The Use of Digital Technologies to Develop Girls' Creativity: Paths and Practices in Greece, Lithuania, Portugal, and Slovenia

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Abstract. The presence (or lack thereof) of women in STEM and ICT has become a key issue for the industry and for policy makers, as complex and nuanced questions of gender are brought to the centerstage of public discussion. As part of this effort, this research aims to shine a light on the factors that keep girls and young women from pursuing careers in the field of ICT and provide tools and orientations to tackle these issues. A two-fold analysis was conducted, with interviews with experts in the sector, in the format of four round-table discussions, and an analysis of 30 case studies of projects/initiatives across four countries: Lithuania, Greece, Slovenia and Portugal. The collected insights point to the persistence of gendered stereotypes, as well as prevailing misconceptions on the nature of ICT work. Furthermore, it points to the importance of teachers and educators, as well as the visibility of female role models in the industry. The investment in concrete and creative pursuits in ICT also appears as a defining factor to spark the interest of girls in the field.

Keywords: Creativity · Girls · Digital technologies in education · Innovative technologies · Learning programs

1 Introduction

The recent push to tackle gender disparities in areas such as STEM and ICT is more than a question of justice or fairness in access to the industry in these male-dominated fields, as important as those concerns may be. Authors such as Lambrecht and Tucker [1] or Neerukonda and Chaudhuri [2] have pointed out how thinking about gender in digital technologies raises important questions on the tackling of biases and blind spots, which might otherwise be rendered invisible. As such, projects that may shine a light on the factors that keep women, particularly young women, from pursuing careers in

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digital technologies (as well as best practices to tackle gender disparities) are crucial to ensure that the field is able to fully provide the solutions to the issues of our time [3]. As such, this research aims to understand: 1) stereotypes and societal beliefs on gender and technology, and 2) available solutions to foster digital literacy skills in girls. By doing so, it hopes to contribute to the opening of new opportunities for creativity and for the fostering of interest in young women to pursue IT or STEM careers.

The discussion in this paper is founded on a two-fold analysis. Firstly, it draws from the insights of a series of semi-structured interviews with experts from the ICT-related sector, conducted in the format of roundtable discussions. The goal was to discuss key factors preventing young girls from exploring career paths in computer science and technology and to suggest valuable perspectives on addressing the problem. Secondly, the present discussion also draws from analysis of 30 different case studies across the four partner countries. These span from available training courses or good practice examples to projects where innovative digital applications, tools or technologies are used. These include artificial reality (AI), augmented reality (AR), virtual reality (VR), 3D Printing, Cyber Security and other innovative technologies.

By bringing together these two components of analysis, the research can find the roadblocks that keep young women from entering the field, as well as open paths to tackle gender disparities ICT. This paper presents a literature review on the current state of women in ICT, as well as the work and orientations that have been developed thus far to tackle the observed disparities. This is followed by a brief explanation of the two-fold methodological approach and by the discussion on the insights provided by the experts and drawn from the case studies. The concluding remarks summarize the key insights, as well as pointing to future directions for the abundant work that stands ahead for the field.

This analysis was developed within the aims of the project SparkDigiGirls - Empower Girls Creativity Through Use of Digital Technologies [4], funded by the Erasmus + strategic partnership in the youth field. The project is being implemented in Greece, Lithuania, Portugal, and Slovenia. Its aim is to analyze the ways in which new and innovative technologies may develop the creativity of girls and young women, by paying close attention to learning scenarios, topics and particular technologies that spark their interest or are better suited for their particular circumstances.

2 Discussion

Women in technology, today, are still a minority, even though their contributions throughout the history of computerized technological development are not to be understated. During World War II, hundreds of women were hired to solve calculations that helped the Allies. During the 1950s, computer software programming was seen as 'women's work', the alternative to the male vocation of hardware development. In the 1970s and early 1980s, the number of American women pursuing degrees in computer science grew up to 37% – nearly double the number recorded in 2015 [5]. However, the Silicon Valley's "gold rush" shifted male focus back to software in recent decades. The media also gave rise to the idea of the "*male tech genius*" with figureheads like Steve

Jobs and Bill Gates. It was at this point that the number of women working in technology began to decline.

