A UNIVERSITY-LED COMPUTER SCIENCE EDUCATION SUMMIT: MEETING THE MOMENT WITH ACTIONABLE, RELEVANT, AND TIMELY EXPLORATIONS

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Abstract

It is well understood that providing all students with access to robust and inclusive computer science education (CSE) is a priority for educational systems worldwide. This will better prepare every student to meet the demands of an evolving job market and better leverage the technology around them to solve problems affecting themselves, their communities, and their world. However, there are many open areas of inquiry in CSE: identifying the appropriate content across many interconnected disciplines, determining the best pedagogical approaches and instructional practices, and tackling the persistent underrepresentation along racial, gender, and other sociodemographic characteristics across the computer science pipeline.

This paper describes the design, implementation, and impact of a university-led Computer Science Summit attended by hundreds of educators, administrators, and other stakeholders across the state of New Jersey. The research shares a detailed account of the development of the Rutgers University CS Summit, describing the motivation behind its development and how both the content and mechanics of the event work to meet its goals: connecting computer science educators with high-quality professional learning, authentically exploring the emerging fields of artificial intelligence and cybersecurity, and providing a forum to clearly understand locally relevant policy matters.

Results of an exit survey, completed by 153 attendees, demonstrate the event's success and underscore the prominence of artificial intelligence and cybersecurity. Implications of this event and this research are explored alongside insights for professional development providers and other CSE advocates, such as the balance of "hot topics" with evergreen concepts, centering student outcomes, and delivering relevant and credible messages.

Keywords: computer science, k-12 education, university outreach, professional learning, professional development, artificial intelligence, cybersecurity

1 INTRODUCTION

As technology continues to advance at a rapid pace, it is more critical than ever to ensure all students have access to high-quality computer science (CS) instruction. Equipping students with foundational computational literacies is essential, as these skills are increasingly indispensable to success in the workplace and across fields [1], [2]. While significant strides have been made in bringing computer science education (CSE) to K-12 students [3], the field lacks the benefit of decades of research on instructional methods and sequencing that underpin other subject areas [4]. Adding complexity to understanding the "*whats*" and "*hows"* of K-12 CSE, the discipline itself is rapidly evolving [5]: artificial intelligence (AI), though it has been steadily progressing since the 1950's [6], has recently taken center stage in public discourse with its generative capabilities. Related fields such as cybersecurity [7], [8], robotics [9], and data science [10], [11], are also gaining prominence in K-12 contexts, reflecting the expanding scope and relevance of computer science in today's world.

Given ongoing work in defining the scope and methods of CSE, as well as continuous developments in the field itself, CSE practice is currently in a transition period. In the US, states are at different stages of development with regards to educator credentialing, student learning progressions, and educational policy [3], [12]. CS teachers often come from different backgrounds [13], and teacher preparation programs do not yet routinely include pedagogical content knowledge and methods for CS instruction [14]. Thus, professional learning opportunities for in-service teachers focusing on both content and pedagogy are important components of the current state of CSE work.

Alongside other efforts in this area, through collaborations between the Department of Computer Science and the Center for Effective School Practices (CESP), Rutgers University offers annual Computer

Science Summits to bring together insights from the latest research, progress from educational agencies and advocacy groups, and successful curricular and pedagogical approaches from developers and individual practitioners. This paper discusses the 2024 Rutgers University Computer Science Summit (hereafter, the "CS Summit"), the 7th summit of its kind. Central to this iteration, artificial intelligence and cybersecurity emerged as key themes on the minds of educators, policymakers, and curriculum developers. In the sections that follow, we discuss the CS Summit's goals and design, highlight aspects of its implementation, describe its impacts, and situate it within the broader context of this work.

2 SUMMIT DESIGN

The CS Summit represents a gathering of CSE stakeholders to learn, discuss, reflect, and advance the work being done around shared problems of practice. The CS Summit extends well beyond professional development by providing space not only for exploration of CS and related content and pedagogy but also for attendees to participate in discussions that shape the future of CSE and CSE policy, forge meaningful connections across roles, grade levels, and organizations, and connect with established leaders across practice, research, and industry. Altogether, the goals of the 2024 CS Summit were to:

1. Provide K-12 educators with content and pedagogical professional development to support their efforts in bringing relevant CS content to their students in inclusive, engaging ways.
2. Equip stakeholders with foundational understandings and space to collaboratively explore artificial intelligence (both education *about* AI [15], [16] and *using* AI [17], [18]) and cybersecurity.
3. Promote authentic connections among and between K-12 practitioners and other stakeholders (government representatives, higher education faculty, curriculum developers, advocates, etc.).
4. Leverage Rutgers' position as a large public research university to partner with districts statewide to achieve the above in a manner appropriate and accessible to all CSE stakeholders.

