



# Developing Digital Awareness at School: A Fundamental Step for Cybersecurity Education

Isabella Corradini<sup>1,3</sup>(✉) and Enrico Nardelli<sup>2,3</sup>

<sup>1</sup> Themis Research Centre, Rome, Italy

isabellacorradini@themiscrime.com

<sup>2</sup> Department Mathematics, University Roma Tor Vergata, Rome, Italy

nardelli@mat.uniroma2.it

<sup>3</sup> Link & Think Research Lab, Rome, Italy

**Abstract.** The theme of cybersecurity regards people *in primis*, considering that everyone uses digital technologies both in professional and private life, and that people's behaviour plays an important role in the occurrence of cyberthreats. The human factor has therefore to be recognized as an essential element to be considered for developing an effective cybersecurity, and education is the key driver. However, since children access online activities at an early age, it is wise to develop interventions to promote digital awareness from first years at school, focusing on the responsible use of digital technologies. Becoming conscious of the risks they are exposed to is an important step for children to move safely on the Internet and to understand the different cyber-risks they have to face. This activity represents hence a fundamental step for cybersecurity education.

In this paper we present a study investigating Italian school teachers' perception of their students' digital awareness and their evaluation of the actions needed for its development. Answers were provided by 2,229 teachers from all over the country belonging to primary and secondary schools, participating in a national project whose goal is to spread computer science and to sensitize students to a proper use of digital technologies.

The results confirm the high sensitivity of teachers towards digital awareness issues. Indeed, students should be prepared to recognize risks when they use digital technologies: not only cyberbullying, they should pay more attention to the protection of their personal data, and to the reliability of news on social media. Moreover, teachers declare the need for themselves to receive specific training on digital awareness, and to be supported in their activities.

**Keywords:** Digital awareness · Cybersecurity · Education

## 1 Introduction

Over the last few years, the theme of cybersecurity has become a great challenge for every country and a significant problem to handle for all organizations. Cyber-threats

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Switzerland AG 2020

I. Corradini et al. (Eds.): AHFE 2020, AISC 1219, pp. 102–110, 2020.

[https://doi.org/10.1007/978-3-030-52581-1\\_14](https://doi.org/10.1007/978-3-030-52581-1_14)

and attacks continue to grow, notwithstanding the availability of innovative technological solutions and important regulations aimed at protecting personal information (The General Data Protection Regulation, GDPR).

Many are convinced that cybersecurity is above all a human problem (e.g. [1, 2]), and that cybersecurity awareness programmes are needed to respond to the gap between people and digital technology [3]. However, there is still a general tendency to mainly focus on a technical perspective, thinking that innovative solutions, for example the newest ones based on Artificial Intelligence, are able to solve both current and future security problems.

On the other hand, developing a different attitude towards cybersecurity is not easy, since it requires an ongoing process based on awareness and education programmes. Outcomes are not immediate, but it is now evident that the poor results deriving from current cybersecurity approaches impose a different intervention model, where human beings must be considered as an essential part of the solution [4]. In fact, if the problem is mainly represented by insecure behaviour, it is fundamental that people are fully aware of cyber-risks and respond to them appropriately. Training and education are the key drivers [5].

Considering that everyone uses digital technologies for both professional and private life, and that children access online activities at an early age and spend more and more time in using digital technologies [6, 7], it is wise to develop interventions to promote digital awareness at school [8]. Children often are not aware of the risks they are exposed to [9], for instance sharing personal photos and posting sensitive information on social media. Moreover, we should not forget that also schools can be a target of cyberattacks [10].

