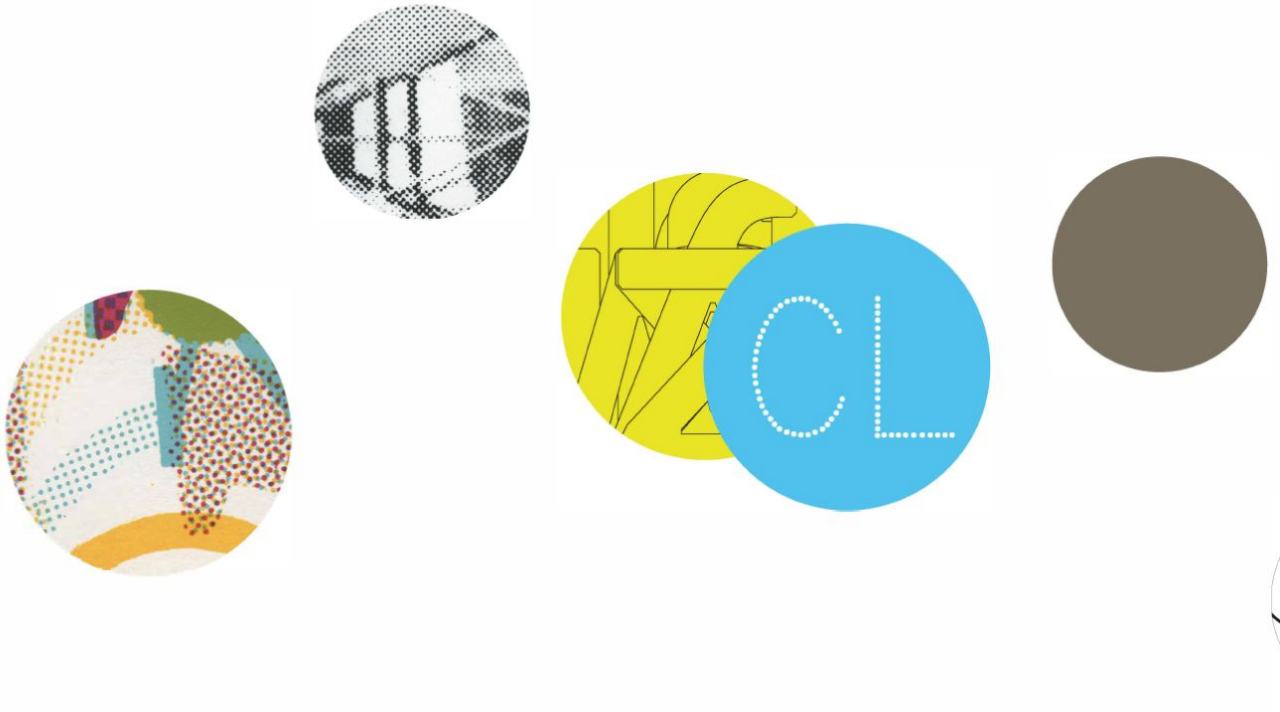

REPORT

AI in Classrooms: Impacts of Merlyn Mind on Teacher Technostress and Time Savings

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June 2022, Phase II Report

UCI

Creativity Labs

Executive Summary

This report serves as an addendum to a previous report submitted to Digital Promise and Merlyn Mind in June 2021. This extension of previous work was commissioned by Digital Promise on behalf of Merlyn Mind to continue examining the impact of Symphony Classroom implementation in response to product developments. Creativity Labs's goal was to design a study that would yield data sufficient to make claims about the following areas of interest identified by Merlyn Mind: A.) How does implementing Symphony Classroom impact teacher stress levels? B.) How does implementing Symphony Classroom impact classroom time expenditures?

Whereas previous research collaboration has focused on design-based aspects of Symphony Classroom implementation, the current collaboration focused on understanding the impact of a successful implementation now that the solution has come to market.

Highlighted findings:

1. On average, Symphony Classroom Users report reduction in technostress (i.e., stress related to technology use) by over 14% after 7 weeks of use.
2. 61% of Symphony Classroom Users report an overall reduction of technostress after 7 weeks of use.
3. Symphony Classroom Users report having significantly more time for teaching and learning than a matched control group ($F(1,36) = 5.67$, $p = .023$) after 7 weeks of use.
4. Symphony Classroom Users report spending significantly less time spent on administrative tasks than a matched control group ($F(1,36) = 4.28$, $p = .046$) after 7 weeks of use.
5. Symphony Classroom integration offers users an opportunity to improve their instructional practices via technology integration, though this improvement is mediated by onboarding, ongoing support, and professional development.
6. Users who experienced difficulties wondered whether the device could understand their accented English. This phenomenon should be explicitly addressed in future implementations to remove barriers to scaled implementation.

Introduction

Introduction

This report serves as an addendum to a previous report submitted to Digital Promise and Merlyn Mind in June of 2021. This extension of previous work was commissioned by Digital Promise on behalf of Merlyn Mind to continue examining the impact of Symphony Classroom, a new AI teacher assistant, implementation in response to product developments. Creativity Labs's goal became to design a study that would yield data sufficient to make claims about areas of interest identified by Merlyn Mind, including the impact of Symphony Classroom on teacher stress levels and classroom time expenditures.

Whereas previous research collaboration focused on design-based aspects of Symphony Classroom implementation, the current collaboration focused on understanding the impact of a successful implementation now that the solution has come to market.

Analytically, we offer the following story of Symphony Classroom's development and the role of Creativity Labs in this collaboration.

Phase One (2020-2021): The primary question guiding this phase of collaboration and research was: Is Symphony Classroom usable in real-world classrooms? The answer, in short, was yes. As detailed in the June 2021 report, implementation at two sites in Orange County, CA provided many learning opportunities with respect to configuration, functionality, and user needs (Peppler & Schindler, 2021).

Phase Two (2021-2022): In this phase, we capitalized on Symphony Classroom's improved functionality, configuration, and response to user needs for onboarding and implementation by designing a traditional quasi-experimental study to compare user perspectives using treatment and control. Merlyn Mind expressed specific interests in understanding the impact of Symphony Classroom on time savings and stress for educators. Toward this end, we undertook a mixed-methods approach to answer the following **research questions:**

RQ1. In what ways do teachers report Symphony Classroom impacting their stress level in the classroom?

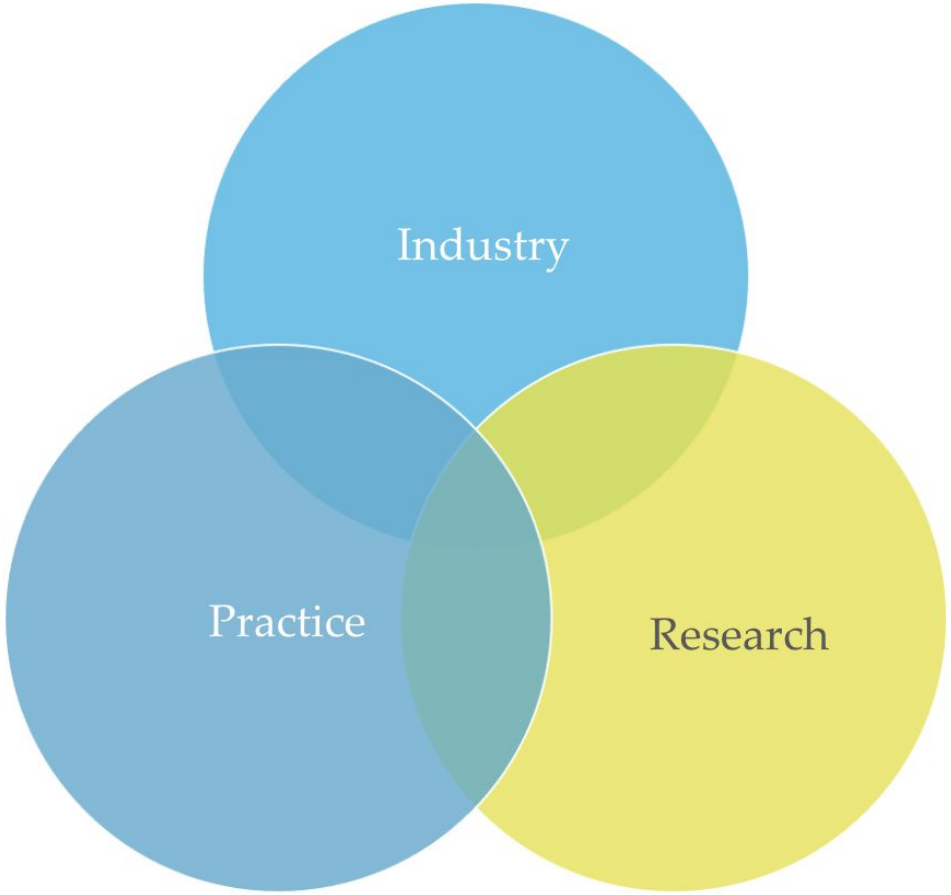
RQ2. In what ways do teachers report Symphony Classroom impacting their perception of time in the classroom?

RQ3. How does Symphony Classroom intervene into existing tech configurations, available tools, and subsequent teaching and learning practices?

Research-Practice-Industry Partnership in Phase 2

Our prior report offered a new model of research, practice, and industry partnerships (RPIPs) and a vision for how they can function as mutually beneficial environments for collaborative solution development (Peppler & Schindler, 2021). As an addendum to that theoretical work, we want to describe how the RPIP model continued to develop through this phase of work.

Whereas the first phase of development required us to co-facilitate most aspects of the initial implementation (e.g., device installation and configuration, onsite user assistance), in this phase, we focused our efforts on design-based research, leaving space for Merlyn Mind to implement sales and customer service company practices, thus simplifying the feedback loop between user and developer. However, just as in other learning environments, the role of the expert facilitator (in this case, the researcher) remains valuable as we continue to facilitate communication across industry and educational practitioners who may struggle to communicate across their different environmental constraints and affordances.



Research-Practice-Industry Partnership Model

Study Design

Study Design

We employed a quasi-experimental approach to make causal claims about effects on perceptions of time savings and stress reduction for users compared to non-users. While most quasi-experimental studies rely on quantitative data, we believe it is important to contextualize quantitative data using qualitative data from interviews and classroom observations.

Research Question	Data Collection Activity	Analysis activities	Deliverable
RQ1. In what ways do teachers report Symphony Classroom impacting their stress level in the classroom?	Survey; interview	Comparative analysis of trends	Addendum Report Section 1: showing trends over implementation Appendix A-1: Technostress subscale Appendix E-F: Pre/Post-Implementation Semi-Structured Interview Protocol
RQ2. In what ways do teachers report Symphony Classroom impacting their perception of time in the classroom?	Survey; interview	Comparative analysis of trends	Addendum Report Section 2: Final Report showing trends over implementation Appendix A-2: Technostress subscale Appendix E-F: Pre/Post-Implementation Semi-Structured Interview Protocol
RQ3. How does Symphony Classroom intervene into existing tech configurations, available tools, and subsequent teaching and learning practices?	Semi-structured observations and interviews with participants	Thematic analysis of patterns of orchestration over time	Throughout Report and Section 3: publishable narratives and interview quotes Appendix E-F: Pre/Post-Implementation Semi-Structured Interview Protocol Bonus: Model for differentiated support for Symphony Classroom usership

Instruments

Instrument Summary

- **Appendix A1: Symphony Classroom Survey- Technostress Subscale**
  - This refers to the first part of the survey instrument, which measures stress related to technology (adapted from Li & Wang, 2021). This instrument was used to measure change in technostress over time.
- **Appendix A2: Symphony Classroom Survey- TALIS Subscale**
  - This refers to the second part of the survey instrument, which measures a range of factors about instructional activity in a target class, including self-reporting of instructional time expenditures. This subscale comes from the TALIS (Teaching and Learning International Survey; OECD, 2018).
- **Appendix B: Symphony Classroom System Usability Scale (SUS)**
  - This refers to the a system usability scale which we have adapted to apply directly to Symphony Classroom. This instrument served as a "temperature check" of user satisfaction with Symphony Classroom as a whole, as well as individual features.
- **Appendix C: Structured Observation Protocol**
  - This refers to a structured observation protocol which was used to systematically describe user activity with technology in the classroom, as well as specific instances of Symphony Classroom use.
- **Appendix D: Pre-implementation Semi-structured Interview Protocol**
  - This refers to the first semi-structured interview protocol, which was administered to users and non-users to gather baseline data before implementing Symphony Classroom.
- **Appendix E: Post-implementation Semi-structured Interview Protocol for Symphony Classroom users**
  - This refers to the second semi-structured interview protocol, which was administered to Symphony classroom users to gather qualitative data on implementation.