Looking at today's concrete statistics, according to the 2018 Women in Tech Index [5], which covers 41 EU and the Organization for Economic Co-operation and Development (OECD) countries, gender disparity is indeed a prevalent factor in the technology sector. Among the four countries of focus, Lithuania had the highest rate of women in ICT - 24,93%. Slovenia and Portugal displayed, respectively, 17,49% and 16,08%, with Greece being the lowest, with 12,70%. According to the 2018 data of Eurostat, girls and women continue to be under-represented, being only 17% of all ICT students in the EU [6]. In 2020, that proportion changed only slightly with 81.5% ICT specialists in the EU still being men, against 18.5% being women [7]. This disparity remains in place despite an increasing social climate that, supposedly, encourages women not to embrace stereotypes in career choices.

This is aggravated when it is considered that Microsoft's regional survey of 11,500 women revealed that, while both girls and boys have similar interest in science, when it comes time to decide on a field of study, five times fewer girls choose science, technology, engineering, and math (STEM) fields and fewer than 1 in 5 choose computer science [8]. Furthermore, the OECD's Program for International Student Assessment (PISA) reveals that boys are far more likely than girls to imagine themselves as ICT professionals, scientists, or engineers [9]. Female interest in STEM subjects, it seems, drops far too early, and evidently by influence of broader social factors, which ought to be understood and tackled.

3 Methodology

The end goal of this qualitative and exploratory study was to discuss factors keeping girls from developing interest in ICT, as well as identifying approaches, tools, and orientations to tackle gender disparities in the pursuit of careers in the field. As such, a two-fold analysis was conducted. Firstly, insights from experts who work on the ICT-related sector were collected, focusing on key factors preventing young women from exploring career paths in computer science and technology and on possible perspectives on addressing the problem.

These insights were collected within the context of a series of four online Round Table Discussions in the four countries. The discussions addressed various learning experiences, samples of usage of different applications or digital tools in the learning process of young people, particularly girls. In total 37 experts from formal and non-formal education institutions, representatives from the IT business sector, local and national government institutions, influential public figures as journalists and opinion makers took part. These were comprised of 12 experts from Lithuania, 8 from Slovenia, 9 from Portugal and 8 from Greece). Considerations on the diversity of speakers were made, in order to ensure a wide range of views and ideas.

Following an inquiry technique, a questionnaire was created to guide the interviews/discussions, directed at collecting insights on the following topics:

- existing successful training programs which could engage and empower girls, and ultimately increase interest in new and innovative digital technologies;
- the use of concrete innovative technologies in their daily lives that solve real world problems;
- ways of incentivizing girls to choose ICT activities/training and later ICT, STEM related studies.

Secondly, the insights from the round table discussions were complemented by an analysis of case studies of relevant projects and initiatives in the ICT sector. The analysis was aimed at finding examples of implemented or current projects used to encourage girls to participate in ICT in four partner countries: Lithuania, Greece, Slovenia and Portugal. By analysing concrete examples, these case studies can provide deeper understandings of the issue and extended experience of how technologies and tools can be used in different learning settings for girls.

All the partners in the study were encouraged to research available training courses, good practice examples, or projects where innovative digital applications, tools or technologies are used (including AI, AR, VR, IoT, 3D Printing, Cyber Security, and other innovative technologies that could be used to foster creativity). The case study analysis was carried out in all partner countries, and, in total, 32 case studies were collected: 7 in Lithuania, 7 in Slovenia, 11 in Portugal and 7 in Greece). Coincidently CodeWeek was listed by 3 partners but was only considered as one case study. Therefore, in total 30 case studies were considered. The case studies were selected using the following criteria:

- Use of the innovative technology – preference would be given to the cases where innovative technologies are used;
- Promoting creativity – focusing on the fostering of young girls' creativity through innovative technologies priority fell on case studies enabling exactly that;
- Usability for training material – since in many instances it is not beneficial for educational projects in this field to create learning materials from scratch, but to adapt existing work to specific needs.

