EdWeek Research Center

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The State of Cybersecurity Education in K-12 Schools

Results of a National Survey

Executive Summary

Cybersecurity is a critical and rapidly growing field in which the demand for jobs is increasingly outpacing the supply of qualified employees. K-12 education has a key role in addressing this shortage both by raising awareness and interest in cybersecurity and by providing students with the fundamental knowledge they need in order to pursue cybersecurity career pathways. A new, nationally representative survey from CYBER.ORG, administered by the EdWeek Research Center, examines the prevalence, forms, and perceptions of cybersecurity education, according to more than 900 K-12 teachers, principals, and district leaders. Results suggest that students and educators alike have limited knowledge of cybersecurity. Less than half of respondents report that their districts or schools offer cybersecurity education. Access is uneven, with the cybersecurity education less likely to be provided in small and high-poverty districts or in cybersecurity deserts that lack cybersecurity companies or universities that study or offer coursework on the subject. When cybersecurity education is offered in K-12, it is typically infused into the existing, broader curriculum rather than taught as a standalone course. In addition, providing cybersecurity education through extracurriculars such as clubs, competitions, or camps too may spark a deeper interest in pursuing cybersecurity as a career. Many key topics, including cryptography, systems engineering, artificial intelligence, and electricity are rarely taught in schools. Likely as a result of this infrequent and uneven access, educators say most students are not well-informed about the educational and career requirements associated with cybersecurity jobs. The report concludes with suggestions for expanding and improving access while also making it more equitable.

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The State of Cybersecurity Education in K-12 Schools: Results of a National Survey

With the explosion of technology that has occurred in recent decades, cybersecurity is a vital and rapidly expanding field. Cybersecurity workers protect critical information, from personal bank accounts to military communications. Yet according to the National Initiative for Cybersecurity Education (NICE), a program of the National Institute of Standards and Technology in the U.S. Department of Commerce, there is a "dangerous shortage of cybersecurity workers that puts our digital privacy and infrastructure at risk." Currently, there are roughly two openings for every person employed in the field, according to NICE. And the situation is only expected to get worse with time. A 2017 projection by consulting firm Frost & Sullivan forecasts a shortage of 1.8 million cybersecurity workers by 2022.

Putting more professionals into the cybersecurity workforce pipeline requires an increase in foundational cybersecurity awareness at every level of education, including K-12, as well as awareness of cybersecurity as a profession. That's especially true since jobs in the field typically require formal education beyond high school, such as a bachelor's degree and additional professional certifications. Students need to be aware of these requirements so that they are prepared to meet them upon graduation. In addition, children and teens need to develop an awareness of cybersecurity even if they don't end up pursuing it as a career, if only so they can better protect their own data and critical infrastructure in the future. Yet until now it has been unclear how, if at all, K-12 students are learning about this essential function. A new survey from CYBER.ORG, administered by the EdWeek Research Center, examines this knowledge gap with a nationally representative online survey of more than 900 teachers, principals and district leaders.

Most K-12 Educators Do Not Know A Lot About Cybersecurity Education

In order to implement cybersecurity education, teachers and administrators need to know something about it. The majority of educators who responded to the survey (91 percent) say they know at least a little bit about the subject, which was defined for the purposes of the survey as providing students with an understanding of how connected electronic devices interact in a digital age, how to protect digital assets from vulnerabilities, and the moral and ethical issues surrounding the uses of technology in our society. However, just 10 percent say they know a lot.