If on one side there is a wide interest in developing cyber-skills at school for future careers in cybersecurity, on the other side it is important to boost digital awareness early in school. This activity, if well-managed, can represent a primary step in order to become aware of cybersecurity risks. It is clear that, considering the age of students, it is not appropriate to talk about cybersecurity; instead, digital awareness or “digital hygiene” might be more respondent to the specific needs, focusing on simple notions about online behaviour. In this sense, it is important to consider that developing digital competences also include soft skills, such as critical thinking, interacting through digital technologies, protecting personal data and privacy [11]. Therefore, increasing awareness of the risks and supporting capacity building of educators in online safety is part of Digital Education Action Plan [12]. These recommendations are fundamental to create educational curriculum to teach computer science at school, considering its social aspects, too. For example, the National Curriculum in England [13] regarding computing programmes of study includes, beyond the scientific and technical aspects of computer science, understanding and using technology, safely, respectfully and responsibly, e.g. recognizing inappropriate contents, protecting online identity and privacy.

In the following, we present a study investigating Italian school teachers’ perception of their students’ awareness about the use of digital technologies, and the need to be prepared to handle this issue with their students. The study is part of a monitoring report that every year is conducted in order to evaluate general participation of teachers and students in a national project on computer science education [14].

## 2 Methodology

Programma il Futuro project ([14, 15]) has the goal to increase awareness in Italian schools both on the scientific principles of digital technologies and on the basic concepts for their responsible use. For these goals the project provides lessons developed on the basis of Code.org materials (for awareness on the scientific principle), and guidebooks based on Common Sense materials (for awareness on responsible use of digital technologies). Teachers and students are voluntarily enrolled in the project that, in its fifth year, has involved more than 30,000 teachers and over 2 million students.

Every year teachers are asked to fill out monitoring questionnaires consisting of 40 items to evaluate their general participation – together with students - in project activities, and the quality of the actions implemented.

One section of the monitoring questionnaire, “Digital Awareness”, aims at investigating teachers’ perception regarding the responsible use of digital technologies by their students and the level of usefulness of the related teaching material developed by the project. The section consists of 15 multiple-choice questions and one open-ended question.

Three areas have been investigated:

**Area 1: Assessment of the usefulness of digital awareness guidebooks.** Teachers are asked to evaluate, using a scale from 1 (low) to 4 (high) how useful each of the following guidebooks provided by the project is to develop digital awareness in students:

- Super Digital Citizen;
- The Power of Words;
- Private and Personal Information;
- Safe Online Talk;
- Going Places Safely;
- Follow the Digital Trail;
- Screen Out the Mean.

These guidebooks, intended for teacher use, contain fully developed lesson plans with teaching content and exercises on different issues, for example: how to use the Internet and social network safely, how to safeguard personal data and digital reputation.

**Area 2: Responsible use of digital technologies.** This area investigates:

- what is necessary to develop a conscious use of digital technologies;
- which activities students mainly carry out through digital technologies (e.g., studying, doing research, getting information, playing music);
- how important the knowledge of certain issues is for students’ preparation (e.g., fake news, online behaviour).

**Area 3: Supporting teachers with specific training in digital awareness and security.** This area investigates what type of activity is useful to support teachers in developing a proper digital awareness among their students (e.g. training, communication). Moreover,

teachers are asked to evaluate their need for specific preparation on topics related to digital awareness and security.

The monitoring questionnaire was sent in December 2019, through the project platform. The total sample who filled out the questionnaire is composed by 2,229 teachers, presenting the following demographic characteristics: Gender (F: 82.01%; M: 17.99%); Age (up-to-30: 0.27%; 31–40: 5.83%; 41–50: 34.19%; 51–60: 51.91%; 61-and-up: 7.81%). The gender distribution is in line with the national distribution of teachers' gender. The majority of teachers is from primary school (59.98%), then around a quarter (26.29%) from middle school, and a minority is from high school (10.32%). There is also a very limited participation from kindergarten teachers (3.01%). All respondents have participated in “Programma il Futuro” activities for at least one year (the project has been active since 2014).

### 3 Results and Discussion

We now report and discuss the main outcomes of our study related to the above three areas of the questionnaire.