2.1 Program Content

The agenda for the CS Summit was thoughtfully designed to include topics traditionally associated with professional learning in K-12 CSE. This included content-specific discussions about curricular resources and model lessons, as well as pedagogical topics like student engagement and inclusive learning. Additionally, the event sought to address specific topics with input from the field. Months prior to the summit, a brief poll was sent out to gauge the popularity of proposed session topics. Results of this poll, summarized in Table 1, establish the centrality of AI, cybersecurity, and state policy alongside core CSE topics. Note that this survey was completed by 130 registrants, who cast a total of 580 votes.

Table 1. Summary results from general interest survey.

Topic	*Share of Votes*	*Proportion of Participants**
AP Courses	9%	40%
CS Instructional Strategies	23%	73%
Cybersecurity	26%	73%
Data Science	3%	17%
(Generative) Artificial Intelligence	20%	72%
Robotics & Physical Computing	2%	8%
State Policy	17%	58%

* The sum of this column will exceed 100%, as each participant could cast multiple votes.

Given the importance of AI, we prioritized its inclusion, as it is essential for educators to have a clear and accurate understanding of AI. In an era where social media, news outlets, and public discourse are often filled with AI, we felt it was crucial to provide educators with reliable, evidence-based insights. Additionally, we wanted to go beyond AI's theoretical aspects and highlight its practical applications in education. Sessions were included to explore how AI is being used in lesson planning and other instructional practices, providing educators with actionable insights for their classrooms.

Similarly, cybersecurity and its education were made central to the CS Summit. Like AI, cybersecurity has been gaining popularity within K-12 CSE contexts, potentially due to its real-life applications and rising demand for trained workers. The CS Summit provided attendees with opportunities to connect with educators that are among the first implementers of cybersecurity courses. There was a strong focus on sharing curricular resources, case studies, highlights of successful practice, and ways to connect students with cybersecurity learning opportunities both in and out of the classroom.

Many sessions met the needs of attendees by exploring locally relevant policy issues. This was particularly valuable for addressing topics where it can be challenging to obtain clear information. For example, CS teacher certification remains a dynamic and rapidly evolving issue for NJ educators. Similarly, the state's student learning standards, introduced just two years ago, are still in the process of being implemented, with specific requirements and implications continuing to take shape across schools.

The success of the CS Summit was not simply in its content, but also its *messengers*, their expertise, and diversity of perspective. Bringing together K-12 educators (including CS and non-CS educators across grade bands, and both school and district administration), higher education faculty, industry experts, and other professionals ensured that attendees received practical, timely, and trustworthy information.

For instance, model lessons were presented by educator leaders from across the state, and robotics and esports discussions were led by recent award recipients. Sessions on AI featured a range of perspectives, including an investigative journalist from a very prominent US newspaper, an executive from an AI education advocacy group, and a former high-ranking state education official. Cybersecurity sessions similarly featured strong voices, with guidance presented by the Director of NJ's Cybersecurity and Communications Integration Cell and curriculum insights offered by the two educators that developed the introductory "Garden State Cyber" curriculum, an open-source project now available statewide. Higher education representatives provided valuable research-driven insights, including lessons learned and implications for practice generated by an ongoing USDOE grant-funded initiative to expand CSE opportunities to middle schools. NJDOE representatives and the policymakers themselves spoke about changes in certifications and standards.

2.2 Program Mechanics

The CS Summit was held on the Rutgers University campus, offering a vibrant and historic backdrop for the event. In the months leading up to the CS Summit, a marketing campaign widely promoted it through various channels, including social media, email lists, CS advocacy groups, professional networks, the local CSTA chapter website, and Rutgers University department pages. To promote educator attendance and reduce barriers to attend, all registration costs were covered through university and grant funding, making the summit free of charge.