About the Survey

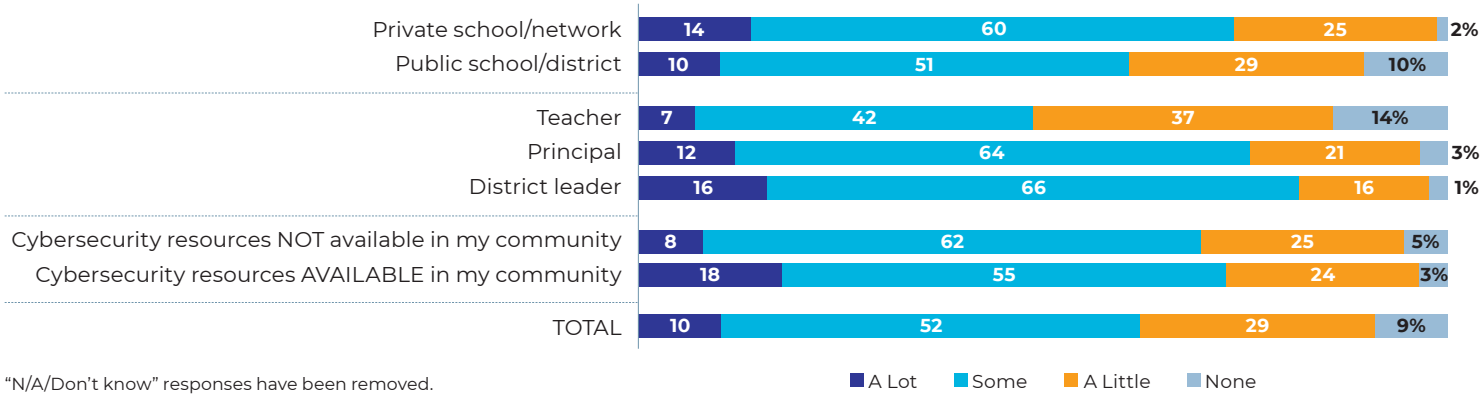
WHO: A nationally-representative sample of 918 K-12 educators [217 district leaders; 179 principals; 522 teachers]from the District of Columbia and all 50 states except Hawaii

WHAT: 21 questions about cybersecurity education. For the purposes of the survey, cybersecurity education was defined as providing students with an understanding of how connected electronic devices interact in a digital age, how to protect digital assets from vulnerabilities, and the moral and ethical issues surrounding the uses of technology in our society.

WHEN: Survey was fielded April and May 2020

WHERE: Survey was administered online

How much do you know about cybersecurity education?



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Cybersecurity Deserts Associated With Inequitable Access to Cybersecurity Education

Levels of educator knowledge vary significantly by work setting and professional role. Higher levels of knowledge are reported by private school employees, administrators, and educators in communities with cybersecurity resources. By contrast, lower levels of knowledge are reported among classroom teachers, in public schools, and in communities without cybersecurity resources such as cybersecurity companies, organizations that employ cybersecurity specialists, and universities that offer cybersecurity programs and/or conduct cybersecurity research. These "cybersecurity deserts" are disproportionately rural and poor: Eighty percent of educators who report no cybersecurity resources live in rural areas as compared to 33 percent of those who say their communities offer cybersecurity resources. And 28 percent of educators who work in cybersecurity deserts say that three quarters or more of their district's students live in poverty as compared to 17 percent who work in communities with cybersecurity resources.

Most Students Know Little or Nothing About Cybersecurity

Educators report that their students know less than they do about cybersecurity: While 62 percent of educators say they know a lot or some about the subject, just 40 percent say the same of their students.

Student and educator knowledge of cybersecurity are correlated: Educators who know a lot about cybersecurity say 66 percent of their students know a lot or some about the subject. Educators who know nothing about cybersecurity education say none of their students know a lot or some about the topic.

Higher levels of student knowledge are reported by private school educators and by those in low-poverty districts or communities with resources such as companies that employ cybersecurity specialists. Student knowledge levels are lower in public schools, and in cybersecurity deserts.

Student knowledge levels are also lower in higher-poverty districts, as defined as those in which survey respondents report larger shares of students from low-income families.

Together, these findings suggest that there is room for growth when it comes to student and educator knowledge of cybersecurity education. Knowledge building is especially critical in public schools, high-poverty areas, communities without cybersecurity resources, and among teachers.