Constructing the Main Survey (Appendix A)

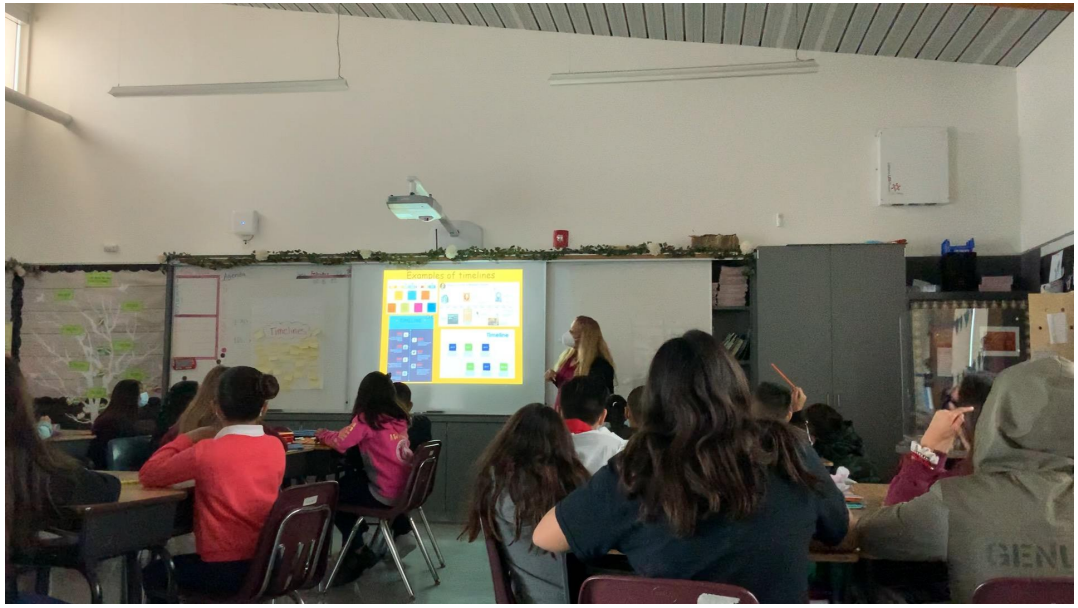
After reviewing many different measures for validated scales to measure time use and stress, we created a series of questionnaires using subscales from validated assessments. The assessments we drew upon and the rationales for these selections are listed below.

Question	Instrument/Scales	Rationale	Validity/Reliability
RQ1. How do teachers report Symphony Classroom impacting their stress level?	Technostress (Appendix A1) Scales Administered: 1. Literacy Facilitation 2. Technical Support Provision 3. Involvement Facilitation 4. Techno-overload 5. Techno-invasion 6. Techno-complexity 7. Techno-insecurity 8. Techno-uncertainty 9. Work performance	• Demonstrating sufficient reliability and validity • Answers the research question by asking about teacher practice with tech and perceived stress related to that practice • Operationalizes the emotional impact of high orchestration load	The measurement model was evaluated for construct reliability, item reliability, convergent validity, and discriminant validity (Hair et al. 2014, 2011). For more, see tables in this article: https://link.springer.com/article/10.1007/s10111-020-00625-0
RQ2. How do teachers report Symphony Classroom impacting their use of classroom time?	Teaching and Learning International Survey (TALIS) 2018 (Appendix A2) Scale administered: • Teaching in the Target Class	• Recommended as best measure of classroom time spent (Camburn & Jones, 2021), with the caveat that classroom time measures remain imprecise • Explicitly asks teachers to estimate time spent on admin, management, and instructional tasks	This instrument demonstrates the following forms of reliability: test-retest and internal. For an extensive rationale speaking to the reliability and validity of the TALIS 2018 teacher questionnaire, see this OECD working paper.

Main Survey: Limitations

Our main survey instrument combines two existing, validated instruments: one which measures technostress and a subscale of the TALIS which uses teacher self-reports to measure the use of instructional time. While validated and reliable, these instruments come with the following caveats:

1) Technostress limitations: The limitation of this instrument is that the construct it measures, technostress, is relatively novel and under development for use in education. Therefore, we use the most currently available validated instrument here, and advise Merlyn Mind to stay on top of the scholarly literature related to this construct.
2) Time Use Limitations: Because the TALIS relies on self-reporting after the fact, we want to stress that these results measure *perceptions* of time use, not actual time spent. After extensive research, we found that measuring actual time spent in the classroom is of current interest to educational survey methodologists, and we advise Merlyn Mind to stay current with methodological developments.



System Usability Scale (SUS) (Appendix B)

To evaluate Symphony Classroom in terms of usability, we turned to the System Usability Scale (SUS)(Brooke, 2013). For in independent evaluation of the System Usability Scale's reliability and validity, see Peres, et. al, 2013). The System Usability Scale measures perceptions of usability using the following items, adapted for Symphony Classroom, on a standard 5-point Likert scale.

SUS Items:

1. I think that I would like to use Symphony Classroom frequently.
2. I found Symphony Classroom unnecessarily complex.
3. I thought Symphony Classroom was easy to use.
4. I think that I would need the support of a technical person to be able to use Symphony Classroom.
5. I found the various functions in Symphony Classroom were well integrated.
6. I thought there was too much inconsistency in Symphony Classroom.
7. I would imagine that most people would learn to use Symphony Classroom very quickly.
8. I found Symphony Classroom very cumbersome to use.
9. I felt very confident using Symphony Classroom.
10. I needed to learn a lot of things before I could get going with Symphony Classroom.

Observation Protocol (Appendix C)

Using ISTE Standards for Technology Integration, we constructed a structured observation protocol, which can be used to evaluate Symphony Classroom use. We administered this protocol during observations at a charter school in southern California (identified here as "CA Charter School"). We share the suggested version, which has been revised over the course of implementation via data collection. The observation protocol encompasses two domains: Classroom Orchestration (see below) and Symphony Classroom use (see page 15).

Domain 1: Classroom Orchestration (w/ or w/o Symphony Classroom)	Beginning	Developing	Proficient	Mature	Qualitative Evidence Examples
1A: Ease of Facilitation/ Orchestration (ISTE Standard 6b Manage the use of technology and student learning strategies in digital platforms, virtual environments, hands-on makerspaces or in the field.)	Facilitation practices heavily disrupt flow of instruction. Teacher does not adapt/recover.	Facilitation practices minimally disrupt flow of instruction. Perhaps teacher is slow to adapt/recover.	Facilitation practices minimally disrupt flow of learning, and pracitioner adapts to maintain quality of student learning.	Facilitation practices do not disrupt flow of learning, but rather enhance it.	Tools don't work as teacher expected; students have to wait while teacher troubleshoots; teacher switches course quickly and easily when tools don't perform as expected. Cite **action** (e.g. teacher tried to do x, it didn't work, and then they...), **sound** (e.g. silent, student off-task talking, student and teacher troubleshoot in whole group), time spent on troubleshooting (minutes/seconds).
1B: Co-orchestrating Tech (ISTE Standard: 4b Collaborate and co-learn with students to discover and use new digital resources and diagnose and troubleshoot technology issues.)	Students and teachers do not facilitate tech tools together.	Students and teachers minimally co-facilitate tech tools, which may or may not lead to productive outcomes.	Students and teachers co-facilitate tech tools, which leads to productive outcomes.	Students and teachers co-facilitate tech tools routinely, which leads to productive outcomes.	Teacher and student may exchange words/gestures to problem-solve technology challenges. Teachers may instruct students to turn their attention elsewhere while they troubleshoot. Teachers may prepare tech tools before the lesson, or they may access them on-the-fly. Teachers and students may ask each other inquiry-based questions regarding the functinality of the device.
1C: Persistence with Tech (ISTE Standard: 6c Create learning opportunities that challenge students to use a design process and computational thinking to innovate and solve problems.)	Teacher encounters terminal problems with technology from which they are unable to recover.	Teacher encounters problems with technology, and gives up attempting to use them.	Teacher encounters problems with technology, and is able to persist in solving them to pursue learning objectives.	Teacher encounters problems with technology, and is able to persist in solving them quickly and seamlessly to pursue learning objectives.	Teacher confronts tech challenges and persists in solving any problems that arise. They may talk to themselves, narrating what their attempts to solve the problem. They may pause, direct students toward other activities, and then return to the original use of tech. They may ask a student to cast their screens, or to attempt to access challenging tools on their machines.

Observation Protocol (Appendix C)

Domain 2 of our structured observation protocol allows observers to evaluate the frequency and manner of Symphony Classroom use. In the future, this tool could be adapted to examine specific tool integrations or patterns of use (e.g., using the remote vs. far-field) via observation.

Domain 2: Symphony Classroom Use	None	Some	Enough	More than Enough	
2A. Frequency of Use (If teacher doesn't use Symphony Classroom because of configuration or device malfunction, mark "N/A" and describe malfunction in qualitative notes section.)	Teacher does not use Symphony Classroom	Teacher uses Symphony Classroom at least once during observation	Teacher uses Symphony Classroom several times throughout the classroom, though it may be clearly new use.	Teacher uses Symphony Classroom seamlessly throughout the observation to aid with a variety of administrative tasks.	*Document the number of times in the qualitative notes section, including a description of the teacher's workflow/workaround/configurations*
2B. Integration with other tech tools (Describe tech tools in qualitative notes section.)	Teacher does not use Symphony Classroom with other tech tools	Teacher attempts to use SC with other tech tools at least once, and may or may not be successful.	Teacher uses SC to manage other tech tools several times.	Teacher routinely uses SC to manage other tech tools, demonstrating mature use.	*Document: the number of times the teacher uses existing tech tools (hardware or software) as well as features of the use experience*

Interview Protocols- Baseline (Appendix D)

We constructed two semi-structured interview protocols, which we administered with participants from CA Charter School. We conducted baseline interviews with all CA Charter participants (n=12). See appendix for full protocol script.

Baseline Interview Items

A. Part One: Background

1) Tell me about yourself. What is your name? Where and what do you teach? How long have you been teaching? How do you like it? b) Walk me through your typical daily schedule. [Possible probes: what do you teach? When do you teach it? To whom?]
2) What made you decide to participate in this study?
3) When you think about your teaching practice, are there any philosophies or theories that guide your work? [If not, what are some guiding beliefs about how students learn best?]
4) Now, I'd like to learn a little more about your teaching practice. What is your favorite lesson to do with students? Why? c) Can you walk me through the components of the lesson? [probes, if they don't specify: Does this happen as a whole group? In small groups? Individual?] d) What technologies do you use in this lesson?[or, It sounds like you use _____ a lot in this lesson.] Why? What do you like about [name of technology] as a teaching tool?

B. Part 2: Attitudes toward Tech Integration- baseline

5) Tell me about a tech tool(s) you use most often in your classroom. What do you like about it?
6) Think back to the first time you used [name of the tool they mentioned in question #5]: I'm wondering about the process you went through to integrate that tool into your practice. For example, how did you find out about the tool? How did you learn to use this technology? What kind of supports (like professional development, for example) were useful?

C. Closing:

7) Is there anything else you want me to know about your teaching practice?

Interview Protocol: Post-Implementation (Appendix E)

We conducted Post-Implementation Interviews with treatment group participants from CA Charter School (n=6). See appendix for full protocol script.

Post-Implementation Interview Items

Part One: Background

1. For the record, remind me of: a)Your name b)What you teach (subjects + grades) c)How long you've been teaching
2. Is there anything you want me to know about you as a teacher that you might have forgotten to mention in our previous interview?

Part Two: Symphony Classroom Use

3. What were your first impressions of Symphony Classroom when you first received the device? a)[Probe: How did it compare to what you expected when you first heard of the device and enrolled in the study?] b)How about your experience of learning to use the device? Do you remember any resources or people being particularly helpful? c)What would you suggest Merlyn Mind do to help teachers learn to use Symphony Classroom?
4. Moving onto after the device was installed, what was it like when you first started using it? i) What do you ask Symphony Classroom to do most often? Why do you think you used that feature the most?ii) What would you say was the hardest part of learning to use Symphony Classroom? iii) How did learning to use Symphony Classroom compare to learning to use other tech tools for your classroom? In what ways was it similar to your previous experiences? In what ways was it different?
5. On average, how often do you use Symphony Classroom when you teach? *If answer = often: Why do you think you use Symphony Classroom so much? What do you like about it? *If answer = less than twice per week/other indication of "not often": What would have to change in order for you to use Symphony Classroom more often?
6. When you think about your experience with Symphony Classroom, what would be some cool features you could imagine? f) Symphony Classroom is early in development, so I'm sure there were times when it didn't function as you'd hoped. Can you talk about any of those times specifically? What were you asking it to do? What happened?
7. What would you tell the Symphony Classroom developers about designing AI for classroom teachers?
8. Would you recommend Symphony Classroom to other teachers? Why or why not?

Part Three: Closing

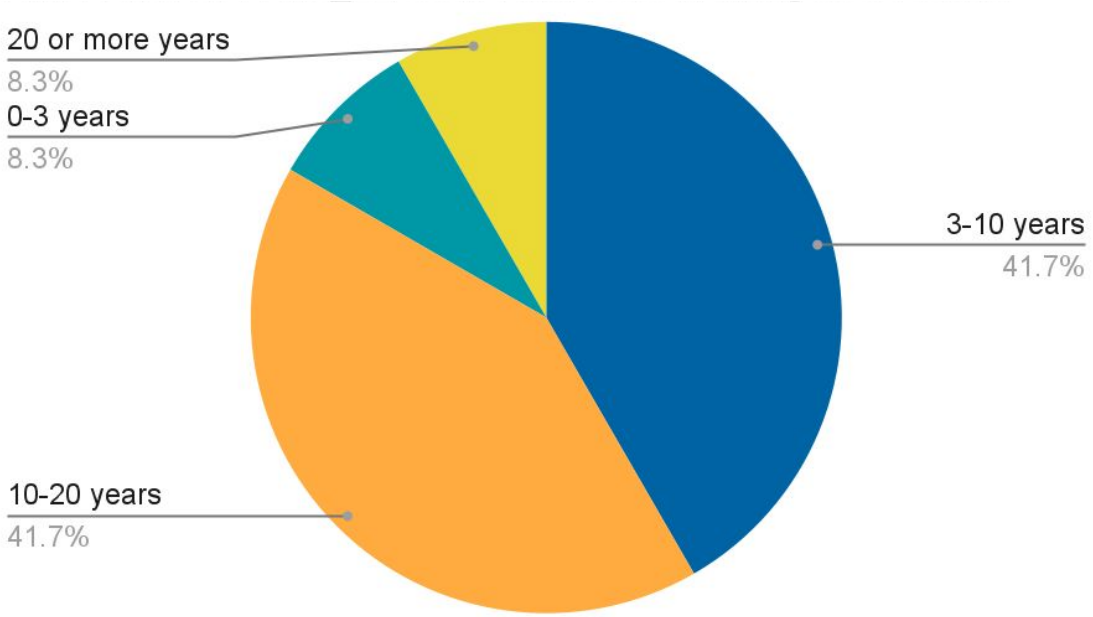
9. Is there anything else you think we should know about Symphony Classroom, or about teaching with technology in general?

