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What do high school students know about the field of cyber security? A survey of perception and experiences

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Abstract

This study investigates high school students' perceptions of cybersecurity careers, focusing on two primary research questions: (1) What are the perceptions of high school students about a career in cybersecurity? and (2) What level of exposure to cyber careers do high school students have? The study used a 21-item survey instrument and collected 208 responses from high school students. The results suggest that students' preparedness and confidence in pursuing cybersecurity careers are significantly influenced by three key factors: high awareness of cybersecurity issues, early exposure to cyber-related activities, and access to dedicated cybersecurity courses. The findings indicate that students who are more aware of cybersecurity concepts and challenges, often through social media, extracurricular involvement, or personal interest, exhibit a stronger interest and confidence in cyber careers. Any other exposure to cyber security careers through cyber clubs, competitions, and hands-on workshops enhances perceived readiness. Additionally, participation in specialized cybersecurity courses within the school curriculum is associated with increased feelings of preparedness and capability to enter the cybersecurity workforce. Our study emphasizes raising awareness, providing early practical experiences, and integrating comprehensive cybersecurity education in high schools to better prepare students for careers in this critical and growing field.

Keywords: information technology, undergraduate students, cyber security, high school, survey

Introduction

The number of cybersecurity crimes is rising, and so is the demand for cybersecurity professionals. According to Rende (2023), over 700,000 cybersecurity positions in various fields must be filled to protect digital assets effectively. While there are extensive opportunities for careers in cybersecurity, many young people on the verge of their career choice do not consider this field a possibility for various reasons. In some cases, the students are afraid of cybersecurity being a highly technical field, not only challenging to study but creating a “nerd” perception toward the professionals in this field. In other cases, the perceived lack of opportunities to grow, especially for women, is a problem compared to other fields that are understood as more inclusive (Hoteit, 2022).

Exposure to career options is significant in high school. Students make their impressions based on information and experiences, and it is overlooked if they are not exposed to a potential career field. According to Rosenzweig and Chen (2023), the overlooked category is the most common among the four categories: appealing, unappealing, polarizing, and overlooked.

Overlooked career prospects or unappealing career perceptions often stem from lacking exposure to the field. In case with cybersecurity, most high school students are familiar with the term due to its popularity; however, they do not always have adequate exposure to information about it, including information about possible careers, professional activities, discussions with professionals, etc. In this paper, we aim to understand how high school students perceive careers in cybersecurity and what exposure (or lack thereof) formed these perceptions. The study includes the following research questions:

RQ1. *What are the perceptions of high school students about a career in cybersecurity?*

RQ2. *What level of exposure to cyber careers do high school students have?*

The rest of the paper is organized as follows: The next section presents a critical review of the extant literature and a description of the data collection methodology. The results section presents the analysis of survey data. The results are discussed, implications are drawn, and conclusions are provided.

Literature Review

Many factors influence a student's decision to enter a computing major in college and a computing career field (Shulga et al., 2023). This is even an issue with non-American students studying English to attain STEM education/careers, where more career information is gained via social media than through their secondary education system (Zigmont & Wolfe, 2022). In high schools with Computer Science (CS) courses, those students report higher motivation and more positive views of the career field (Armoni & Gal-ezer, 2023). It is not only the CS courses; however, math anxiety can dissuade high school students from careers with high math intensity (Eidlin-Levy et al., 2023). Additionally, the impact of high school CS teachers (Craig et al., 2019; Brassai & Kiss, 2020) and even career days (Kutlu & Bedel, 2021) can help lead students down or away from this path.

Targeting recurring programs to specific demographics can have even more effect, especially in the middle school years (Rowland et al., 2018; Shan & Yang, 2021). This would be extremely helpful in attracting more women to the field, given that high school females overwhelmingly least prefer CS-type careers because they feel they would not fit in (Rosenzweig & Chen, 2023). Outside of the classroom, some factors contribute to students' career decisions. Parents who are overly involved and frequently intervene in their child's career planning process negatively affect the child's ability to select a career (Cheung, 2024). Determining the perceptions of high school students on STEM careers goes beyond the general field of CS. Sub-fields, such as robotics, are perceived as adding efficiency to the classroom and life in general (Tinmaz & Fanea-Ivanovici, 2023). The field of cyber security has its issues with perception. Some students report feeling that cost and time are barriers to entering the field (Crandall et al., 2019). Gamification of cyber concepts has also been tested at a cyber camp regarding perceptions of the field, with males realizing a more positive impact than females (Jin et al., 2018). Another camp found the opposite effect, surmising that males attempt to protect their self-worth by devaluing cyber tasks when perceived as too difficult (Turner et al., 2014).