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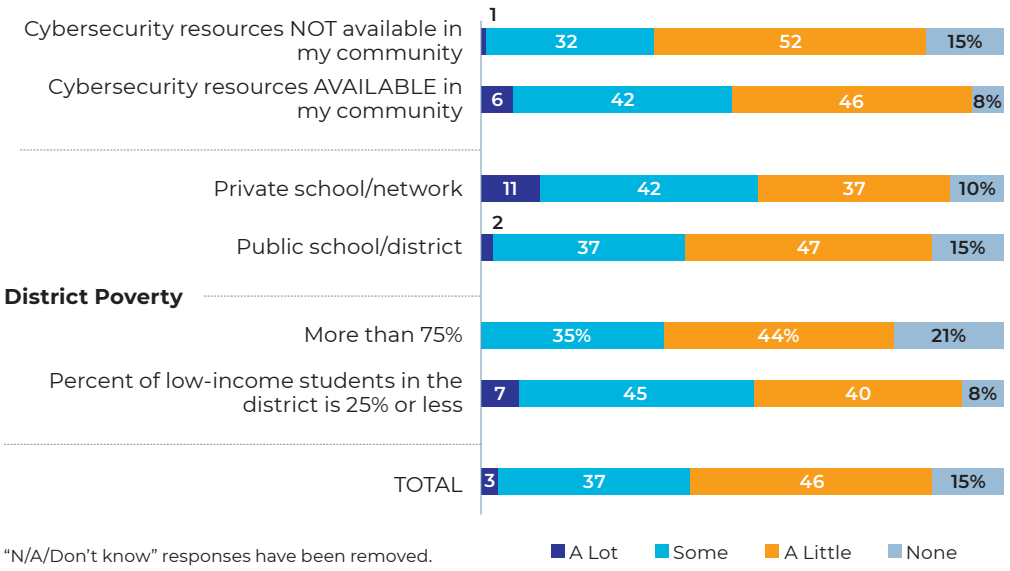
How much do your students know about cybersecurity education?



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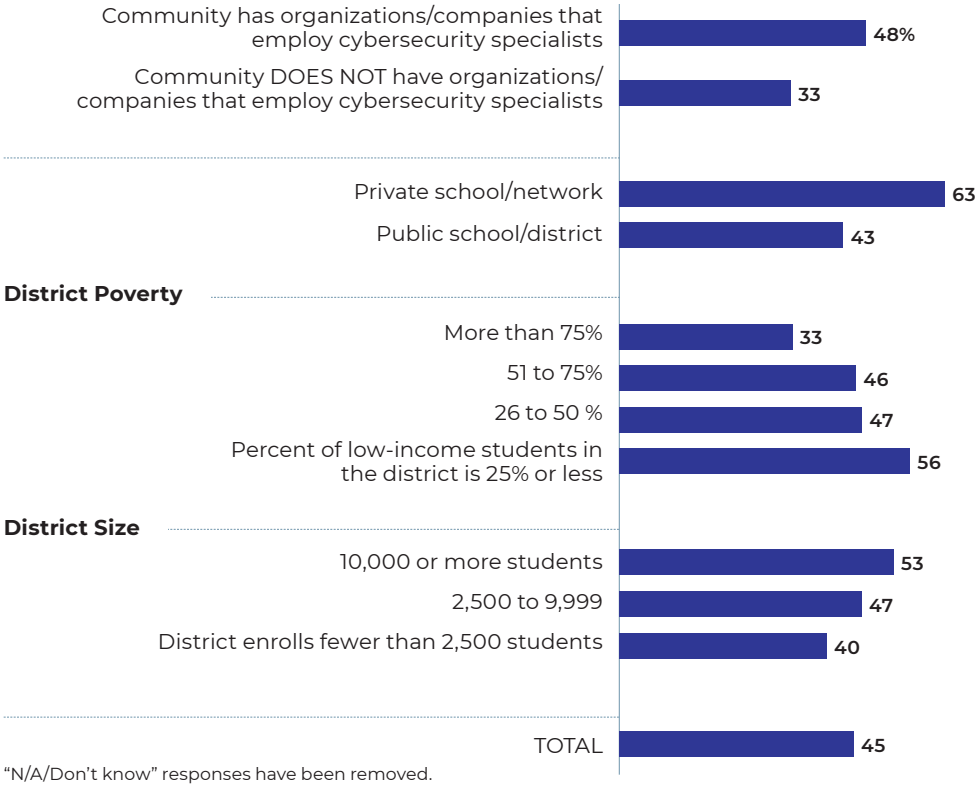
Access to Cybersecurity Education is Infrequent and Uneven

Given the dearth of knowledge about cybersecurity education, it is perhaps not surprising that less than half of educators surveyed (45 percent) say their students are learning about the subject.

However, it is clear that access to cybersecurity education resources is not consistent across communities and educational settings.