Sites and Participants

Site 1:
CA Charter School

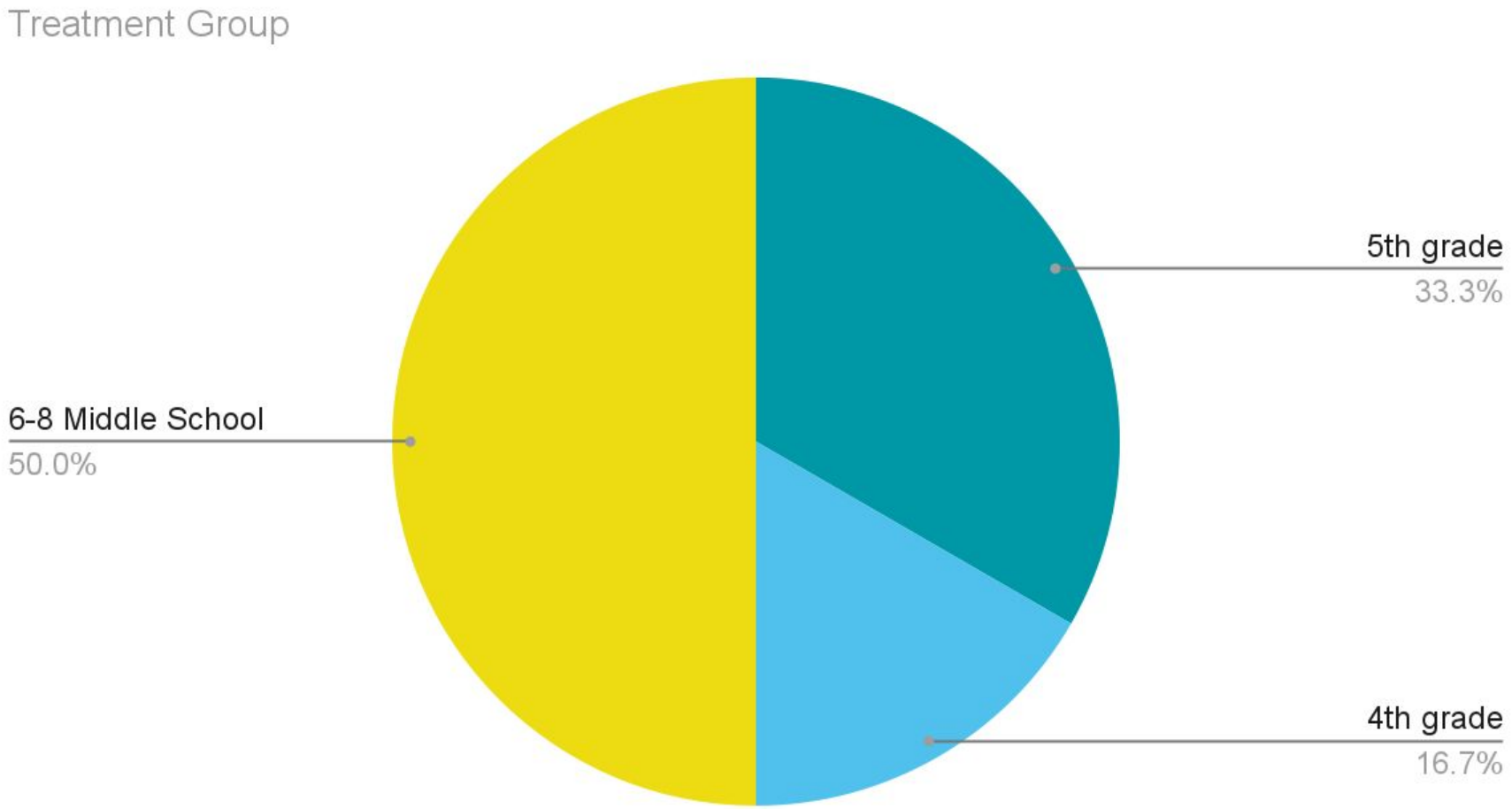
Site 1: CA Charter School

CA Charter School is a charter school located in California. The school is located at a mid-size city with a population of ~310,000 residents according to 2020 census data. Of those residents, 76.8% identify as hispanic or Latinx. We highlight this demographic factor because it mirrors the population of CA Charter School teachers, staff and students (n=12). Over 75% of CA Charter study participants identify as Hispanic or Latinx. Additionally, 58.3% of CA Charter (n =7) participants identify Spanish as their first language. Other first languages represented include English (4/12 participants; 33.3%) and Bengali (1/12 participants; 8.3%). Treatment and control groups were distributed at random (treatment n = 6, control n = 6).



CA Charter Participants (n=6*): A Snapshot

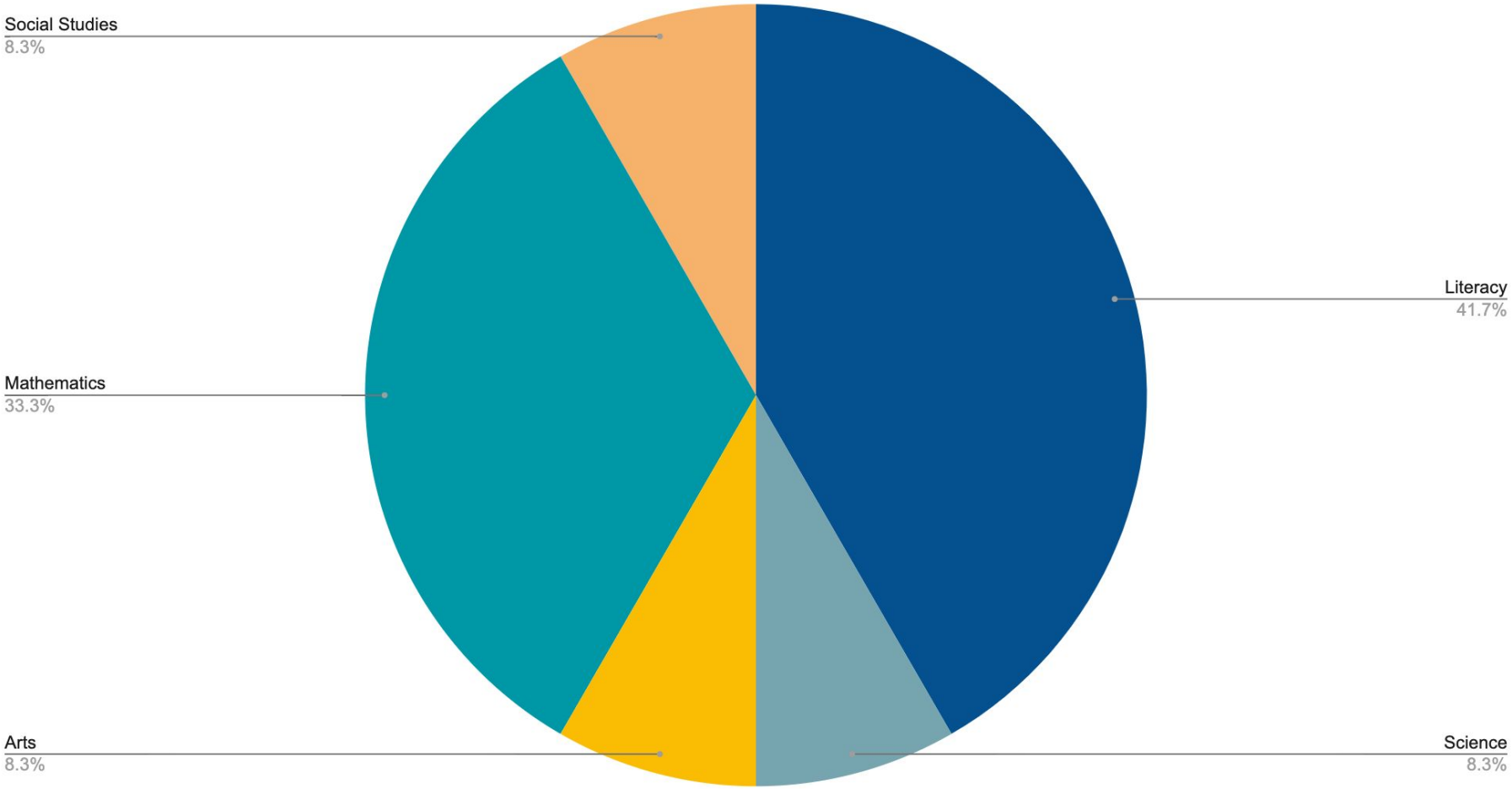
In addition to these demographic factors, the participants from CA Charter School teach in an array of grade levels, 3-8.



*This data only shows the grade assignments of the treatment group at CA Charter due to missing data.

CA Charter Participants (n=12): A Snapshot

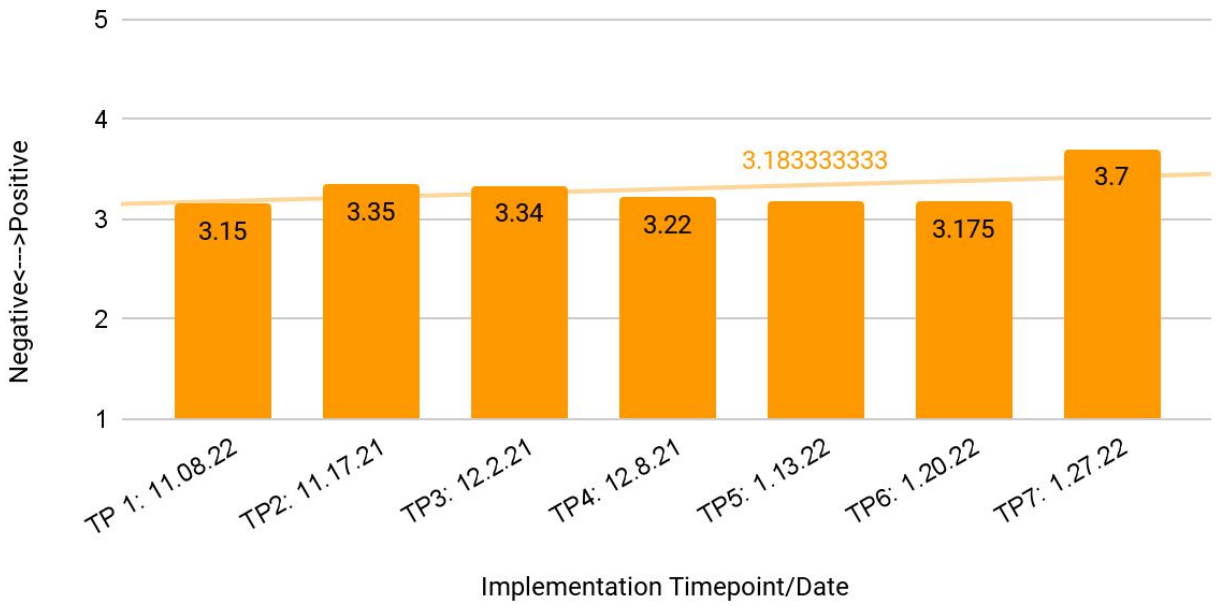
In addition to these demographic factors, the participants from all CA Charter School teach in an array of subject areas:



SUS Profile at CA Charter

Users at CA Charter School reported increasing satisfaction with Symphony Classroom. This may indicate that as users deepen their expertise with using Symphony Classroom, their satisfaction increases. However, these results should not be extrapolated widely, due to the small sample size of the CA Charter treatment group.

Clearly, user perceptions of Symphony Classroom as a solution started and remained high throughout the implementation period, despite limiting contextual factors like an extended holiday break due to the Omicron variant of COVID-19. Note the dip down at the start of the year and during high stress periods.



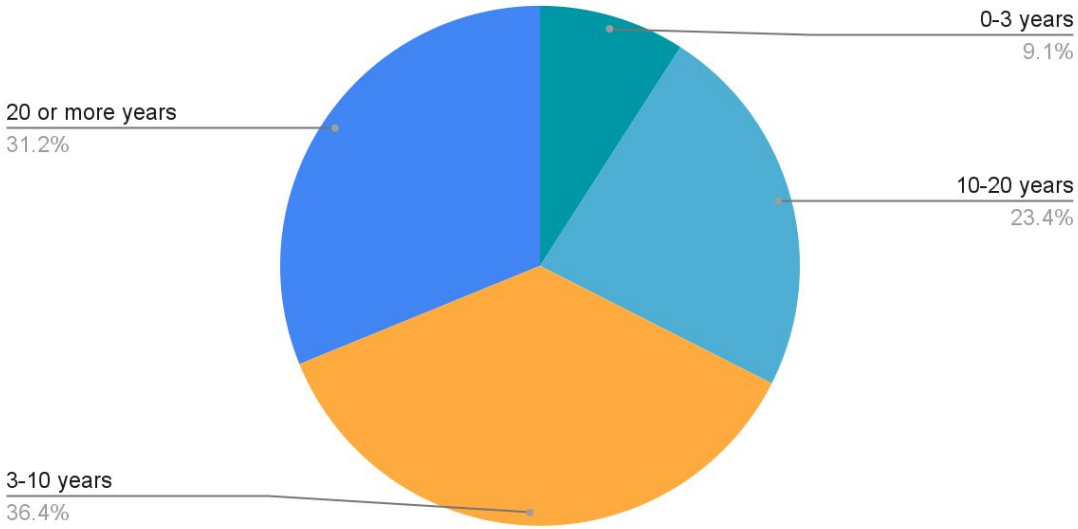
Site 2:
North Carolina (NC) Schools

Site 2: North Carolina (NC) Public School

In contrast to the demographic landscape of California, 98.7% of a NC Public school respondents identified as white and non-Hispanic or Latinx. The 2020 census for NC puts the percentage of white, non-Hispanic citizens at 86.7%, indicating that our sample is whiter than the wider local population.