The schedule was intentionally designed to both balance and blend the robust content discussed above with authentic opportunities for collaboration. The day opened with a morning plenary session, consisting of a keynote address followed by an interactive panel discussion. After the plenary, attendees could choose from one of four concurrent breakout sessions, which allowed for smaller, more focused discussions and deeper dives into specific topics. These took place in a variety of formats, including presentations, panels, hands-on workshops, and birds of a feather talks, among others. The afternoon followed the same structure as the morning, and the day concluded with an optional unstructured reflection and debrief space in the main auditorium.

Recognizing that CS educators often lack the departmental support structures available to their peers in other disciplines, the summit prioritized networking opportunities to help participants build and strengthen professional connections. These connections are essential for creating and strengthening working relationships where groups of educators can plan, co-create, and refine future work, sharing and amplifying individual efforts. This focus on community-building was reflected in several parts of the agenda, such as the "working" lunch, which featured speed networking activities and themed seating areas where attendees with similar interests could share ideas and experiences over their meals. These intentional efforts ensured that the knowledge and insights shared at the summit were paired with the partnership necessary to sustain and extend that learning into the future.

3 RESULTS & TAKEAWAYS

The CS Summit was attended by a total of 205 of the 245 registered individuals, an 84% attendance rate. Following their attendance at the summit, participants were asked to complete a brief post-survey,

allowing us to better understand the impact of the CS Summit and what components of the summit were most beneficial to attendees. Of the 205 individuals that attended the conference, 153 completed the survey (75%). Most were teachers: 55% of responses were from high school teachers, and 31% were K-8 teachers. The remainder of the responses were from K-12 administrators (5%), higher education representatives (3%), school media specialists (2%), and others (3%).

Each K-12 teacher selected the two types of experiences that were most impactful to them, considering their experience at the summit as a whole (the survey stated these experiences could have happened at one session, across multiple sessions, or through conversations with others throughout the day). Table 2, below, displays these results by role. The 5 types of experiences were relatively similar in frequency, with new content and skills being slightly more common than the rest. Networking, relationship building, and general information (such as AP course info or policy changes) proved more beneficial to high school teachers, whereas K-8 teachers found content knowledge more impactful.

Table 2. Most impactful experiences by attendees' role.

	K-8 Teachers	***9-12 Teachers***	***Total***
Learning something that challenged your ideas.	33%	39%	37%
Learning new content knowledge about a topic.	46%	38%	41%
Learning strategies or skills you can use in your work.	42%	40%	41%
Learning general information about CS education.	23%	33%	30%
Networking and building relationships.	19%	46%	36%

Participants believed that the CS Summit would have a moderate impact on their work, but one that would grow over time. Overall, 71% of participants reported that they believed the summit would have at least a moderate impact on their work *this school year* (with 23% saying it would have a big impact); when considering the impact for the *next school year*, this figure grew to 88% (with 46% anticipating a big impact). This is likely due to the timing of the summit mid-school year along with the time needed to fully reflect on new knowledge, consider its implications, and translate it to practice.

AI and cybersecurity were central to the 2024 CS Summit, and many attendees referenced these two fields in their responses. For instance, of the 49 (37%) K-12 educators that mentioned that "learning something that challenged your ideas" was an experience from the summit, 18 (37%) mentioned that this experience was related to AI, such as "I viewed AI as a tool to get a quick answer, not realizing that it could be used as a learning tool" or "AI has always been a negative in my school, I realize that I need to approach it differently than I originally thought." Similarly, 7 (14%) mentioned cybersecurity, citing experiences like "I learned that it is a new path in CS," and "the cybersecurity keynote made me realize how little focus I put on this area, I need to improve how I teach this." Educators also shared shifts in their beliefs on instructional practices, such as culturally aware teaching, integrating career and technical education, and teaching about bias and ethics.

The underlying mechanics behind AI are not widely understood, and learning more about them was an impactful experience for many summit attendees. Of the 54 (41%) K-12 teachers that were impacted by learning new content knowledge, 31 (57%) mentioned learning AI-related content knowledge as the most impactful. Before the summit, only 13 (42%) of these individuals said they had at least an "intermediate" understanding of AI; afterwards, this figure grew to 21 (67%). Similarly, 18 (33%) shared that content knowledge in cybersecurity was most impactful, with them having at least an intermediate understanding of the topic growing from 3 (16%) to 7 (39%).