Students in small and high-poverty districts are significantly less likely to be exposed to cybersecurity education, as are those attending public versus private schools, or living in communities with no cybersecurity companies. These results suggest that relatively more privileged students may have more opportunities to be exposed to the field. This lack of access can have consequences down the road as coursework can build interest in careers. Educators who report that their students lack access to cybersecurity education are also less likely to say that their students are interested in learning more about cybersecurity careers.

Percent of survey respondents who say their students currently receive cybersecurity education



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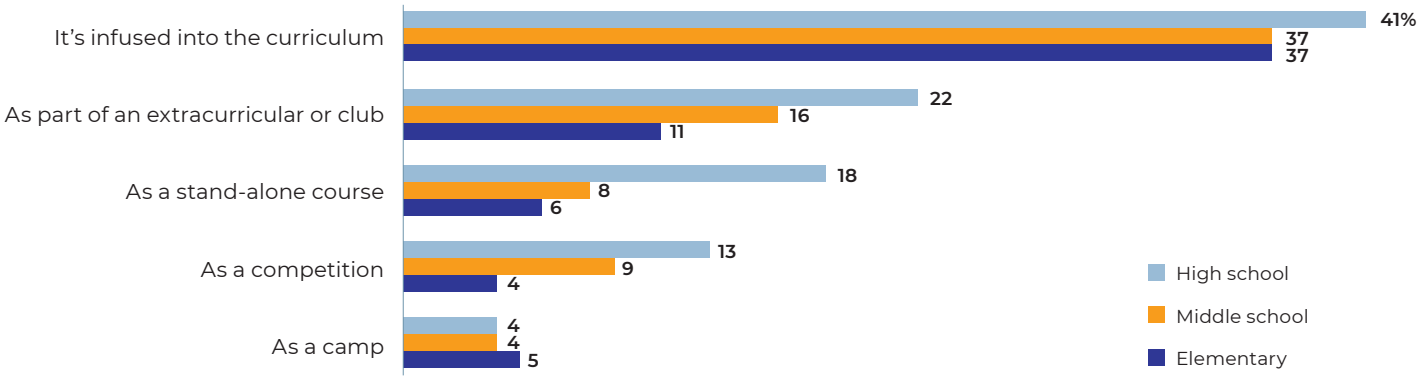
Many topics in cybersecurity education (such as digital literacy and electricity) are appropriate for the youngest learners.

Despite Student Interest, Cybersecurity Education is Rarely A Focus of Extracurriculars

Cybersecurity education is most frequently infused into existing, core curricula provided by schools, districts, and states. It's less often provided as a standalone course or provided via extracurriculars such as clubs, competitions, and camps. Many topics in cybersecurity education (such as digital literacy and electricity) are appropriate for the youngest learners. However, high school students are significantly more likely to be exposed to cybersecurity than are their younger peers both in the classroom and through extracurriculars. For example, 13 percent of educators say cybersecurity competitions are available to their high school students but just four percent report that elementary-aged children have that opportunity.

How, if at all, does your district provide cybersecurity education at the following grade levels?



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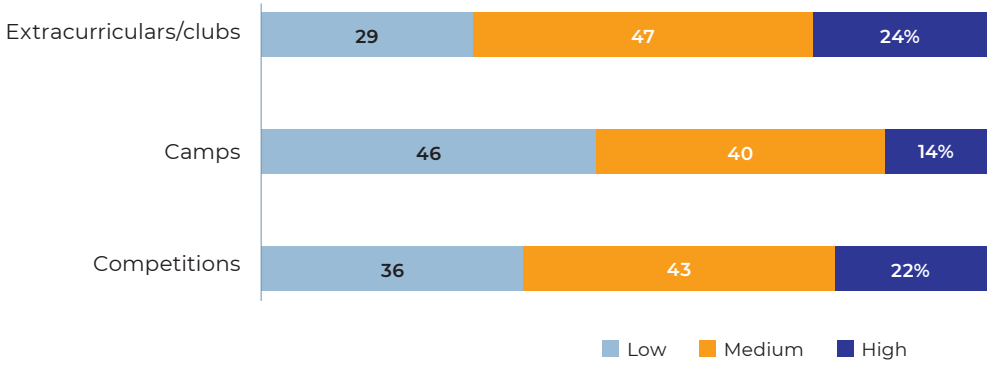
Although the most common approach to cybersecurity education is to infuse it into the curriculum, the majority of educators say their students would have at least a medium level of interest in also learning about the topic through extracurricular activities such as clubs, competitions and camps.

