, I could view the repository, that's the only way I could find out which repository ties to which GitHub ID. Which student ties to which GitHub ID. It might be nice if when I download it if there's something that told me. I don't have an answer off the top of my head but that has caused me confusion."
- "Also maybe a small obstacle right now is Classroom Assistant doesn't run very well on Linux. So maybe someone should work on that."
- "So if you use this classroom assistant software it can download all of the repositories but it's mostly for archiving as far as I can see that but it would be better if it would have something similar for grading. That you download all the repositories and you are able to push back to them."
- "I found some guy who developed some scripts. For example, one of them is downloading the timestamps of the latest submission. That was really nice. For example if we had a deadline, did the students just push 5 minutes before the deadline or did they continually work on the repository? And there was some guy who provided some scripts for that. I don't know his name or repository but there are scripts out there that ease teaching beyond Classroom."

A few have raised concerns about cheating.

- “We do MOSS validation since plagiarism is becoming a bit of an issue. We download to add to MOSS.”
- “I can’t always stop cheating however, it happens. But for the assignment itself, I think I may have made the assignments public. But that could be an issue too because unfortunately a lot of professors recycle their assignments which is good for the teacher [audio choppy] but students also recycle the solutions. But I think it’s best to make them private if you can. You want them to be honest with you.”

Insights for the student experience

Lack of feedback leaves students unsure about system status and what is happening.

- “‘Did you see my assignment?’. That was interesting because my thing was ‘Did *you* see it?’. If you get in your repo that means that I can see it. So, umm, that was also a thing too. It was a lot of, I guess, misunderstanding. It wasn’t for all of the students. It was just for a small few. They would ask me the same questions each time ‘Can you see my assignment? Did it show up for you?’ But I kept explaining to them actually you can see the running log. GitHub is a system like any other technical system where it logs every single thing that was done. Every time you push, pull, whatever you do, it is documented. So I can see everything that you’re doing.”
- “One negative thing that I have to say is that sometimes when a student would go to accept the assignment what happens is GitHub automatically creates a repository for them to begin their work but a lot of times that screen would get stalled. It wouldn’t completely process like it’s supposed to so many of them just sat there on the screen.”

Other product improvements/opportunities

Students continue to experience problems with assignments.

- “I’ve had a lot of students complaining about the process failing. It’s hard to recreate since it’s not consistent. The other thing I’ve noticed is that students can enter non URL encoded characters in the team name, and it’ll show up in the team listing, but it won’t match with the url for cloning, since some characters get stripped.”
- “I have noticed one issue with templates, they don’t clone recursively. They’re supposed to be faster, but it doesn’t pull submodules. It’s just missing.”

Unclear value proposition—even for someone who underwent Campus Advisors training.

- "I had learned about GitHub Classroom during the Campus Advisor training so I posted a question on the forum "Why should I use GitHub Classroom? What's the advantage?" because my colleagues are using just GitHub. And I got several responses saying it was helpful for particularly cloning repositories down to your machine, that you could look at all the code at once if you want to run it. So I just decided that I would be the explorer and I would go out and just use it. And so far it's been going fine but I don't know if I'm using it right or using all the features but I am using it."

Improve how we handle announcements and notifications

- "Maybe something with the due dates? … Something to let them know that the due date has passed."
- "it's slightly off-topic but it's something that caused me problems. There was maintenance in the middle of the day. I didn't know what was happening. I didn't get an email. Nothing. This is all free, I know, and I'm not trying to complain but it would have been nice to know in advance because this was in the middle of the day right as I was actually trying to grade."

Ability to easily duplicate a classroom

Most (if not all) teachers often don't want to start from scratch every time they need to set up a different section of the same class, duplicate an existing class (because they teach the same class at two different universities), or teach the same class for a new semester.

- "I guess I will basically copy the assignments from last semester and maybe tweak it a little bit but I mean it worked quite well."

- **Provide a more helpful default suggested classroom name**
  We've previously observed teachers having to take an extra step to erase the current default classroom name which uses the `organization name + num` pattern and replace it with their preferred naming convention. Based on observation, many teachers often use `coursename + semester + section num` (e.g., Data Structures Fa19 01, Web Programming Sp20 02) as a naming convention for the classrooms—the same pattern used on the prototype.

Fragmented product experience

Once teachers set up assignments, they move from Classroom to Assistant but the experience between the two is fragmented. There's fragmentation between Classroom and dotcom as well.

Better integration / cross-promotion of relevant content from community at large or other Education resources. Improve organization, curation, and discoverability of useful resources.

Improvements for assignment deadlines

When scheduling something for midnight, teacher didn't realize they needed to schedule the deadline for the next day.

- "The assignments, I think, I was just trying to set it at midnight and so when the students would submit something and I would pull it up in the Classroom there was no checkmark beside my assignment but I turned it in. So that was something that was like 'Oh ok, I just need to select the next day.'"

A few would like the ability to prevent students from submitting once the deadline has passed. Notifying students of the deadline would be helpful.

- "I don't even know if you could shut those repositories down or that even makes sense. Something like a warning? I don't know. Something to let them know that the due date has passed."