The bigger problem, however, is that the lack of awareness of the cyber field exists at the primary school level, with infrequent training having little to no effect (Ondrušková & Pospíšil, 2023). Part of the problem is that some K-12 educators are not confident in designing and implementing cybersecurity lessons (Childers et al., 2023). Providing these educators with professional development and support is essential to achieve teaching excellence in these topics (Chen et al., 2021). Including cyber/CS concepts as part of the curriculum using a gamified environment is one way to have more frequent interactions with the subject

matter while still being at a level comprehensible to the learner (Videnovik et al., 2023). Sub-fields that could lead students to cyber, such as Artificial Intelligence, are still in their infancy in the K-12 classroom. However, the United States and China are implementing more than others (Casal-Otero et al., 2023). Others, such as robotics, are also being introduced at the primary school level to teach algorithmic and programming skills (Athanasiou et al., 2017) as well as problem-solving and presentation skills (Evripidou et al., 2020). Many other studies have been done on various cyber topics with pre-university students. Altogether, the body of literature can be distilled into four perception-influencing items: interest, field importance, career rewards, and career opportunities, but a gap still exists with the foundation of these perceptions.

Methodology

We used a survey as the instrument in this study, which included three sets of questions: (1) Perception of a career in cybersecurity, (2) Exposure to information about cybersecurity careers, and (3) Demographics. The first two sets were mapped to two research questions and included a quantitative portion with the Likert scale questions and a qualitative portion with open-ended questions. In the first question set, we addressed the four most common factors described in the literature as influencing people's career decisions: interest, perceived importance of the field, perceived career rewards, and perceived career opportunities. The second set addressed all the most common ways of exposure to the field and the frequency of exposure: activities/competitions, media, and high school curricula/extracurricular activities. This set included one open-ended question asking the students to name other sources of exposure, if applicable. The demographics set included questions about the student's age, gender, grade (only junior and senior were acceptable), plans after high school, type of school, GPA, and exposure to social media. The subjects included junior and senior high school students. We did not require equal demographic distribution in any characteristic except gender, where we wanted to see the same groups of male and female students. A third party, a data collection agency, was used to recruit participants and ensure they qualified for the study. To qualify, a respondent must be a current junior or senior high school student familiar with "cybersecurity." Data collected from 230 qualifying respondents was then analyzed using descriptive statistics, correlation tests, and ANOVA. The results of this analysis are presented in the following section.

Results and Discussions

230 students completed the survey. The age breakdown is shown in Table 1. The age range for participants was 15 years to 19 years. 35.8% reported their age as 17, and 34.9 % reported their age as 18. 28.2% of students were 16 years old. The gender breakdown was approximately even, with 48.8% male, 48.3% female, and 2.9% non-binary. The grade breakdown of the sample shows 45.5% as Juniors and 49.2% as seniors in the pool. The majority (65.3%) reported their plans to attend college. Table 1 shows all of the students' reported plans.

Table 1: Career intent after high school

Grade	Count N=208	Percent
College	136	65.3
Trade School	22	10.5
Military	11	5.2
Work	20	9.6
Other	2	1
Not sure	17	8.1

Most students (70.4%) reported attending a public school, with 9.6% in private schools, 6.1% being homeschooled, and 3.9% in a charter school. The subjects' reported GPA is shown in Table 4, but almost 80% reported having a GPA over 3.0

Table 2: GPA

GPA	Count N=209	Percent
3.5 or more	101	48.3
3.0 to less than 3.5	66	31.6
2.5 to less than 3.0	25	12
2.0 to less than 2.5	9	4.3
Under 2.0	8	3.8

60% of the students reported using Social media three or more hours a day, with more than 28% reporting over 5 hours daily. Complete data is shown in Table 5.