How would you rate your students' level of interest in learning more about cybersecurity in:



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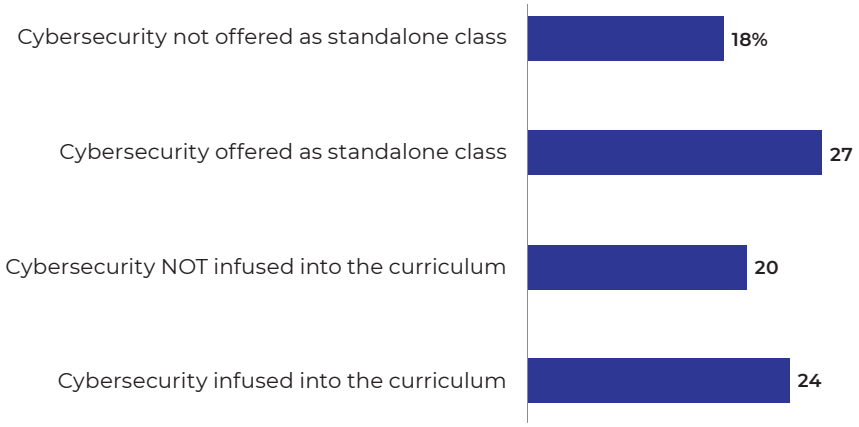
Student interest in cyber-related extracurriculars is a desired outcome of a strong cyber-infused curriculum, and an indicator of overall student interest in cyber pathways. For instance, students whose districts or schools infuse cybersecurity into the curriculum or offer the subject as a standalone class are significantly more likely to have a high level of interest in learning more about cybersecurity through competitions than are their peers who do not have access to cybersecurity subject matter during the regular school day.

Percent of educators who report that their students have a HIGH level of interest in learning more about cybersecurity through competitions



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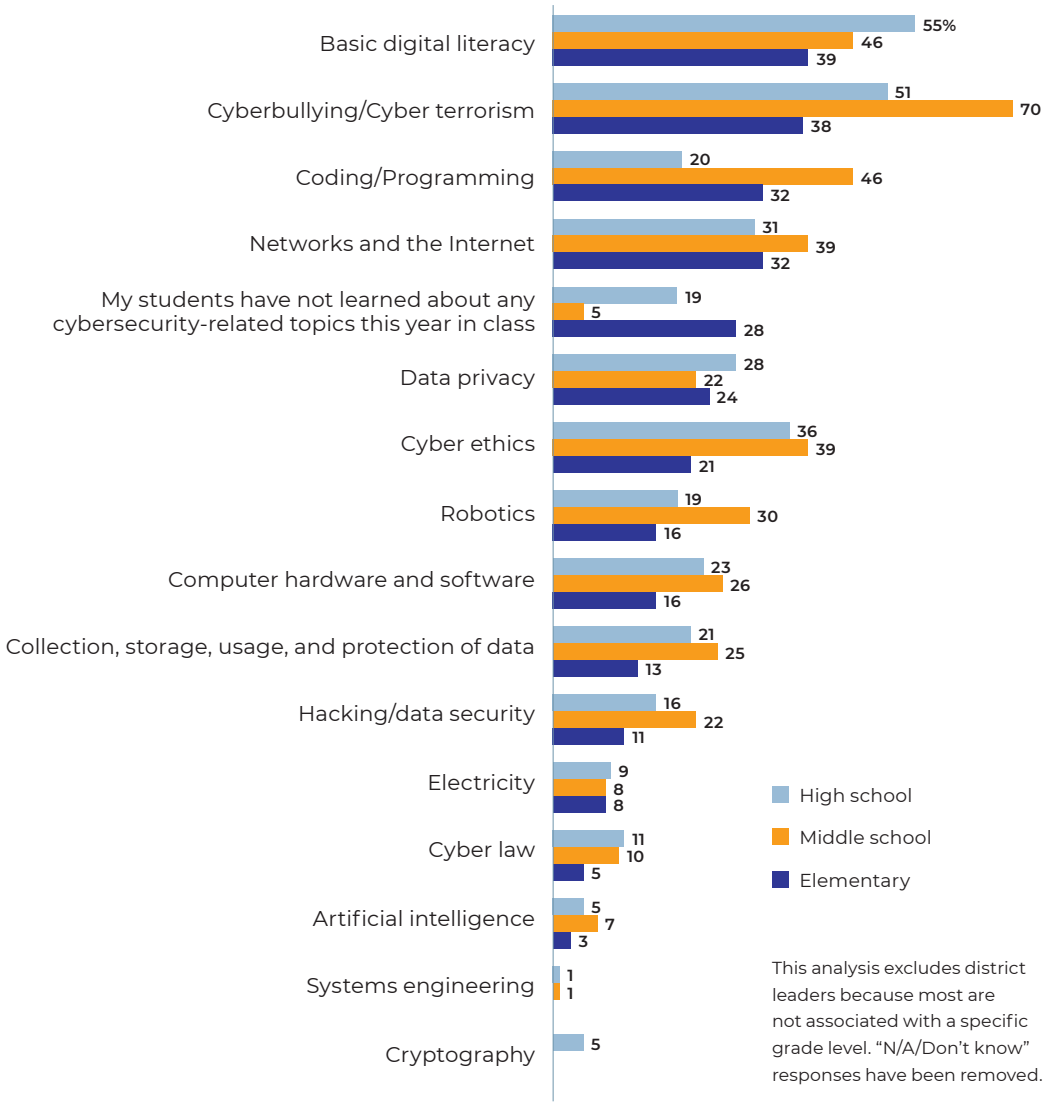
Less than 10 percent of educators say their students have learned about cryptography, systems engineering, artificial intelligence, electricity, or cyber law in the past year.