#### Area 1. Assessment of the usefulness of digital awareness guidebooks

Results confirm a high perceived usefulness of the guidebooks used to spread digital awareness (Fig. 1). Note that between 80% and 90% of teachers evaluated the guidebook with “high” or “medium” usefulness. Teachers who still do not know these materials

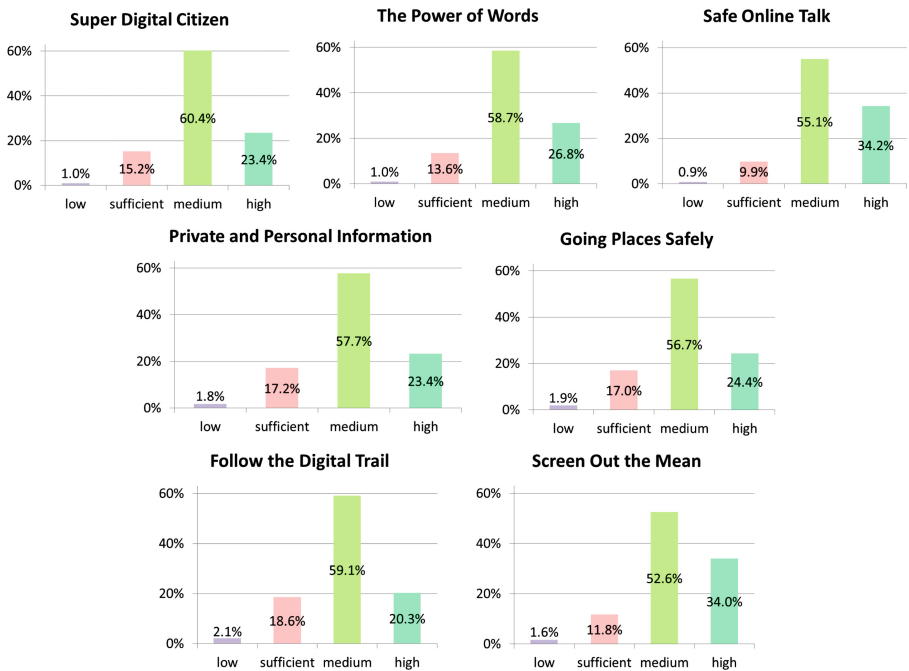


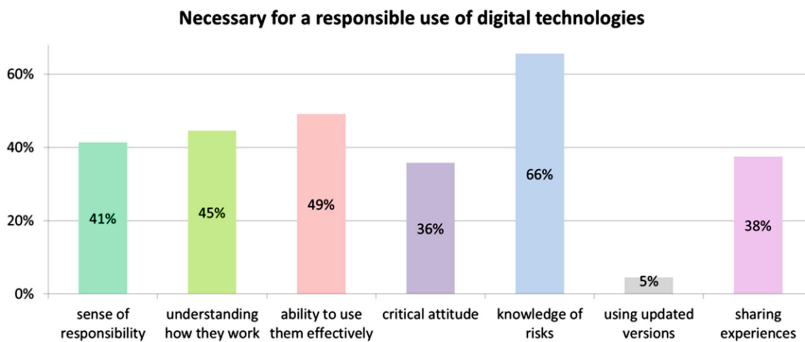
Fig. 1. Usefulness of the various guidebooks for digital awareness.

declare their intention to apply them in their classrooms, because of the topical nature of the issues dealt with. In particular, materials focused on communication (e.g. “Safe Online Talk”) have been particularly appreciated by teachers.

The interest demonstrated by teachers is also confirmed by suggestions provided in the open-ended question, where they underline the need for producing further materials on online communication issues, especially about the use of social network.