Beyond obtaining new knowledge, a key desired outcome was for educators to feel ready to put their new knowledge into practice. 54 (41%) K-12 teachers were impacted by gaining new skills, with some (9, or 17%) sharing they were taking away general instructional strategies. "I liked learning about different approaches to group and collaborative work," one educator shared. Others (21, or 39%) mentioned skills related to AI, citing experiences around learning how to introduce it to students, "not being afraid to use AI," or "to teach students to use AI systems responsibly." Similarly, 16 (30%) gained cybersecurity skills, which were mainly focused on how to implement introductory instruction, the importance of doing so, and specific resources to use (such as Cyber.org or gamified resources like CTF). One shared how they learned how to teach "cybersecurity throughout the course instead of treating [it] as a separate skill. In retrospect, this seems like it should have been obvious!"

4 CONCLUSION

The design and implementation of the 2024 Rutgers University Computer Science Summit, discussed in this paper, provided CSE stakeholders with a meaningful forum to learn, collaborate, and grow. AI and cybersecurity are both becoming increasingly popular in CSE spaces, and educators and other stakeholders are looking for information on both content knowledge and practical guidance for instruction in K-12 environments. The CS Summit sought to meet this need, and based on 153 survey results, did so successfully. Beyond delivering content related to these "hot" topics in CSE, the summit also highlighted many perennial topics in CS: creating engaging and inclusive instruction, building awareness of career opportunities within and beyond traditional CS pathways, and providing information on many popular CS curricular options (including AP courses).

In addition to the content of the summit, the structure of the event itself contributed to its success. Being a *statewide* summit, information on changes to locally relevant topics (such as educator certifications and student learning standards) was made accessible to attendees, who would otherwise need to locate and interpret often complicated policy documents to stay current on these evolving issues. The summit was organized by a large research university through interdepartmental collaborations that leveraged a deep, longstanding network to create a robust agenda that delivered the right *messages* from credible *messengers*. The summit provided an organized venue for educators to access accurate knowledge from trustworthy sources (which, in increasingly complex media environments, is an important credential for PD). Finally, the summit operated within a collaborative environment at an academic venue – where meandering hallways and big lecture rooms against the backdrop of a historic campus made spontaneous connections and talking to peers inevitable.

Computer science, artificial intelligence, and cybersecurity are evolving topics themselves, and they will soon be joined by other fields (e.g., data science or quantum computing, which are gaining traction in K-12 CSE). Educational systems typically lag behind other innovations, but with computational literacies becoming ingrained across disciplines, K-12 systems must be prepared to equip all students, regardless of their career trajectories, with the knowledge, skills, and mindset to exist in, and shape, our future society. So, there is still work to be done; individual educators are looking for ways to bring cutting edge topics to their classrooms, expose students to computational literacies earlier and more frequently throughout their K-12 education, and continuously refine their CS instructional practices to be as effective, engaging, and inclusive as possible.

As such, high-quality, accessible professional learning opportunities need to be made available to this audience. The field must think creatively in terms of what professional learning can look like. The traditional definition of a "professional learning provider" may not be broad enough to meet demand, and there are numerous benefits for universities, state agencies, curriculum organizations, advocacy groups, and individual educators to participate in the process. Funding for this event was provided by an ongoing grant initiative, which allowed us to make this event free to attend, but this is not always the case; sponsored, or open-sourced delivery models, among others, can ensure all educators have access to learning opportunities. Events like this summit are well-positioned to foster connections among educational stakeholders and deliver a broad message to a broad audience, but more focused venues can differentiate content across educators with varied background knowledge teaching varied topics.

In short, an understanding of core computational literacies is an essential component of all students' K-12 education [2]. Supporting in-service educators in developing, delivering, and refining high-quality instruction in CS, AI, cybersecurity, and other emerging fields is necessary. The 2024 Rutgers University Computer Science Summit demonstrated success in advancing this work, and this paper presents both an adaptable case study of how it was conceptualized and implemented alongside a call to action for the development of similar events and complementary work.

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