Cyberbullying/Terrorism is the Most Frequent Cybersecurity Education Topic in K12 Schools

When it comes to providing cybersecurity education through coursework rather than extracurriculars, educators say cyberbullying/cyberterrorism is the topic most likely to be taught. A majority of educators say their students have learned about this subject this year. Cyberbullying/cyberterrorism is the most frequently taught cybersecurity topic at the middle school level, where 70 percent of teachers and principals say their students have learned about that subject in the past year. Basic digital literary is the most frequently-taught topic at the elementary and high school levels. Many important cybersecurity topics are rarely if ever taught in schools. Less than 10 percent of educators say their students have learned about cryptography, systems engineering, artificial intelligence, electricity, or cyber law in the past year.

Artificial intelligence is the top interest at the middle and high school levels.

Which of the following cybersecurity-related topics have your students learned about this year in class?



This analysis excludes district leaders because most are not associated with a specific grade level. "N/A/Don't know" responses have been removed.

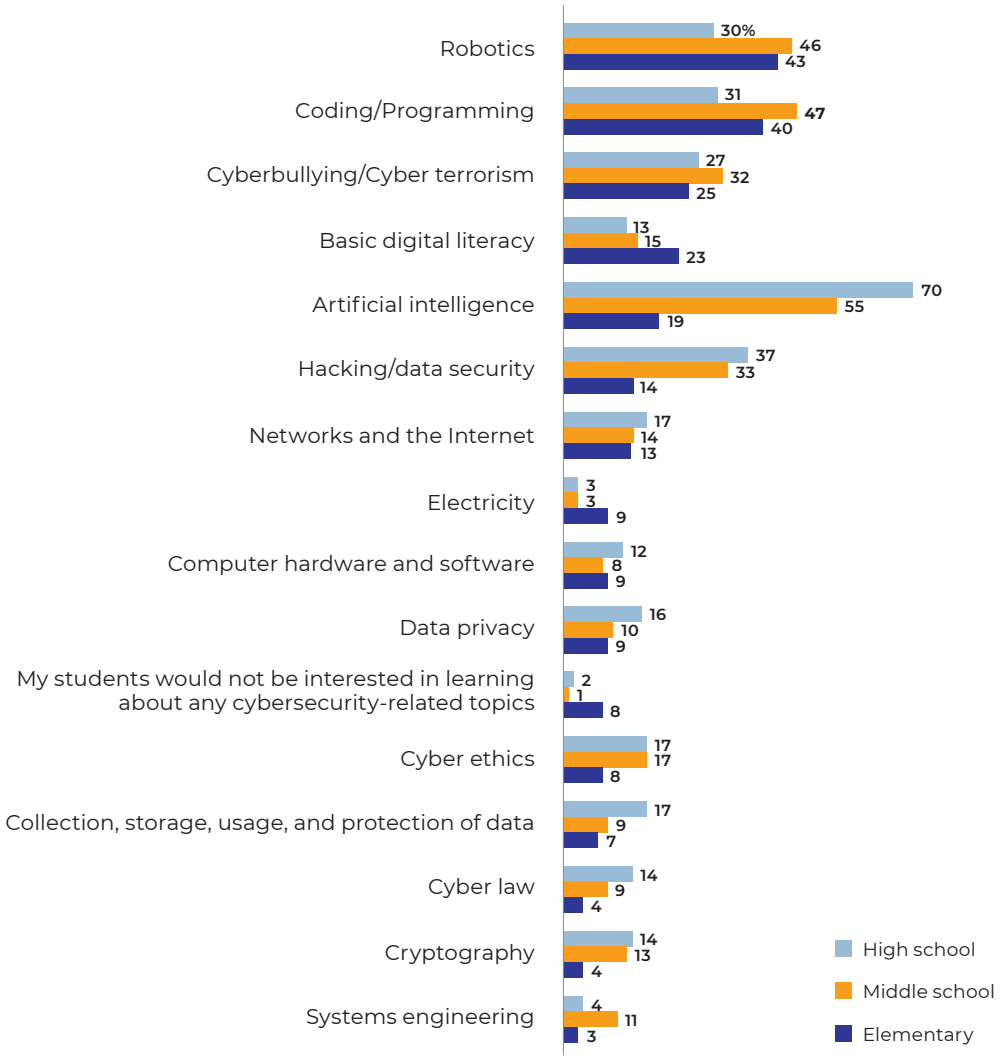
Robotics and Artificial Intelligence Fascinate Students