Table 3: Social Media Use

Hours per Day	Count N=209	Percent
Less than 1 hour a day	8	3.5
1 to less than 3 hours a day	63	27.4
3 to less than 5 hours a day	73	31.7
Five or more hours a day	65	28.3

RQ1. What are the perceptions of high school students about a career in cybersecurity?

All of the students had heard of cybersecurity as a career choice, but only 24.1% were “Extremely Interested” or “Very Interested,” with 34.1% reporting “Not Interested” or “Not at all interested”. At the same time, 85.5% reported that cybersecurity was “Extremely Important” or “Important” in today’s digital age, and 12.3% thought cybersecurity would be an “Easy” or “Very Easy” field the majority.

In the sample, 55.5% reported that it would be a “Difficult” or “Very Difficult” field of study. Only 3.7% thought the field would not be financially rewarding. This mirrors their view on the opportunities for careers in cybersecurity, with 60.9% seeing “plenty or sufficient” opportunities and only 2.8% seeing little or no opportunities. The students were less confident about what a career in cybersecurity entailed, with only 32.3% reporting being “Extremely confident or Confident” in their knowledge of the field.

The data clearly show that most students think cybersecurity is an essential field of study, that a majority think it is financially rewarding, and that they are interested in pursuing a career in it. However, they were also aware of their limited knowledge of cybersecurity as a career choice.

Post Hoc RQ1

A series of ANOVAs was conducted to compare respondents' reported age and gender with their views on the cybersecurity field. Table 4 shows significant results. The ANOVA reported significant differences between the reported genders and the survey question. “How challenging (difficult) do you perceive a career in cybersecurity to be?” This same question found differences in groups based on their plans. A Tukey analysis showed significant differences between the students headed to the military and those who listed “College” ($p = .027$) and “Not Sure” ($p = .048$) as their plans. The ANOVAs for the survey question, “How important do you believe cybersecurity is in today's digital age?” yielded two significant results; “Future

Plans” and “GPS.” A Tukey analysis showed significant ($p = .041$) differences between the students headed to college and those who listed “Other” as their plans. Students with a GPA of 3.5 or more had a significant difference ($p=.011$) from the group with an OA between 2.0 and 3.5.

Table 4: ANOVA results for demographic vs cybersecurity knowledge

Survey Question	Age	Gender	Year in school	Plans	GPA
How interested are you in learning more about cybersecurity as a potential career?	.301	.199	.143	.637	.390
How important do you believe cybersecurity is in today's digital age?	.864	.913	.432	.049	.017
How challenging (difficult) do you perceive a career in cybersecurity to be?	.121	.021	.731	.024	
How financially rewarding do you think a career in cybersecurity would be?	.781	.915	.767	.835	.081
Do you believe there are enough opportunities for careers in cybersecurity?	.923	.701	.076	.997	.345
Are you confident that you understand what a career in cybersecurity is?	.183	.465	.326	.397	.311

Students responded to the question, “Are you confident that you understand what a career in cybersecurity is?” using a 5-point Likert-type scale. Those results were recorded down to a 3-point scale with “Extremely Confident” and “Confident” being merged and “Not so confident” and “Not at all confident” being merged. ANOVAs were conducted between this new variable and the other survey questions. Two of the questions showed significant interactions. “How interested are you in learning more about cybersecurity as a potential career?” ($p= .009$) and “How challenging (difficult) do you perceive a career in cybersecurity to be?” ($p = .002$). A Tukey analysis showed a significant difference between the students most confident in their knowledge of cybersecurity, the neutral group ($p=.017$), and the group not confident ($p=.013$).

Our data suggest that the more confident the student is in their understanding of cybersecurity, the more willing they are to consider it a career. The responses were diverse when asked about the potential benefits of pursuing a cybersecurity career. One respondent emphasized personal safety, stating, “Knowing how to be cautious and protect yourself from any cyber harm or digital stealing”. Others expressed a desire to contribute to society, with one respondent saying, “I think you have the potential to help many people in a world with growing technology daily, and that is a crucial role in our modern society.” Another respondent highlighted the professional advantages, stating, “cybersecurity comes with many benefits. It is in high demand currently, so anyone can honestly find a job in it. Also, it pays well and offers an intellectual challenge to those who want it”.