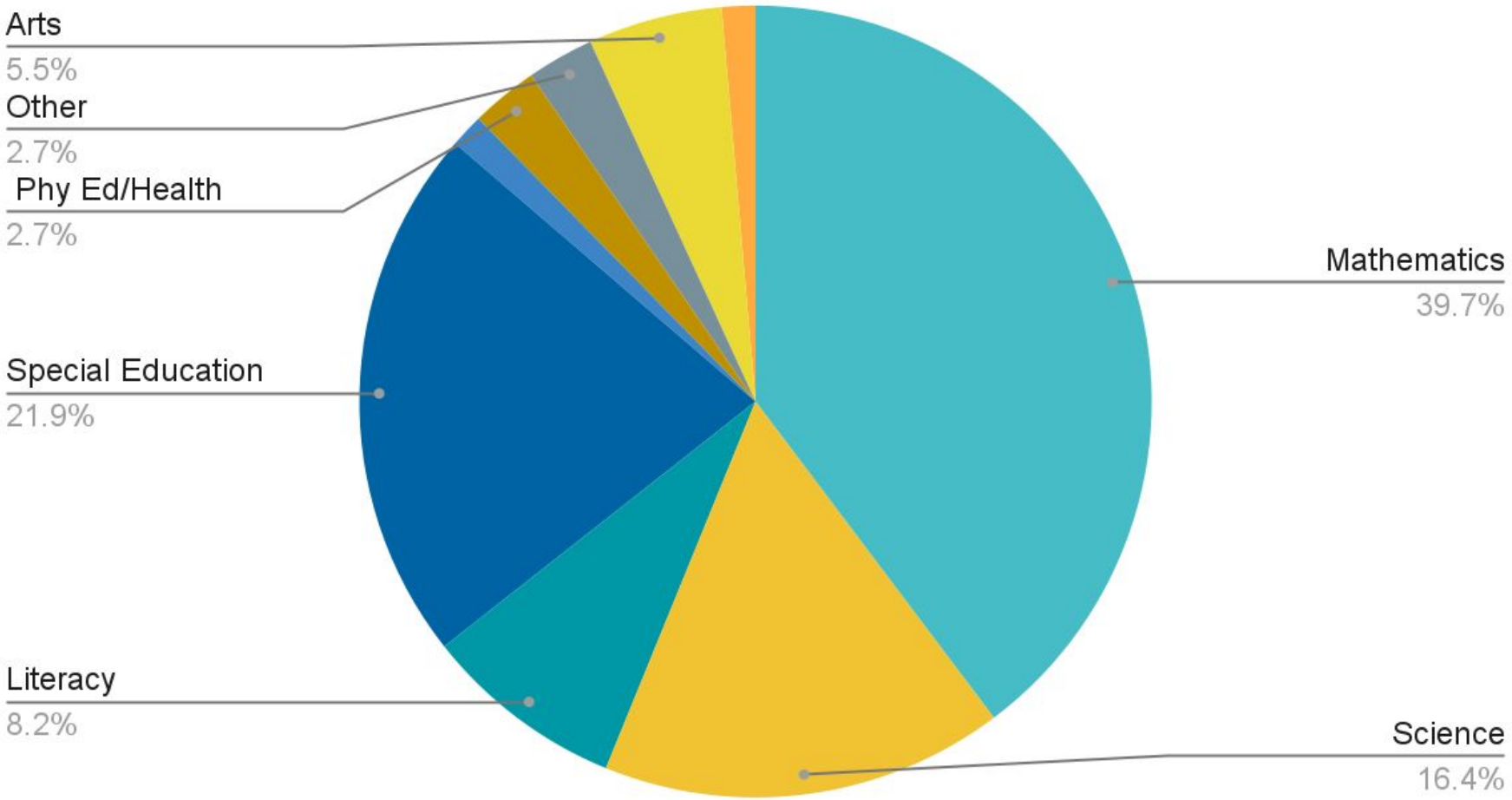
Of particular interest, 100% of respondents from NC identify English as their first language. We highlight this result as it may significantly impact the perception of Symphony Classroom's usability if one speaks accented English.

While the racial and social demographics of the NC sample are relatively homogenous, we see a wide range of diversity when it comes to **subjects years of teaching experience.** The treatment and control groups break down within 5% of one another when it comes to years of teaching experience.



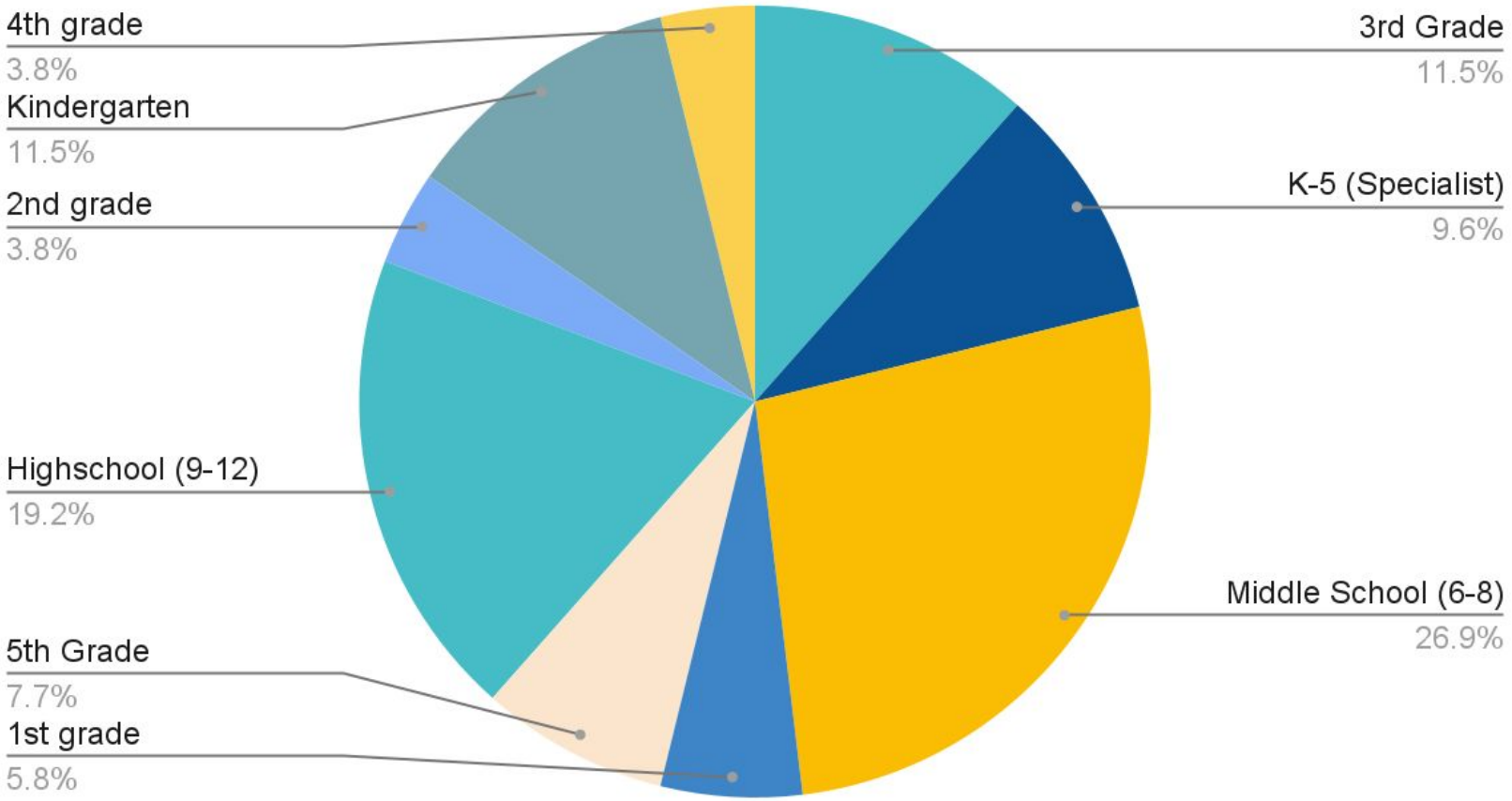
NC Teachers (n=67): A Snapshot

In addition to these demographic characteristics, the NC sample represents a range of subjects taught.



NC Teachers Treatment Group(n=44*): A Snapshot

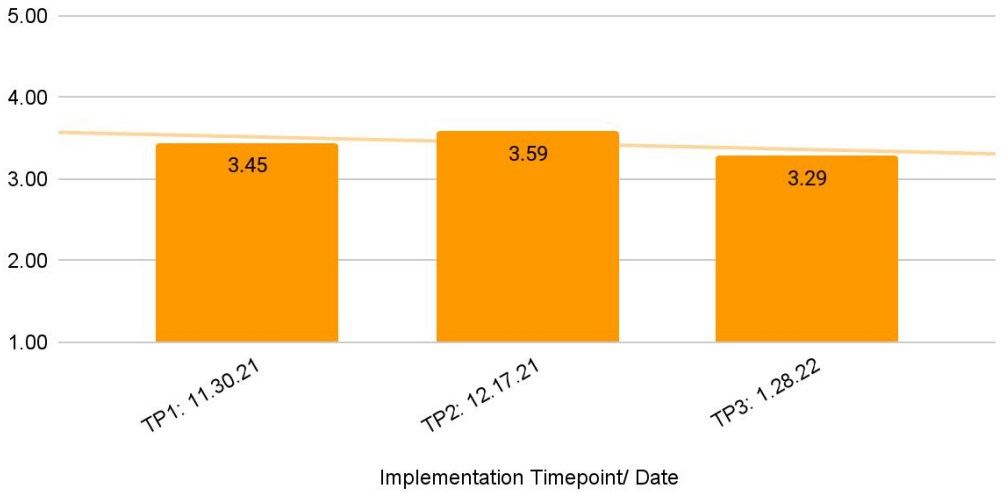
In addition to these demographic characteristics, the NC treatment represents a range of grade levels taught.



*This data only reflects the grade level assignments of the NC treatment group.

SUS Profile at NC Schools

Though the System Usability Scale data for NC Symphony Classroom users shows a slight decline in perceptions of usability over the course of implementation, we want to note that this measure indicates that users report high levels of usability over the course of the seven week implementation window. Additionally, though week six's score is slightly lower, the standard deviation is much lower, indicating that the score is both high enough, and more broadly representative of the group's overall perception.



We offer the following caveats around this data:

1) This data only reflects ~ 7 weeks of implementation. It is possible that initial perceptions of usability would go down simply due to the introduction of a new device.
2) An alternative explanation might lie with complications with administration, which required the UCI team to wait for the NC team to deploy the survey. It's possible that there was simply too much time between the second and third administration.
3) Finally, the contextual reality is that this implementation took place almost in lockstep with a COVID-19 surge in cases due to the Omicron variant. Given this fact, it is positive that the sense of usability didn't decline further amongst users.

RQ1. Overall Technostress Findings at NC Public Schools

Teachers and techno-stress

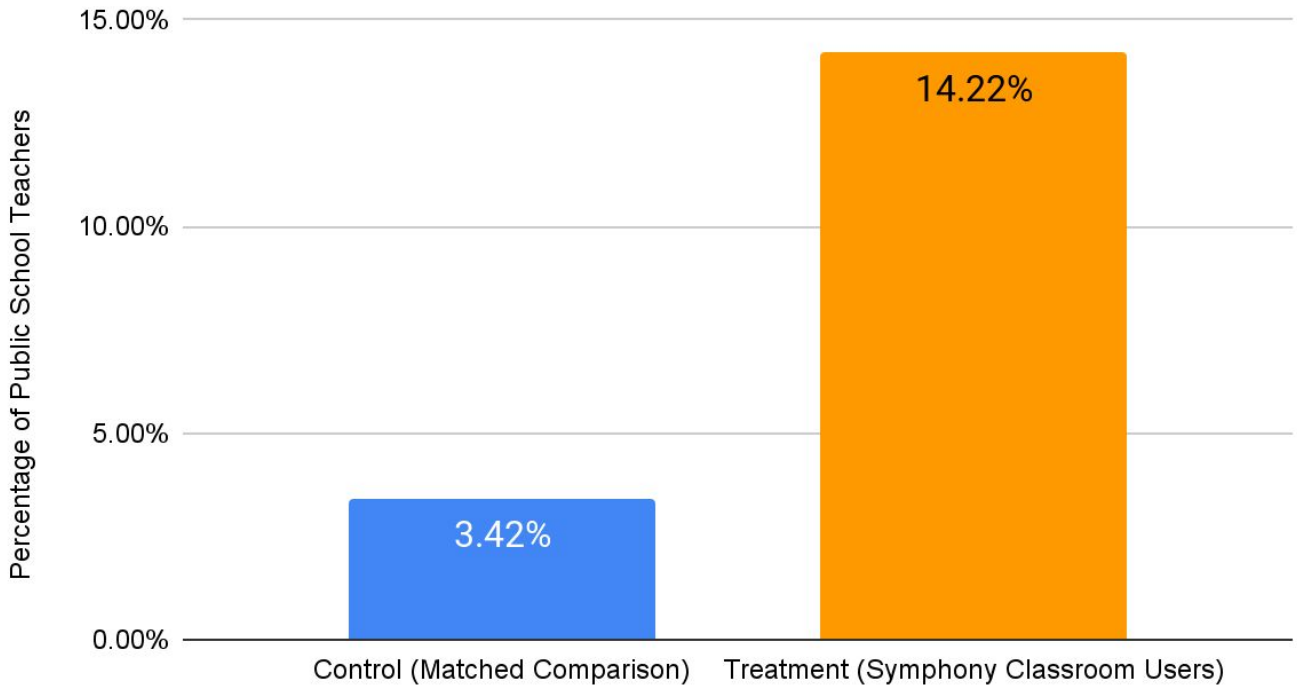
- **Technostress** is a term that has been widely used in industry and government work environments to describe the stress produced by technology tools and processes that are instrumental to job success, productivity, and satisfaction (Brod, 1984). More recently, scholars have begun applying the concept of technostress to teachers, who have experienced large shifts in the use of technology in learning. We chose the technostress instrument (Li & Wang, 2021, 37 items organized into 8 subscales) because it specifically measures stress related to technology use in the workplace, as opposed to other measures of general or other types of stress (e.g., relational stress).
- **Symphony Classroom** acts as a central hub for all technology-enhanced teaching and learning, simplifying classroom orchestration tasks like switching inputs, setting timers, searching Google Drive, controlling videos, etc. Consequently, we hypothesized that Symphony Classroom would reduce technostress by allowing teachers to manage their technology-involved tasks more seamlessly and efficiently.