### **Area 2 – Responsible use of digital technologies**

For a responsible use of digital technologies, teachers think that this mainly requires the development of an adequate knowledge of risks associated with their use (Fig. 2). Therefore, students should be prepared to recognize risks when they use digital technologies. The prevalence of risk element in digital awareness confirms results deriving from previous monitoring report [9]. After “knowledge of risks” (66%), a responsible use of digital technologies passes through “the ability to use them effectively” (49%), “understanding how they work” (45%), and “sense of responsibility” (41%). It was possible to provide up to 3 answers out of 7 and the remaining 3 were selected by less than 40% of respondents.



**Fig. 2.** What is necessary for a responsible use of digital technologies.

For what regards how digital devices are used by students (Fig. 3), according to teachers’ perception they use them mostly “to play” (85%), “to communicate/share with friends/classmates” (56%), “to listen/watch/download music” (54%), “to study/research” (28%), and in only 11% of cases “to get information” (multiple answers were possible).

The high value obtained by “playing” agrees with the fact that many participants involved in the study are primary school teachers. Clearly, at this stage, students’ activities are not focused on searching information on the Internet. However, it is recognized the social significance that digital tools and devices have for students, given that they permit to communicate with their friends/schoolmates and to share news (in particular in the secondary school).

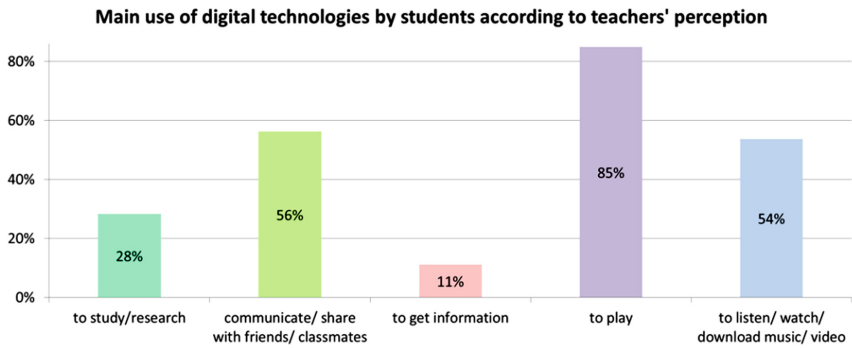


Fig. 3. How students use digital technologies according to teachers' perception.

In Fig. 4 you can see how teachers evaluated the importance of various issues to prepare students to use digital technologies in a safe and responsible way. “On line harassment”, “Data protection and privacy”, and “Safe online behaviour” are the most important topics for students’ preparation. If on the one side “Online harassment” received the highest evaluation, given it is probably the hottest topic in the discussion on the Internet risks regarding children and teenagers, on the other one it is interesting to notice that teachers appropriately recognize the importance of protecting data and guaranteeing privacy while online.

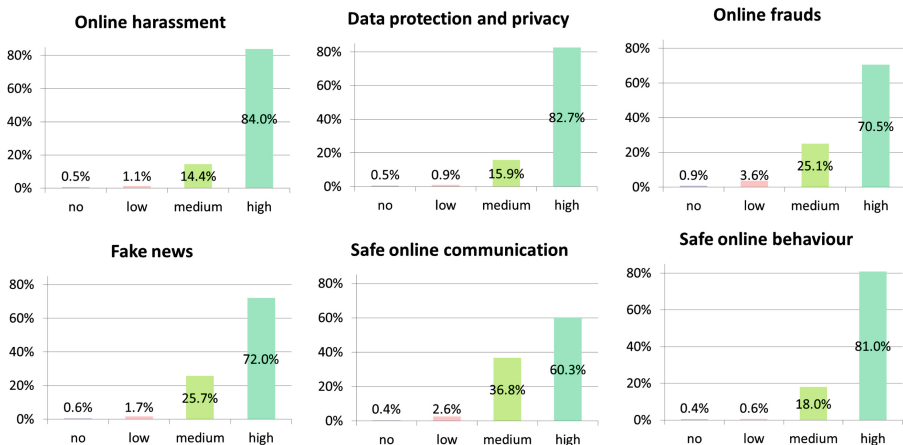
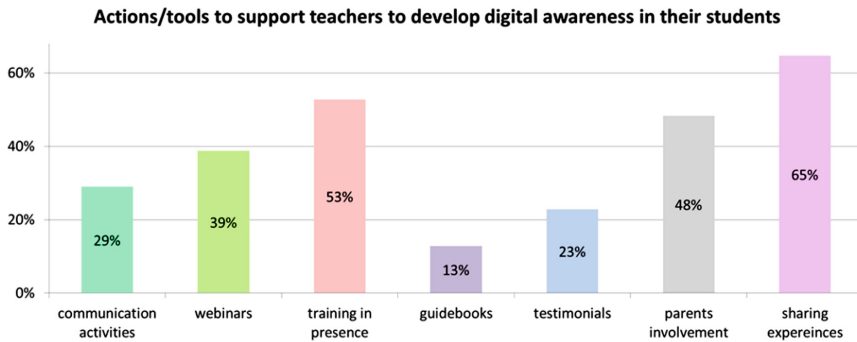