One of the open-ended questions was about the potential drawbacks of pursuing a career in cybersecurity. Many respondents reported that lacking knowledge and evolving skills could limit personal growth in the field. Constantly learning newer skills is challenging and complex. One respondent noted, “Might be highly technical, and a big learning curve is involved.” Our respondents consistently noted that the field is technical and requires much hard work and dedication to succeed. As noted by a respondent, “The amount of studying required, the mathematics involved, the understanding and logic is a lot.”

The survey has open-ended questions about factors that discourage high school students from pursuing a career in cybersecurity and their perception of that career. A follow-up question was about the skills necessary for a cybersecurity career. Our respondents feel that the complex content in the cybersecurity curriculum and the level of difficulty in sustaining and keeping up with the job requirements are the factors that discourage high schoolers from pursuing cybersecurity careers. They find math and coding in the cyber field intimidating compared to other majors. One respondent suggests, “Many things high school students nowadays would rather get a career in healthcare, engineering, or office work, something that does not require that much-advanced technology and training.” This underscores the crucial role of educators, policymakers, and career counselors in addressing these challenges and developing strategies to encourage more students to pursue cybersecurity careers.

When asked, “What do you think a career in cybersecurity involves?” our respondents suggested that it is hard to stop hackers from stealing data. They shared that it involves long working hours on computers and not having enough social life. One respondent noted, “I think that a career in cybersecurity involves doing a lot of trial and error based on what you already know, team effort, and careful navigation of dangerous files, among other things.” The skills/qualifications necessary for a career in cybersecurity, as our data suggests, are coding, math, problem-solving, and dedication.

Our respondents believe that a solid background in computer science, a good understanding of human nature, and hard work are required to succeed in this field. They also believe that certifications are an excellent way to get technically literate. One respondent noted, “At least to be a very successful person at a very high IT level, you should have a CISCO certification since a certification like that is more useful than a college degree.”

RQ2 What level of exposure to cyber careers do high school students have?

Students were asked about their exposure to cybersecurity-related activities, and only 24.5% reported doing anything related to cybersecurity. When asked how the media portrays cybersecurity, 38.9% reported either “agree” or “strongly agree” that it is portrayed as an attractive field. With only 15.7% reporting, the media did not portray it as an attractive field. Almost 70% reported that they do not know enough about careers in cybersecurity, and almost 65% think “That it is important for high schools to offer more courses or extracurricular activities related to cybersecurity.” When asked, “What additional information/experiences/resources do you think would be helpful for high school students interested in pursuing a career in cybersecurity?” The students responded with a variety of options. After a thematic review and two-level reduction of the responses, Table 5 shows the results.

Table 5: Emergent themes in qualitative thematic analysis

Theme	Count
Classes/Education	31
More info about the field/info from working professionals	15
Internships/hands-on experience	13
Learning coding	7
More Extra-curricular activities	6
Salary information	4

These themes support the quantitative results showing that students want more information and that their lack of experience with extracurricular activities is due to their lack of availability rather than their lack of participation.

Spearman’s Correlations were run for the survey questions. Significant results were found and are listed in Table 8. Interestingly, the correlation between the questions, “Do you believe there is enough information available to high school students about careers in cybersecurity?” and “Did you participate in cybersecurity-related activities or competitions?” was only .086.

The survey item, “How interested are you in learning more about cybersecurity as a potential career?” was found to be correlated with “Are you confident that you understand what a career in cybersecurity is?” and “Did you participate in cybersecurity-related activities or competitions?” (table 6). Students with a high level of interest and awareness in cybersecurity are interested in knowing more about cyber careers.

The survey item “How important do you believe cybersecurity is in today's digital age?” is correlated with the item “Are you confident that you understand what a career in cybersecurity is?” and negatively correlated with “Did you participate in cybersecurity-related activities or competitions?” (table 6). These relationships make sense since the importance of cybersecurity in today’s world can be appreciated if students are confident about what a career in cybersecurity entails.