Robotics is the cybersecurity subject that educators are most likely to say greatly interests their students. At the elementary level, 43 percent of teachers and principals say their students would like to learn more about it. Artificial intelligence is the top interest at the middle and high school levels. Seventy percent of high school teachers and principals and 55 percent of their middle school peers say their students would be very interested in learning more about this topic.

Education often drives interest. For example, teachers and principals say that 65 percent of students who learned about robotics this year in class are very interested in learning more about it. By contrast, just 35 percent of students who did not learn about robotics this year are interested in learning more about that subject, according to their teachers and administrators.

More than 2 out of 3 educators say their students have a low level of awareness of steps they need to take to obtain a cybersecurity job.

Which of the following cybersecurity-related topics do you think your students would be VERY INTERESTED in learning about?



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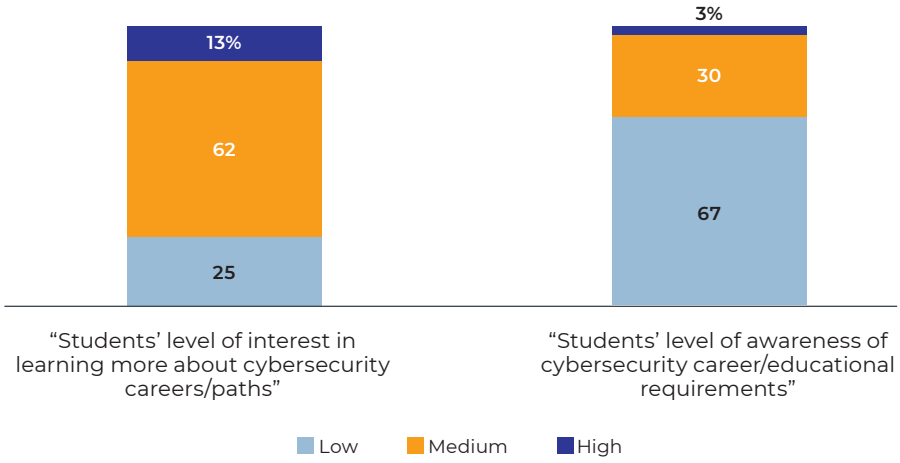
Focus on the Future

When it comes to cybersecurity education in K-12 schools, there is certainly room for growth. But, there is also plenty of evidence to suggest that cyber education is in demand. For example, three quarters of educators say their students have a medium or high level of interest in learning more about cybersecurity careers and career paths.