Suitability of the Technostress Survey

- Overall, the results of this pilot research demonstrate the suitability of the technostress survey for use by Merlyn Mind in future implementations.
- This pilot study demonstrate that the Symphony Classroom implementation was significant between treatment and control groups from pre- to post- test at the p = 0.141 level (F (1, 36) = 2.26, p = .141). The results of one-way ANOVA is largely driven by the small sample size.
- While a power analysis should be done to inform future study designs, we would guesstimate that around 100 teachers in both the treatment and control groups (total N = 200) would likely push this finding to be significant at the $p < .05$ level.

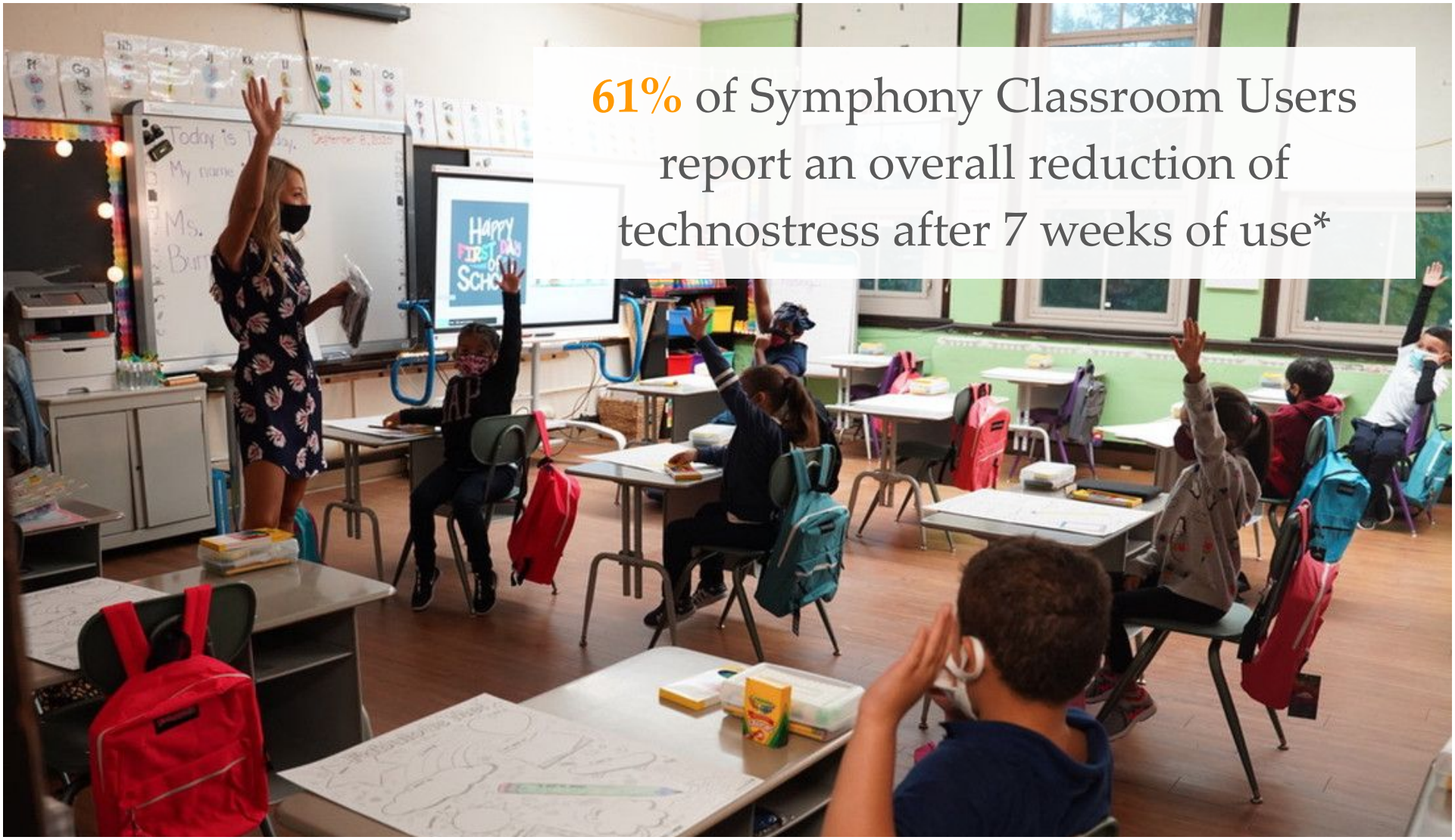
Overall Average Reduction in techno-stress

On average, Symphony Classroom Users report technostress being reduced by over 14% after 7 weeks of use*



** Note that this and all data presented here was collected in both the height of the Omicron outbreak and over the holiday season from November 2021 - February 2022*

Teacher Reported Reduction in Technostress



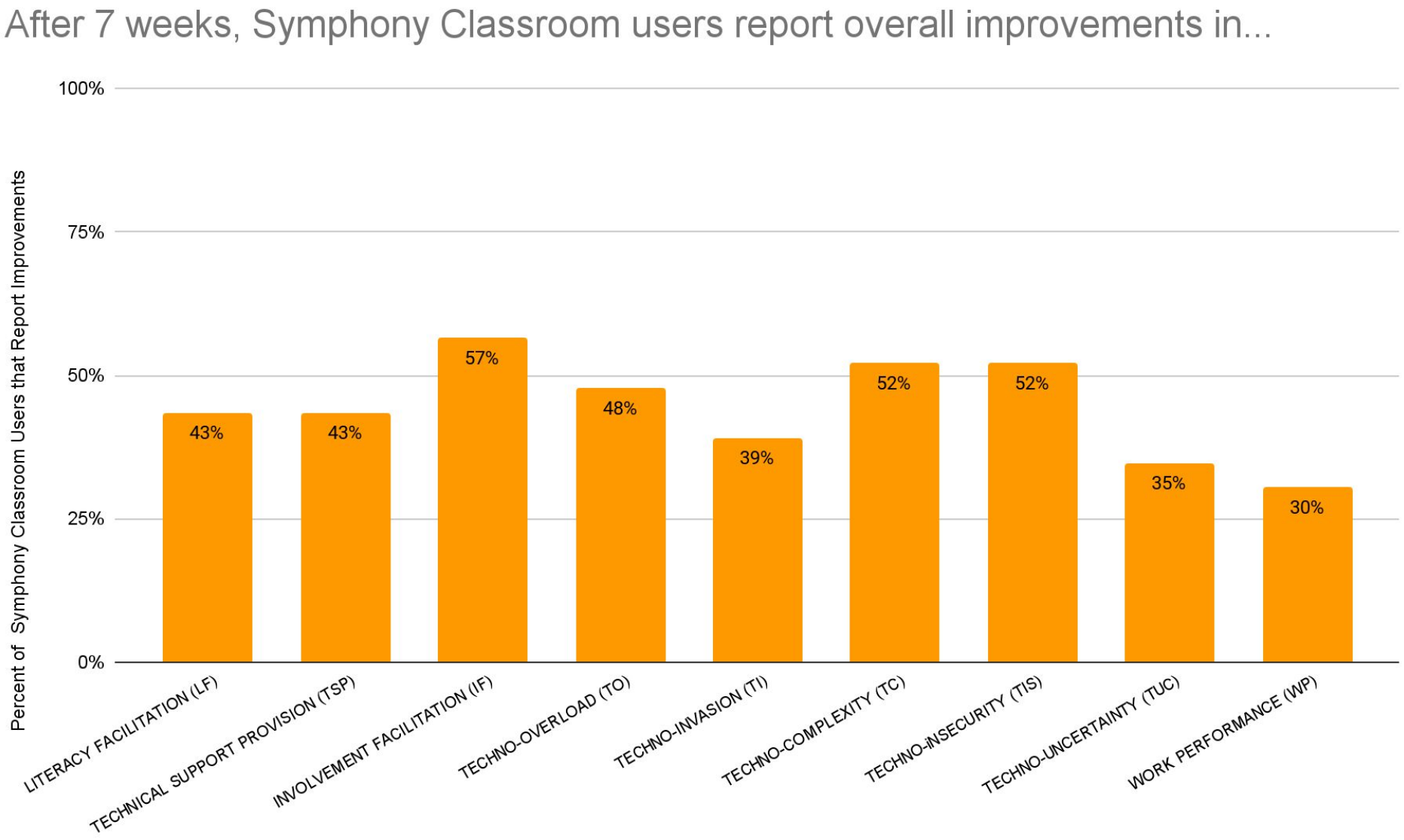
** Note that this and all data presented here was collected in both the height of the Omicron outbreak and over the holiday season from November 2021 - February 2022*

Impacts on Areas of Technostress

Technostress Subscales

techno-stress Subscale + Definition	% Symphony Classroom Teachers Reporting Improvements
Literacy Facilitation: techno-stress is reduced when teachers feel technologically literate and supported to implement.	**43%** of Symphony Classroom users reported feeling more technologically literate and were more supported to implement.
Technical Support Provision: techno-stress is reduced when teachers receive robust technical support.	**43%** of Symphony Classroom users reported an improvement in robust technical support.
Involvement and Facilitation: techno-stress is reduced when teachers feel involved in decision-making related to implementation and facilitation.	**57%** of Symphony Classroom users reported an improvement in their sense of involvement in decisions related to technology facilitation.
Techno-Overload: techno-stress is produced when teachers feel overloaded by technology devices.	**48%** of Symphony Classroom users reported feeling less overloaded by technology devices.
Techno-Invasion: techno-stress is produced when teachers feel as though technology is invading their lives outside of school.	**39%** of Symphony Classroom users reported feeling less as though technology was invading their lives outside of school.
Techno-Complexity: techno-stress is produced when teachers feel as though technology is too complex, and they will be replaced by it or something they don't understand.	**52%** of Symphony Classroom users reported feeling less as though technology was too complex, and they will be replaced by it or something they don't understand.
Techno-Insecurity: techno-stress is produced when teachers feel insecure in their work performance or job security because of technology.	**52%** of Symphony Classroom users reported feeling less insecure in their work performance or job security because of technology.
Techno-Uncertainty: techno-stress is produced when teachers perceive their classroom technology as changing frequently.	**35%** of Symphony Classroom users reported perceiving that their classroom technology was changing less frequently.
Work Performance: techno-stress is reduced when teachers feel as though technology enhances their work performance.	**30%** of Symphony Classroom users reported that Symphony Classroom enhanced their work performance.

Improvements in Areas of Technostress



Which SUBSCALES should be targeted?

Technostress Subscale	Treatment (N = 23)	Control (N = 15)
Literacy Facilitation (3 items)	t (22) = 1.52, p = .142	t (14) = 1.66, p =.119
Technical Support Provision (3 items)	t (22) = 1.35, p = .189	t (14) = 1.76, p =.105
Involvement and Facilitation (5 items)	***t* (22) = 2.65*, *p* = .015**	t (14) = 1.16, p = .264
Techno-Overload (7 items)	t (22) = 1.31, p = .203	***t* (14) = 2.27*, *p* = .039**
Techno-Invasion (2 items)	***t* (22) = 2.41*, *p* = .025**	t (14) = 1.57, p = .138
Techno-Complexity (5 items)	***t* (22) = 2.40*, *p* = .004**	t (14) = 1.09, p = .294
Techno-Insecurity (5 items)	***t* (22) = 1.19*, *p* = .025**	t (14) = -.354, p = .728
Techno-Uncertainty (3 items)	t (22) = 1.19, p = .248	t (14) = -.44, p = .668
Work Performance (4 items)	t (22) = -1.53, p = .140	***t* (14) = -3.62*, *p* = .003**

Additional Insights

Insight #1: Symphony Classroom teachers feel significantly less afraid of being replaced by new technologies than non-users.

Symphony Classroom users report a significant improvement in techno-stress related to fears of being replaced by technology. This finding is particularly interesting in light of current debates amongst educational technologists about how to communicate the affordances of AI-based educational technologies as augmenting, rather than replacing, teachers (e.g., Roschelle, et. al, 2021). It shows that teachers who use Symphony Classroom feel less afraid of being replaced by AI, and we can therefore assume that Symphony Classroom delivers on the vision of AI as augmentation.

Subscale	Question	Treatment	Control
TECHNO-INSECURITY (TIS)	29. I have to constantly upgrade my skill set to avoid being replaced by new classroom technologies someday.	t (22) = 3.22, p =0.00	t (14) = -1.15, p =0.27

Insight #2: Symphony Classroom Users feel more involved in the refinement of classroom technology itself.