Table 6: Spearman Rho results

Question	Q1	Q2	Q3
How interested are you in learning more about cybersecurity as a potential career?	.212**	.346**	.117
How important do you believe cybersecurity is in today's digital age?	.148*	-.220**	-.074
Are you confident that you understand what a career in cybersecurity is?	1.00	.168*	.202**

** Correlation is significant at the .01 level

* Correlation is significant at the .05 level

The survey item “Are you confident that you understand what a career in cybersecurity is?” is correlated with items “Did you participate in cybersecurity-related activities or competitions?” and “Do you believe there is enough information available to high school students about careers in cybersecurity?” (table 6). Our data indicates that confidence about understanding a cybersecurity career is related to cyber activities that students have participated in during high school. It also suggests that if enough information and exposure about cyber-related fields and careers is provided to students during high school, their confidence in understanding the career challenges and goals in the cybersecurity arena goes up.

The negative correlation between the “importance” variable and the “Activities” variable shows that the importance of cybersecurity is a widely held belief. It is held by individuals well beyond those who are interested in the field, as shown in the crosstabs in Table 7.

Table 7: Belief in cybersecurity importance vs. participation – crosstab analysis

		Did you participate in cybersecurity activities or competitions?				
		Yes, All the time	Yes, many times	Yes, occasionally	Barely	No, I do not participate
How Important do you believe cybersecurity is in today's digital age?	Extremely Important	5	9	5	15	83
	Important	1	9	11	10	37
	Somewhat important	2	3	5	5	13
	Not so important	0	0	3	0	0

For this research question, we had an open-ended question: “What additional information/experiences/resources do you think would be helpful for high school students interested in pursuing a career in cybersecurity?” A thematic analysis of all the answers provided suggests three themes: awareness, early exposure, and opportunities in high school. Our data suggests that awareness about cybersecurity through campaigns or speakers/clubs during high school would greatly interest young kids in a potential career field.

We also found that early exposure to cyber-related activities helps shape the perception and confidence of young students. Reaching out to young kids through social media platforms such as TikTok or Instagram might help educate these young adults about the importance of cybersecurity in the world. One of the respondents noted, “More classes about learning how to do things online and how the Internet affects society and telling us the darker sides of the Internet and how we can protect others.” This exposure to cyber security could be through competitions, clubs, or dedicated cyber security courses to get students interested in the field. As one of our respondents suggested, “Things that would be helpful for students interested in the cybersecurity field would be ensuring proper computer and access to different forms of malware attacks and see how it works.”.

This study has limitations. The sample used for the study was selected by an outside vendor providing these services. It cannot be assumed to be a representative sample of the population. We did not have a breakdown of ethnicity and race, which is an essential factor for this study. For surveys, self-reporting bias always exists. We did not collect identifying demographic information about the type of high school (public/private) and modality (in-person or online). These factors always influence the perception of high school kids about potential majors and careers.

This study has implications for research and practice. Our results imply that policymakers, educators, and high school and university administrators need to work at a societal level to create awareness and interest in young adults about the need and importance of cybersecurity professionals in the workforce. The cybersecurity talent shortage is due to limited exposure to the profession and a lack of cyber education and training in this domain at a younger age with school systems (Help Net Security, 2023). It is time to demand better K through 12 education system coverage of cyber topics.

More research is required to find strategies to improve student confidence in math and coding. The perception of the cybersecurity field needs to be managed so that high school students do not feel intimidated by it. Many cybersecurity areas, such as security compliance, IT auditing, and risk management, are not math-heavy or coding-intensive. These jobs and skills could be highlighted, and the barriers to applying for such discipline could be removed.

Conclusion

This study highlights high school students' perceptions of cybersecurity careers and explores crucial factors influencing their confidence and preparedness to pursue cyber career paths. Survey data was collected from 208 high school students and analyzed using SPSS and qualitative thematic analysis. Our results suggest that a multifaceted approach helps create interest and readiness in cybersecurity careers. Students aware of cybersecurity issues—through social media, extracurricular activities, and personal interests—demonstrate tremendous enthusiasm and confidence in this field. We also found that early exposure to cybersecurity through activities like cyber clubs, competitions, and hands-on workshops significantly boosts students' confidence in cybersecurity careers. These findings have implications for educational institutions and policymakers. They underscore the critical role that awareness and early exposure/experiences play in shaping students' perceptions and confidence for careers in cybersecurity.

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