Fig. 4. Degree of importance of various topics for students' digital awareness.

**Area 3 – Supporting teachers and specific training in digital awareness and security**

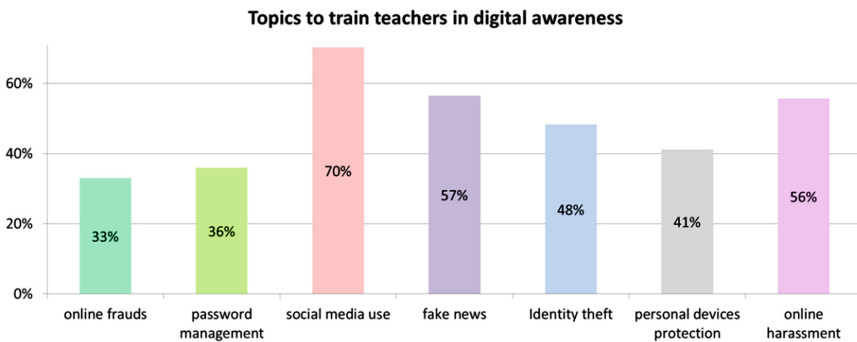
Regarding the activities considered useful to help teachers to develop students’ digital awareness (Fig. 5), the most important action according to teachers is “sharing experiences” (65%), followed by “training in presence” (53%), and “parents’ involvement” (48%). It was possible to provide up to 3 answers out of 7, and the remaining ones were

selected by less than 40% of respondents. These results confirm the importance of dealing with these issues and the need for the contribution of others, e.g. parents' students, to achieve effective results.



**Fig. 5.** Actions/tools to support teachers to develop digital awareness in their students.

On the other hand, teachers highlight the need for themselves to receive a specific training on digital awareness issue, as a response to a specific yes/no question (Y: 97.74%). Among the topics to be included in this training they identify (Fig. 6): “social media use” (70%), “fake news” (57%), “online harassment” (56%), and “identity theft” (48%). It was possible to provide up to 4 answers out of 7, and the remaining 3 were selected by less than 45% of respondents.



**Fig. 6.** Topics for training teachers in digital awareness.

This training could provide useful clarifications about common terms used in the area of cybersecurity, given that some of them are often improperly used, because of the lack of knowledge.

## 4 Conclusions and Future Work

In this paper we have analysed how teachers evaluate the importance of spreading digital awareness among their students and the necessary actions in order to improve the responsible use of digital technologies. Answers from 2,229 teachers - belonging to primary and secondary school - confirm their high sensitivity towards digital awareness issues. Students should be prepared to recognize risks when they use digital technologies: not only cyberbullying, they should pay more attention to the protection of their personal data, as well as to the reliability of news on social media. Becoming conscious of the risks they are exposed to on the Internet is an important step for children to move safely and to understand the different cyber-risks they have to face.