Symphony Classroom users report a greater sense of involvement in the refinement of educational technology. We attribute this finding to Merlyn Mind's approach to development within a research-practice-industry partnership (RPIP; Peppler & Schindler, 2021), and Merlyn Mind's attention to teacher/user feedback and learning. We suggest that this approach ought to continue to characterize future development for Symphony Classroom.

Subscale	Question	Treatment	Control
INVOLVEMENT FACILITATION (IF)	10. We are involved in the refinement of classroom technology itself.	t (22) = 2.24, p =0.04	t (14) = 0, p =1.00

What do teachers say about the impact of Symphony Classroom on technostress?

While the survey data results show an overall decrease in technostress in general, and techno-overload in particular, teachers do not mention stress reduction explicitly in our post-interview data. However, they do enthusiastically express a desire to continue using Symphony Classroom, and the entire treatment group said that they would recommend other teachers use Symphony Classroom.

Here are some of the reasons they provide:

User: "Being able to display a website for a simulation, and modeling that, but being able to walk around and help students with different computers? That was super helpful."

User: "[Without Symphony Classroom] can I still use my ELMO [document camera]? Sure. I can. The difference is being able to walk around and use a remote control to access the websites, to pinpoint things on my drive, that I can't do without Symphony Classroom. I can't do **that** [without it]."

Future Technostress Target Items

Which ITEMS are promising?

	Scale	Question	Treatment (23)	Control (15)
1	IF	8. We are rewarded for using classroom technology in our daily work.	***t* (22) = 2.31, *p* =0.03**	*t* (14) = .56, *p* = 0.58
2	IF	10. We are involved in the refinement of classroom technology itself.	***t* (22) = 2.24, *p* =0.04**	*t* (14) = 0, *p* =1.00
3	IF	11. We are involved in the refinement of ways to implement classroom technology.	***t* (22) = 1.91, *p* =0.07**	*t* (14) = -.44, *p* =0.67
4	TO	13. I have to do more work than I can handle due to the implementation of classroom technology.	***t* (22) = 1.68, *p* =0.10**	*t* (14) = .44, *p* =0.67
5	TI	**21. I feel like my personal life is being invaded by classroom technology.**	***t* (22) = 2.01, *p* =0.06**	*t* (14) =. 44, *p* =0.67
6	TC	22. I often find classroom technology too complex for me to understand it well.	***t* (22) = 2.79, *p* =0.01**	*t* (14) = .44, *p* =0.67
7	TC	24. The high complexity of classroom technology causes me to doubt its usefulness and practicality in education.	***t* (22) = 1.70, *p* =0.10**	*t* (14) =.81, *p* =0.43
8	TC	25. I do not have adequate knowledge of classroom technology to make it serve my work effectively.	***t* (22) = 2.58, *p* =0.02**	*t* (14) = .81, *p* =0.43
9	TC	26. I need to spend considerable amount of time and effort to use classroom technology effectively.	***t* (22) = 2.60, *p* =0.02**	*t* (14) = .32, *p* =0.75
10	TIS	27. The classroom technology disrupts my normal work pattern.	*t* (22) = 1.45, *p* =0.16	*t* (14) = 0, *p* =1.00
11	TIS	28. I feel constant threats to my job security due to the introduction of continually emerging new classroom technologies at my school.	*t* (22) = 1.14, *p* =0.27	*t* (14) = 0, *p* =1.00
12	TIS	29. I have to constantly upgrade my skillset to avoid being replaced by new classroom technologies someday.	***t* (22) = 3.22, *p* =0.00**	*t* (14) = -1.15, *p* =0.27
13	TIS	31. I do not share my knowledge regarding classroom technology with my colleagues for fear of being replaced someday.	*t* (22) = 1.28, *p* =0.21	*t* (14) = 0, *p* =1.00
14	*TUC	33. There are constant changes to the functionalities in the classroom technology we use at our school.	***t* (22) = 2.01, *p* =0.06**	*t* (14) = -.56, *p* =0.58

RQ2. Overall Time Savings & Efficiency Findings at NC Public Schools

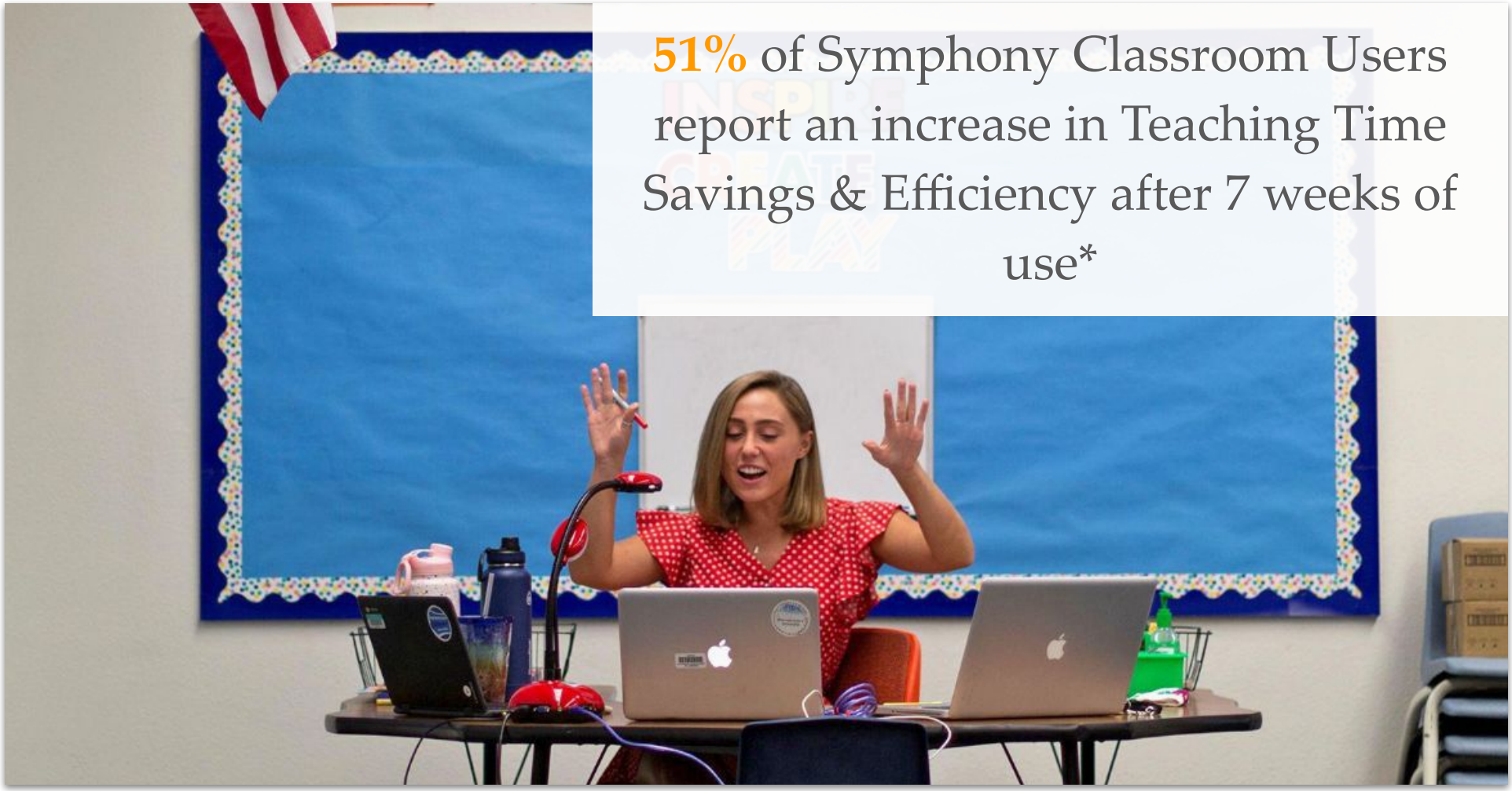
Teachers, Time Savings, and Efficiency

- The concept of instructional time expenditures is difficult to measure. Scholars continue to lament the black box that is teacher instructional time expenditures, and are actively working on methodological innovations that would provide a large-scale model of how teachers spend time in the classroom, and further, how teacher time expenditures correlate with student achievement (Camburn et al., 2021). Therefore, when it comes to understanding whether Symphony Classroom saves teachers time, we centered our inquiry on whether teachers who used Symphony Classroom perceived an overall feeling of "**time-savings and increased efficiency"** (e.g., Symphony Classroom saved them time, or made their teaching easier and/or more efficient, reduced number of steps to task completion.)
- To measure this tricky construct, we looked to a highly validated, well-established measure: **OECD's Teaching and Learning Survey (TALIS),** which has been administered in 2008, 2013, and 2018. Specifically, we used a subscale from the TALIS called "Teaching in the Target Class", which asks respondents to evaluate a number of constructs for one class as an exemplar. This scale asks about specific classroom activities and how often teachers complete them. Additionally, one scale item that was particularly relevant asks teachers to estimate the daily time the spent on administrative tasks, managing technology, keeping order in the classroom, and actual teaching and learning.
- Symphony Classroom streamlines workflows for managing and completing tasks with classroom hardware and software. Additionally, teachers can complete these tasks using their voices at a distance from their laptop, which saves time and effort. Consequently, we hypothesized that Symphony Classroom use would save teachers time, and make them more efficient in their workflows.

Suitability of the TALIS Survey

- Overall, the TALIS subscale is suitable to measure self-reported classroom time expenditures. We recommend incorporating this measure, and staying current with methodological innovations to the measurement of instructional time use (see pg. 12). This instrument demonstrates significant differences between control and treatment time-savings pre- and post-implementation, therefore suggesting that the instrument is sensitive to what's happening with Symphony Classroom.
- While this study does not demonstrate that the Symphony Classroom implementation was significant between treatment and control groups from pre- to post- test (F (1, 36) = .47, p = .50), these results of the one-way ANOVA were likely driven by the small sample size of the control group in particular. While a power analysis should be done to inform future study designs, we would guesstimate that around 100 teachers in both the treatment and control groups (total N = 200) would likely push this finding to be significant at the $p < .05$ level.
- In future implementations, we recommend reducing the number of questions asked in the TALIS "Teaching in the Target Class" subscale, because not all questions in this subscale are germane to Symphony Classroom's purpose and it's designed to be a more reflective/documentation tool rather than to assess overall gains. We especially recommend using items 41a-41d (see Appendix A.2).

Teacher Reported Increases in Teaching in the Target Class

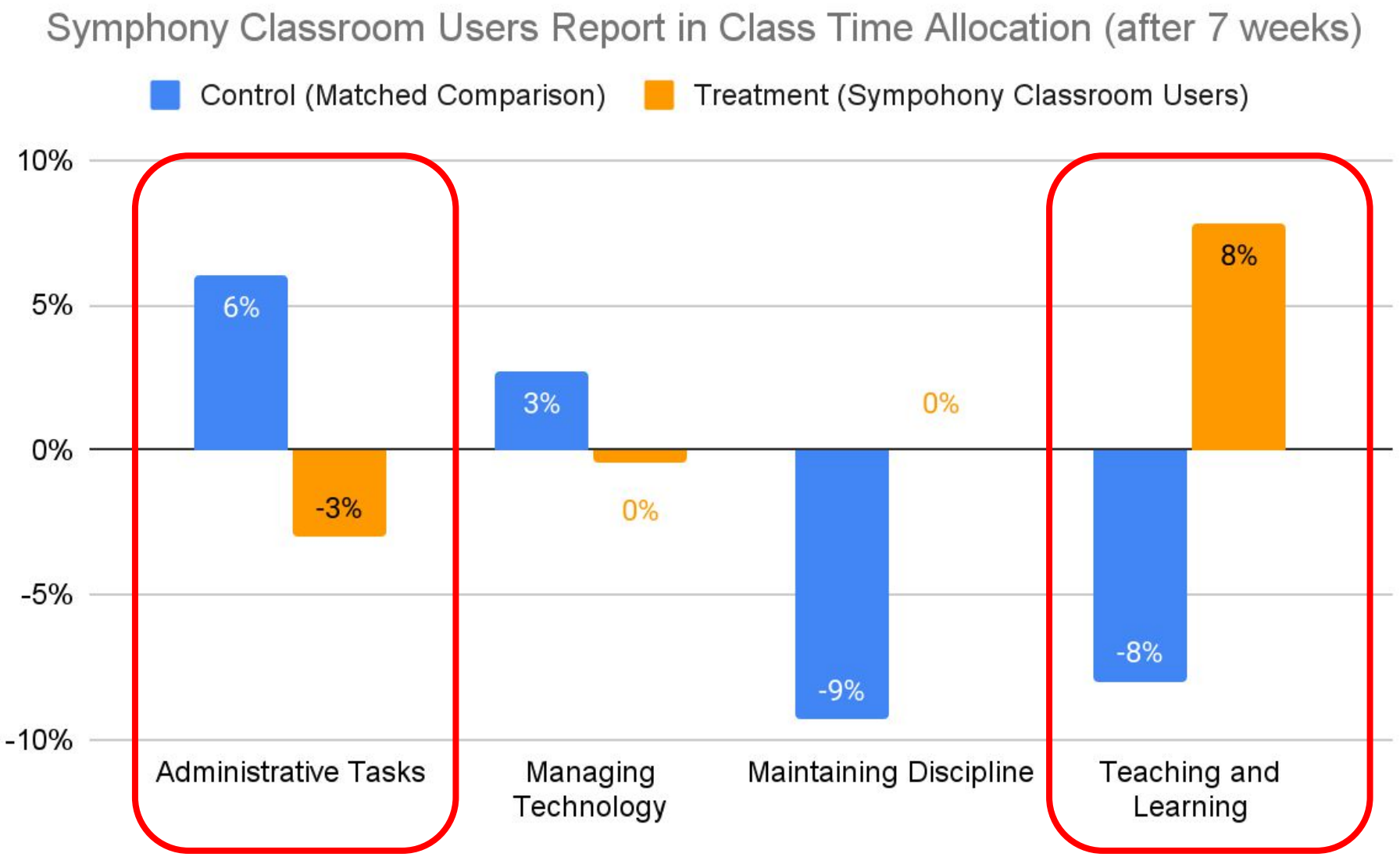


** Note that this and all data presented here was collected in both the height of the Omicron outbreak and over the holiday season from November 2021 - February 2022*