That said, more than 2 out of 3 educators say their students have a low level of awareness of steps they need to take to obtain a cybersecurity job. Rates of awareness are even lower in cybersecurity deserts. Seventy-three percent of educators in these communities say their students' awareness of cybersecurity career paths is low, as compared to 58 percent in areas that do have cybersecurity resources. This finding suggests that where cybersecurity ecosystems are not yet established, K-12 education is even more critical.

Even when community resources do exist, educators still play a critical role by finding ways to engage their interest in cybersecurity-related subjects.

Cybersecurity careers: Level of interest versus level of awareness



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Conclusions and Recommendations

Cybersecurity is an important and rapidly growing career field that can lead to well-paid jobs that offer the opportunity to pursue mission-based work protecting the privacy and safety of the world around us. Yet a sizeable and growing gap exists between the supply of jobs and the size of the workforce qualified to fill them. The results of the survey reported in this white paper suggest that one very basic reason may be a dearth of knowledge, awareness, and engagement with the field, not only among students, but to a certain extent, among K-12 educators. While students

in communities with cybersecurity companies, university cybersecurity programs, and other relevant resources may bridge that gap with knowledge acquired outside of school, those who live elsewhere rely more heavily on educators to teach them what they need to know. And even when community resources do exist, educators still play a critical role by finding ways to engage their interest in cybersecurity-related subjects. For example, educators were significantly more likely to report that their students were very interested in learning more about cybersecurity topics that had been taught to those students in the past year. The findings of this survey suggest several ways in which K-12 educators can improve the odds that students pursue cybersecurity careers, or, even if they don't end up pursuing those careers, develop the basic level of understanding they need to protect their own data privacy and security. These recommendations include:

- **Ensuring access to cybersecurity education in cybersecurity deserts:** Survey results suggest that students who live in communities without resources like cybersecurity companies or universities that study cybersecurity also have less access to multiple aspects of cybersecurity education, from coursework to educators knowledgeable about the topic. These communities, which are disproportionately low-income and rural, represent a critical starting point for expanding access to cybersecurity education if students are to have equitable opportunities to choose cybersecurity career pathways.
- **Raising basic levels of knowledge about cybersecurity education.** Educators can't teach their students about cybersecurity unless they know something about it themselves. In fact, educators who report higher levels of knowledge about cybersecurity education say their students also have higher levels of cybersecurity knowledge. Knowledge-building efforts are especially critical in areas where knowledge levels are lower, such as high-poverty school districts, and cybersecurity deserts and also among teachers, who report lower levels of knowledge than do administrators.
- **Increasing the number of schools offering cybersecurity education:** Less than half of survey respondents say their students are exposed to cybersecurity education, which encompasses everything from basic digital literacy to systems engineering and cryptography. Cybersecurity education is less likely to be found in low-income communities, in smaller school districts, in public schools, and in cybersecurity deserts, suggesting a focus for expansion efforts.
- **Enhancing educational offerings:** When provided, cybersecurity education is most often infused into the curriculum. It's also sometimes offered as a standalone course or incorporated into competitions, clubs, and camps. By varying the venues in which the material is introduced, educators might engage a wider array of students, while also better serving those with higher and lower levels of interest in the subject matter, or niche passions for specific topics.
- **Informing students about cybersecurity careers:** Gone are the days when students walked out of their high school graduations and onto the floors of factories providing

When provided, cybersecurity education is most often infused into the curriculum rather than offered as a standalone course or incorporated into fun activities such as competitions, clubs, and camps.

well-paid work. Like most positions that pay a living wage, cybersecurity jobs typically have educational requirements, even for entry-level positions. If students are unaware of these requirements by the time they reach the upper grades, they may not pursue the prerequisites necessary to fulfill them through postsecondary education. When this occurs, graduates waste valuable time and money acquiring skills, knowledge, and certifications they could otherwise have gained in high school.

Some schools are already exposing students to key aspects of cybersecurity education, from basic digital literacy to coding and hacking and many students are already interested in the subject, but there is certainly room to grow with respect to K-12 cybersecurity education, especially when it comes to equitable access. By building knowledge, expanding and enhancing curricular and extracurricular offerings, and raising awareness about career pathways, K-12 educators, especially those located in underserved communities, can help brighten students' career prospects, while ensuring that the nation's critical data security needs are met for years to come.

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