Considering that digitization is unstoppable and that cyberthreats are likely to grow, a precocious education on the responsible use of digital technologies can be a fundamental step for an effective cybersecurity education. Indeed, we think that, given the age of students, talking of cybersecurity training in primary and secondary school is excessive; instead, educating students to understand the concept of digital risks and highlighting the importance of online behaviour can be an effective way to develop digital awareness.

Finally, also teachers need to be supported in this activity; among the preferred actions, they identify sharing of experiences, training classrooms and parents' involvement. They declare the need for themselves of a specific training on digital awareness, and the use of social media is one of the most important topics to be managed.

In conclusion, we think that education is an essential key to handle cyber risks, now and in the future. Not only for workers [5], but also for students and, in general, for all citizens. We will continue to produce guidebooks and materials on the basis of teachers' requests, and to monitor the project activities.

**Acknowledgements.** We thank all teachers involved in “Programma il Futuro” for their continued participation to the project and their involvement into this research. Thanks also to Common Sense for having provided us the digital awareness teaching material and to Code.org for their activity to support Informatics education in schools. Last, but not least, a big thank to Francesco Lacchia for his excellent work in the adaptation of the Common Sense guidebooks.

## References

1. Schneier, B.: *Secrets and Lies*. Wiley, New York (2000)
2. Safa, N.S., Solms, R.V., Fitcher, L.: Human aspects of information security in organisations. *Comput. Fraud Secur.* **2016**(2), 15–18 (2016)
3. Corradini, I.: *Building a Cybersecurity Culture in Organizations. How to Bridge the Gap between People and Digital Technology*. Springer, Cham (2020)
4. Zimmermann, V., Renaud, K.: Moving from a “Human-as-Problem” to a “Human-as-Solution” cybersecurity mindset. *Int. J. Hum Comput Stud.* **131**, 169–187 (2019)
5. Corradini, I., Nardelli, E.: Building organizational risk culture in cyber security: the role of human factors. In: *AHFE 2018*, pp. 193–202. Springer (2018)
6. Livingstone, S., Haddon, L., Görzig, A., Olafsson, K.: *Risks and Safety on the Internet: The Perspective of European Children: Full Findings and Policy Implications from the EU Kids Online Survey of 9–16 Year Olds and Their Parents in 25 Countries*. LSE, London (2011)



7. Kardefelt-Winther, D.: How does the time children spend using digital technology impact their mental well-being, social relationships and physical activity? An evidence- focused literature review, Innocenti Discussion Paper 2017-02, UNICEF Office of Research – Innocenti, Florence (2017)
8. Schilder, M.J.D., Brusselaers, B.J., Bogaerts, S.: The effectiveness of an intervention to promote awareness and reduce online risk behavior in early adolescence. *J. Youth Adolescence* **45**, 286–300 (2016)
9. Corradini, I., Nardelli, E.: Awareness in the online use of digital technologies, In: 11th International Conference of Education, Research and Innovation (ICERI-2018 ), pp 7036–7042, Sevilla, Spain, November 2018
10. Modan, N.: Recent school ransomware attacks highlight need for ongoing vigilance. *EducationDive*, January 2020
11. European Commission, The Digital Competence Framework 2.0
12. European Commission, Digital Education Action Plan
13. Gov.UK, Dep. Education, National Curriculum in England: computing programmes of study, September 2013
14. Corradini, I., Lodi, M., Nardelli, E.: Computational thinking in italian schools: quantitative data and teachers’ sentiment analysis after two years of programma il futuro project. In: ITiCSE 2017, ACM (2017)
15. Nardelli, E., Corradini, I.: Informatics Education in School: A Multi-Year Large-Scale Study on Female Participation and Teachers’ Beliefs. In: ISSEP-2019, pp. 53–67, Cyprus, November 2019