TALIS: Percent of class time typically spent on…

Tasks	Treatment (23)	Control (15)
41a. Administrative Tasks	t (22) = -1.27, p =0.22	t (14) = 1.5, p = 0.16
41b. Managing technology for yourself, your students, or both	t (22) = -.20, p =0.84	t (14) = 0.55, p = .59
41c. Keeping order in the classroom (maintaining discipline)	t (22) = 0, p = 1	t (14) = -1.90, p =0.08
41d. Actual teaching and learning	**t (22) = 2.20*, p =0.04**	t (14) = -1.29, p = .22

Symphony Classroom Users report having **significantly more** time for teaching and learning ($p < .05$) after 7 weeks of use*


Symphony Classroom Users Report in Class Time Allocation (after 7 weeks)
Control (Matched Comparison)
Treatment (Sympohony Classroom Users)
10%
5%
0%
-5%
-10%
6%
-3%
3%
0%
0%
-9%
-8%
8%
Administrative Tasks
Managing Technology
Maintaining Discipline
Teaching and Learning

Treatment vs. Control Comparisons

(1) Symphony Classroom Users report having **significantly more** time for **teaching and learning** than a matched control group **(*F* (1,36) = 5. 67, *p* = .023)** after 7 weeks of use*

(2) Symphony Classroom Users report spending **significantly less** time on **administrative tasks** than a matched control group **(*F* (1,36) = 4.28, *p* =.046)** after 7 weeks of use*

** Note that this and all data presented here was collected in both the height of the Omicron outbreak and over the holiday season from November 2021 - February 2022*

What do teachers say about the impact of Symphony Classroom on time-savings and efficiency?

In addition to the quantitative results, the qualitative data shows that perceptions of efficiency and time-savings are heavily situated within the goals users bring to Symphony Classroom. When asked why they like Symphony Classroom (as all users in this sample said that they do), they say that they like how SC functions as a hub for their other peripheral devices, and would like to continue refining their configurations so that Symphony Classroom acts as a portal to all classroom technology. This is particularly evident in the way that users in this sample mention voice-driven input-switching as the most useful feature. In our analysis, this pattern could indicate that users perceive"time-savings" and "efficiency" when they are able to reduce the number of steps they have to take in their environment to accomplish a given task. And, with that framing, we can see that users resoundingly report a reduction in steps to accomplish embedded tasks, like switching between a document camera and their laptop, without having to walk back to their computer or press any keys.

Here are some examples of users reporting on time-savings and efficiency:

Maria: "I would [recommend Symphony Classroom to other teachers because] each second, or millisecond, adds up. So just saving those small increments of time makes just the daily lesson or routine of things that much easier. So I would recommend it."

Maribel: "[Symphony Classroom] is great. We need it. Anything that takes away even two, three minutes of going and opening [applications] by hand for us, and instead to just speak to the machine. It's helpful."

User: "...just being not tied to my desk and having to constantly click, especially when, I mean, so many students need help with technology. **So it just saves time.**"

TALIS: Which other ITEMS are promising?

In addition to items 41a-d, which measure teacher perceptions of instructional time spent, we noticed three other TALIS items that are sensitive to Symphony Classroom's impact on classroom activity. Though we could not establish significance for all items in this administration due to the sample size, we see directional differences between the treatment and control responses to items 43e, 43h, and 43p, which speak directly to the type of instructional activity underway in Symphony Classroom environments.

While this information is not yet significant, the difference between treatment and control responses indicates that these items are valuable measures which illustrate the impact of Symphony Classroom on shifting modes of teaching and learning to be more student-centered.

Question	Treatment (23)	Control (15)
43e. Thinking about your teaching in the target class, how often do you do the following? [e) I present tasks for which there is no obvious solution]	***t* (22) = 3.15*, *p* =0.005**	*t* (14) = 1.31, *p* =0.21
43h. Thinking about your teaching in the target class, how often do you do the following? [h) I ask student to decide on their own procedures for solving complex tasks]	***t* (22) = 2.15*, *p* =0.043**	*t* (14) = 0.59, *p* =0.57
43p. Thinking about your teaching in the target class, how often do you do the following? [p) I let students use ICT (information and communication technology tools) for projects or class work.]	***t* (22) = 1.70, *p* =0.10**	*t* (14) = -0.49, *p* =0.63

Triangulating with Technostress Survey Item #26

Finally, our analysis of Symphony Classroom's impact on time can also be triangulated with item #26 on the Technostress Subscale: "I need to spend considerable amount of time and effort to use classroom technology effectively." This data confirms that Symphony Classroom users perceive a time-savings in comparison to non-users.

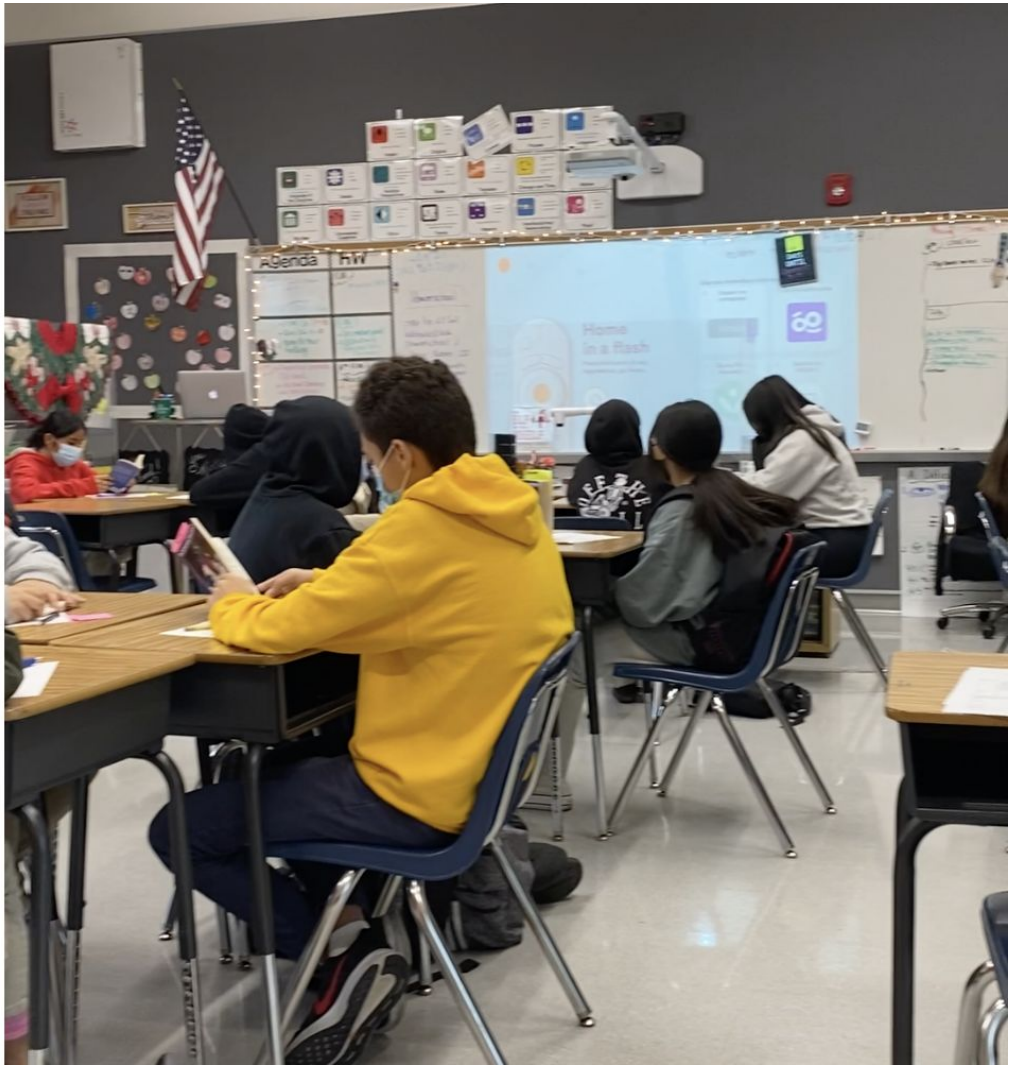
Subscale	Question	Treatment	Control
TC	26. I need to spend considerable amount of time and effort to use classroom technology effectively.	***t* (22) = 2.60, *p* =0.02**	*t* (14) = .32, *p* =0.75

RQ3: Qualitative Insights from CA Charter

A Deep Dive into Usership at CA Charter

To triangulate our quantitative findings, we conducted semi-structured interviews and observations with CA Charter teachers between 11/08/21-2/25/22. Our objective was to identify patterns of usership so that **Merlyn Mind can begin to differentiate support** for teachers who approach the use of educational technology differently. In this way, we answer RQ3: How does Symphony Classroom intervene into existing tech configurations, available tools, and subsequent teaching and learning practices?

In this section, we propose a model of how pre-implementation usership of educational technology connects to Symphony Classroom implementation by sharing the cases of three different personas. These categorizations offer scalable and systematic ways to understand how different users can be supported to get the most out of Symphony Classroom. As such, we accompany each persona with recommendations for next steps.



Data Collection Overview

In addition to the survey data we collected at both CA Charter and NC Public School, we also conducted a series of interviews and observations at CA Charter School. The baseline interviews and observations were conducted with the entire site sample (n=12), and the post-implementation interviews and second round of observations were conducted with the treatment group only (n = 6). Below, see the data collection windows for interviews and observations. For a structured interview protocol, see Appendix C.

Data Collected	Time Range
Baseline Interviews (n=12)	11/01-11/20/21
Observation 1 (n=12)	12/9/2021
Observation 2 (n=6)	02/15/2022
Post-Implementation interviews (n=6)	02/08-02/25/22

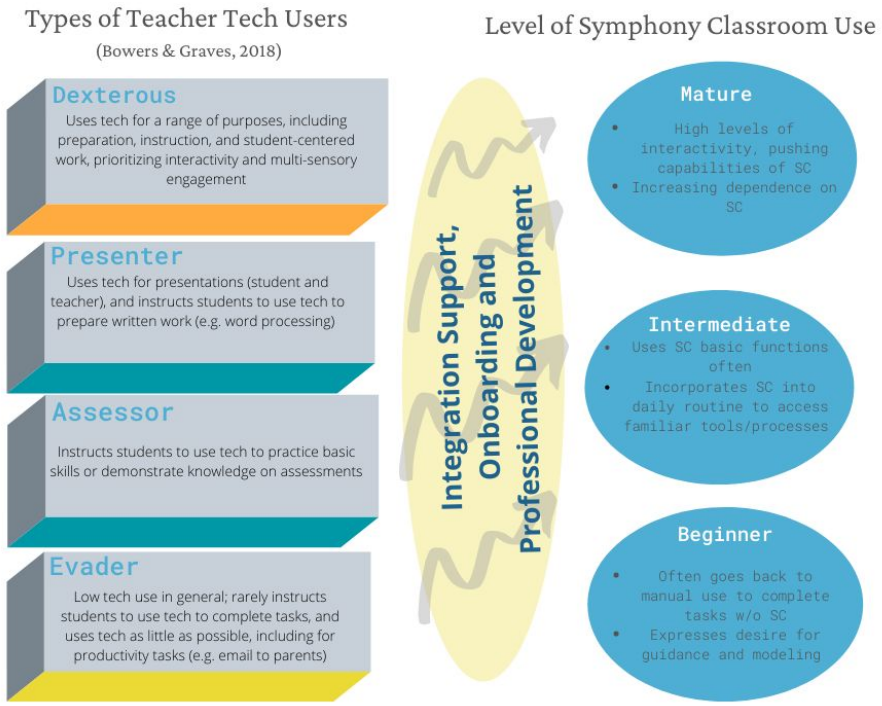
Can Symphony Classroom be a mechanism for instructional improvement?

Profiles of Teacher Tech Users and Corresponding Levels of Symphony Classroom Use

To provide further insight into Symphony Classroom users at CA Charter, we present three user personas. While there are many ways to frame users, we choose to frame them in terms of their technology user profile and the level of Symphony Classroom use they displayed when observed at time point two. We've chosen to use a recently-developed typology of teacher technology user from scholarly literature (Bowers and Graves, 2018) which provides four profiles: **dexterous, assessor, presenter, and evader.** See figure for definitions of each user type.

Why a focus on Technology User Typologies and Corresponding Levels of Symphony Classroom Use?

In our previous report, our goal had been to understand how Symphony Classroom impacts patterns of Classroom (Co)Orchestration. While the framing of Classroom Orchestration remains relevant (as this is a major construct that Symphony Classroom impacts), we frame this analysis using types of teacher tech users and corresponding levels of Symphony Classroom use to provide a roadmap for scaffolding different sorts of teachers into productive use of Symphony Classroom. In connection to our previous report, one can assume that Dexterous users of educational technology would also demonstrate agile patterns of technology-enhanced classroom orchestration. Conversely, one can assume that Evaders of classroom technology would demonstrate more stilted patterns of technology-enhanced classroom orchestration, though other forms of classroom orchestration (like moving between social groupings) may be more agile.



However, the most important application of this model is as a guide to help customer support differentiate the manner and type of resources they offer users, who will require different scaffolds to become mature users of Symphony Classrooms.

Persona #1: Maria

Dexterous User and Mature Use

Maria is a middle school science teacher who is in her fourth year of teaching. She is a dexterous user of technology in her teaching, integrating tools that serve **specific purposes**. In her teaching, she articulates and demonstrates a commitment to multi-sensory engagement; that is, when she teaches, she plans for students to encounter information and concepts in multiple ways. This ensures that her instruction is accessible to students with different learning preferences, talents, identities, and aptitudes.

What makes Maria a dexterous user?

Maria is a dexterous user of classroom technology **before** she started using Symphony Classroom. Despite the fact that Maria names several specific tools that she integrates into her teaching practice (e.g. Schoology, EdPuzzle, Google Suite, Youtube, PET Simulations, Blooket, and Kahoot), Maria says:

> **"I'm still learning in this area; I want to use more interactive tools."**

Maria: "I use my Symphony Classroom with my computer hooked up every single day and every single period, for the most part, just to display even a document that they're working on or to use the timer, things like that. So I would say I used it on a daily basis for every single period. I really liked that it displayed the big timer which helps with lab rotations, like [saying to students] 'Okay, you have five minutes.' It's nice, it's clear, and other students enjoy the little chime."

What makes Maria a mature user of Symphony Classroom?

Maria demonstrates mature use with Symphony Classroom upon observation, using it multiple times throughout observations at timepoints 1 and 2. In her post-implementation interview, Maria says:

> **"The best way to learn [to use Symphony Classroom] is just to try it out yourself, and run into any issues and problem-solve. I would say [Symphony Classroom] was really easy to learn, especially in the beginning, like the basic functions."**

Maria: Analysis and Next Steps

Tech Use patterns prior to implementation: Evidence of Dexterity

Maria:

- Names a range of tools that she uses frequently and occasionally for specific purposes
- Mentions student engagement and inquiry as her primary purpose for enrolling in our study
- Clearly articulates components of her own process for learning how to use and integrate tech into her teaching

Symphony Classroom Use During and After Implementation: Evidence of Maturing Use

Maria:

- Uses Symphony Classroom frequently (multiple times per day)
- Predicates classroom learning becomes increasingly on Symphony Classroom functionality: if device functionality fails, then teaching practice also suffers
- Constantly explores new features and capabilities
- Troubleshoots creatively and persistently when solution malfunctions

How to further engage Dexterous/Mature users like Maria:

- Facilitate sharing expertise amongst peers via asynchronous platforms (e.g. a group chat with video capabilities, like a Slack channel)
- Support their collaborative, ongoing leadership with peers
- Issue new feature use challenges, and offer 1:1 support/incentives for completing them

Persona #2:Maribel

Assessor/Presenter User → Intermediate Use

Maribel is in her third year as a licensed classroom teacher, but has worked at her school for over thirteen years as an instructional aide. Her entire career has been at the same school. She has switched to 4th grade from 6th-8th grades this year, and so she is learning a new curriculum as a generalist with a new age of students.

What makes Maribel an assessor/presenter?

Before implementing Symphony Classroom, Maribel uses technology frequently in her classroom to assess student learning, or enhance lectures. She mentions using EdPuzzle, Kahoot, and Quizlet frequently. **Maribel says:**

"I try to do little things [with technology] as opposed to just [having students] playing with flashcards or doing a quiz…it's just more interactive, and [students] love it– they love having a computer in front of them."

> …Fourth graders have so many questions they want to know, [and] they want to know right now. So it's just nice to have that tool that can give you [the answer]- How tall is that mountain? Just simple things like that. You don't have to go and open your browser and look. I would recommend [Symphony Classroom]. - Maribel, 4th grade teacher

What makes Maribel an intermediate user of Symphony Classroom?

Maribel uses Symphony Classroom multiple times per lesson, especially the timer and input switching function (upon observation). Additionally, Maribel says that she is **interested in learning more** about how complex features of Symphony Classroom can help her. She wonders aloud about streamlining the use of Youtube videos, saying:

" I've tried opening YouTube, because we try to do breathing exercises with my kids. SC does open to a few of them. I just don't know if there will be a way that I can rename [videos], kind of like you do with Google documents? …Like 'open my presentation' or something. So something maybe more pinpointed to my account?"

Maribel: Analysis and Next Steps

Tech Use patterns prior to implementation: Evidence of Assessor/Presenter

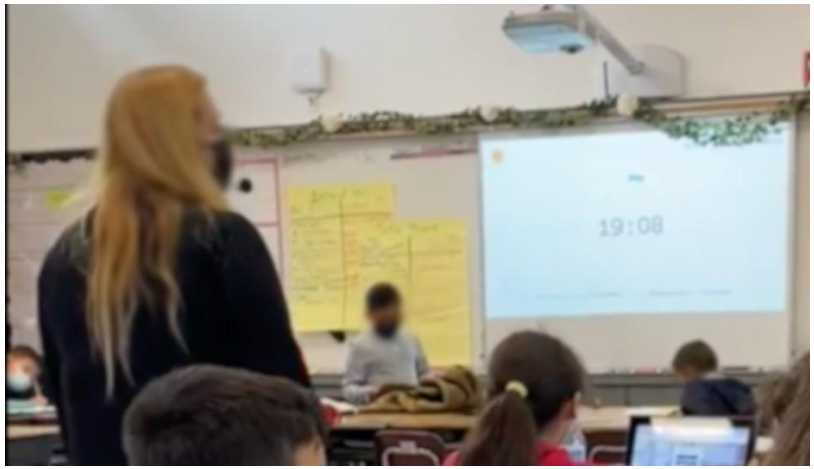
Maribel:

- Reports frequent use of presentation/assessment tech (e.g. Kahoot, EdPuzzle, Quizlet, Google Slides)
- Names favorite lesson as one on peer assessment (using rubrics to peer-assess use of RACE writing strategy)
- Does not state a reason/purpose for using digital tech tools vs. pen/paper, indicating a tool-first approach (e.g., technology is fun for kids, so we will use it to accomplish less engaging instructional goals)

Symphony Classroom Use During and After Implementation: Evidence of Intermediate Use

Maribel:

- Frequent use (multiple times per day)
- Both observations show use of timer and display for presentation, indicating successful pairing and configuration
- Minimal troubleshooting when solution malfunctions
- Has discovered device limitations (e.g. that she cannot play music from her laptop at the same time she's projecting the ELMO document camera)
- Is curious about changing pre-existing workflows in order to streamline using the solution capabilities (e.g. planning to embed Youtube videos into Google Slides presentations rather than saving them in folders on Youtube).



How to further engage Assessor Presenters and Intermediate Users:

- Support early use with frequent, personalized check-ins
- Suggest integrations to support interactive lessons (e.g. lessons that include multiple encounters of the same concepts that mobilize different sensory capabilities, like seeing, touching, hearing, etc.)
- Pair with dexterous users and evaders for heterogeneous learning groups.

Persona #3: Luis

Evasive User→Beginning Use

Luis is a dedicated educator who has been teaching for over 20 years, most of them at the same school. He is particularly beholden to his team of 5th grade teachers, and he describes in depth what each member of that team brings to their collective work. Because his team has volunteered to try out Symphony Classroom, Luis has decided to participate as well, despite the fact that he describes feeling very uncomfortable with both the use and integration of technology.

What makes Luis an evader?

Before implementing Symphony Classroom, Luis mentions that he finds it challenging to implement technology in his teaching practice, but he realizes that technology is instrumental to success in the 21st century. He describes his decision process to implement digital technologies in his teaching as heavily-influenced by his 5th grade team. Luis says:

"[I find new technology options when] I just hear from teachers. I use a Google slide or Google doc, and I try to figure it out and implement it with my homework assignments, with the kids, giving them assignments–PowerPoints or presentations. So I mean, I'm adding layers here and there, but it doesn't come naturally. I need to hear and see before I implement."

> My Achilles heel is technology, but I'm a team player. I said, I want my friends to [be able to do the trial]. I don't want to be the odd apple of the bunch. So I decided to [try Symphony Classroom]. - Luis, 5th grade teacher

What makes Luis a beginning user of Symphony Classroom?

Luis describes the process of learning to use Symphony Classroom as a process of trial and error, and accepting help from his students, transitioning workflows to SC. He also wonders whether device malfunctions are his fault, but he persists and troubleshoots successfully. He says:

I did use the timer a lot. I did do some research sites. Then one kid suggested, 'Mr. X, can you go straight to your Google Drive?' ' Let's test it out– Symphony Classroom go to my Google Drive'. Boom: everything was there!…I mean, but for me, I'm still trying to do the old way where I just have to [click], but I know that I have to be comfortable with using a speaking device that'll do [tasks] for me. I was doing a 50/50. Sometimes I just did it manually, or sometimes I did it with speaker. Because for whatever reason, I mean, [Symphony Classroom] will freeze and it wouldn't understand the first or second time I said [commands]. Maybe it's in my pronunciation– I'm trying very hard to pronounce it as correctly as I could. And then when they didn't understand me after the second or third try, then I just disconnected everything, restarted and it worked.

Luis: Analysis and Next Steps

Tech Use Patterns Prior to Implementation: Evidence of Evasion

Luis:

- Describes feeling nervous and stressed when he has to integrate new technologies into his teaching practice, because he feels vulnerable when his student see him learning something for the first time.
- Describes high levels of technostress when forced to teach with tech, especially during virtual schooling in 2020-2021 school year.
- Describes struggles and trepidation with basic classroom technology, like Google Docs

Symphony Classroom Use During and After Implementation: Evidence of Beginning Use

Luis:

- Reports co-orchestration and in-the-moment learning with students to learn the correct command
- Expresses a desire to see other, more advanced peers implement
- Describes being on the fence between using Symphony Classroom to complete tasks and completing tasks with hands

How to further engage Evaders/ Beginning Users:

- Partner them with a dexterous teacher type or mature/intermediate users. Even partnering with another beginning user would be beneficial.
- Provide 1:1 listening about any difficulties they experience so they can gain confidence that they will be able to solve problems with the device.
- Encourage co-orchestration of Symphony Classroom with students, framing the implementation of the device as inquiry-based, authentic technical learning, as opposed to a diversion from the official curriculum.

An Emerging Caveat Across Intermediate and Beginning Users: Wondering about Algorithmic Bias

Perceptions of Algorithmic Bias for Specific Versions of English Speech

Across the sample at CA Charter, when Symphony Classroom malfunctioned, beginning and intermediate users wondered if the reason was that the device couldn't understand their English pronunciation. **We recommend significant, intentional, explicit instruction and training for users related to this phenomenon, as it could be interpreted as evidence of bias within voice technology itself**, which could present a significant barrier for scaling into diverse and multilingual environments (which characterize the majority of contexts in the United States). This training should clearly communicate that the source of the malfunction rests with the device, and not with the users' English pronunciation. Left unaddressed, perceptions of bias might affect a user's persistence with the device itself, because they could feel as if the device was not designed for people like them to use, thus constructing an avoidable barrier to scaled use.

Here is what some participants said:

Luis: When I when I noticed that [Symphony Classroom] wouldn't listen on the first two tries [to issue a command], I said forget it, I need to go back to my assignments. I just clicked on [the interface manually], and said let's go– just move on.

Maribel: I don't know if it was the mask, too. Maybe. That could have had something to do with [malfunctioning]. And maybe it didn't hear me right. There was once that it just went black, but I don't know if it was the actual Symphony Classroom or if it was the projector or…you know, I turned everything off. So I can't say, you know, it was the actual Symphony Classroom, but I just had to turn off everything…but overall, sometimes I would have to repeat myself. You know that it happens with Siri and happens with Alexa. So it wasn't like anything big...

Flora: I was saying, "switch [the timer] to five minutes". And it would do the timer at 20 or 25 minutes. And then I would take off my mask, and I had to repeat it. And I would say "set timer to 25 minutes". So I'd have to drop that timer to five minutes. So, you know, the language part. I don't know- it could be that it's catching my second language. Well, my first language is English. But still I still have a second language (Spanish). Maybe [Symphony Classroom] could still hear that? I don't know if it's catching that. I mean, it would be interesting to see [how SC works] with other people who may have an accent or a second language.

Appendices

Appendices

References

References

Bowers, A., & Graves, K. (2018). Toward a typology of technology-using teachers in the "new digital divide": A latent class analysis (LCA) of the NCES fast response survey system teachers' use of educational technology in US public schools, 2009 (FRSS 95). *Teachers College Record*, *120*(8), 1-42.

Brod, C. (1984). *Technostress: The human cost of the computer revolution*. Reading, Mass.: Addison-Wesley.

Jones, N. D., Camburn, E. M., Kelcey, B., & Quintero, E. (2022). Teachers' Time Use and Affect Before and After COVID-19 School Closures. *AERA Open*, *8*, 23328584211068068.

Peppler, K. & Schindler, E. (2021). Classroom Orchestration: Leveraging Research Practice Industry Partnerships (RPIPs) to Refine a New AI Assistant for Teachers [Unpublished report]. Informatics & Education, University of California, Irvine.

Roschelle, J., Fusco, J., & Ruiz , P. (2015, March 15). AI or Intelligence Augmentation for Education? [web log]. Retrieved April 2, 2022, from https://cacm.acm.org/blogs/blog-cacm/251188-ai-or-intelligence-augmentation-for-education/fulltext.

Santoro, D. (2020). Teacher demoralization isn't the same as teacher burnout. *Education Week*.

Wang, X., Tan, S. C., & Li, L. (2020). techno-stress in university students' technology-enhanced learning: An investigation from multidimensional person-environment misfit. *Computers in Human Behavior*, *105*, 106208.

Thank you!

Questions?

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