A structured observation grid was devised as an analytical tool for each case study and document analysis techniques were applied. For the purposes of this analysis and discussion and to facilitate reading, with regards to each case study's meeting of the stated criteria, they were characterized on a scale from "somewhat satisfies", to "satisfies" and "greatly satisfies".

By conducting this two-fold analysis, the research aims to provide a clearer look into the roadblocks and challenges for the ICT sector with regards to fostering girls' interest, as well as illuminating the pathways and current work by industry experts and leaders.

4 Analysis of Results

The analysis of the insights gathered in the interviews reveals how, generally, prevailing stereotypes and gendered attitudes, as well as systemic insufficiencies, particularly in education, remain decisive factors for the low involvement of girls in the sector. One of the most prevailing and impactful of these are the deeply rooted stereotypes on "masculine" and "feminine" careers, with ICT being broadly seen as a male occupation.

As Viktorija Mačiūnė, Quality Assurance Engineer and Developer at Zyro.com from Lithuania, pointed out in the Round Table: "Our society dictates what is expected of a woman and what is expected of a man. From a very young age, even in toy shops, there are already different toys for girls and boys". This means that girls and boys often choose their career paths not based on their talents or skills, but according to stereotypical gender roles. Likewise, Carolina Salgueiro, OutSystems Consultant at Nexllence from Portugal, pointed out how this is reinforced since a young age, giving the example of videogames. These are generally heavily directed towards the stereotypical interests of boys and remain a common denominator for many adult men in the field.

Another stereotype that was revealed during the discussions is related to girls' perception that ICT is solely about hardware and programming. As Renata Daniliene, lecturer at Vilnius University in Lithuania, remarked: "Many girls still think that people who work in IT sit in front of a computer screen from morning to late night and programming". This belief reduces the field to only so called "hard coding" and ignores the many different occupations and career paths under the umbrella of ICT. As Renata Daniliene added: "underneath the IT sector there are many different job positions like graphic designers, data analyst, engineers, IT project managers, etc.".

As the RT participants pointed out, much of this starts at school. During early education, girls and boys display equal interest in science, technology, and engineering. However, as adolescents move between primary and secondary school, girls are more likely to choose careers in social, environmental, and medical fields as opposed to science, technology, engineering, and mathematics. This is exacerbated by the fact that the numbers of students dropping out of STEM and ICT is often higher than students in any other field of study and by the lack of significant progress in the context of school curricula.

The round table participants highlighted how this must be combated with the embedding of ICT within the curriculums across the students' education and its integration into all subjects. Teachers were pointed out as the key to promote girls' interest in ICT. Laura Grineviciute, director of the Rural Internet Access Points association in Lithuania, noted how teachers can "give a chance to the girls to talk about what ICT or STEM looks like for them, what they like or dislike about science, engineering, technology and maths. What careers exist they have never heard of or considered suitable. What ideas and issues in STEM interest and inspire them".

However, the barriers they find must be considered. Teachers feeling insufficient qualifications in ICT, lack of confidence, effective training and resources were reasons the most mentioned by the round table participants. As Petra Vanič, Head of the non-formal education and capacity development programme at the Kersnikova Institute in

Slovenia, pointed out: "We see a fear of using digital technology among primary school teachers. Different measures should be taken into account to encourage teachers to use ICT with pedagogy".

The discussions also revealed that lack of female examples which girls can relate to also contributes to their low interest in digital technologies, with the dominance of male examples tending to push girls further away. Brigita Dane, Project lead at Simbioza in Slovenia, elaborated on this: "Since many IT positions are rather new there are very few real-life examples and success stories in the girls' environment - family, relatives, friends. Many young people tend to see their future in one field or another on the basis of concrete examples". Participants agreed that the best way to address entrenched stereotypes is to share and publicize stories of female excellence in IT, as to provide living examples that girls can see themselves in. "The more girls get used to hearing about and from women in IT roles, the more normal it will seem", as stated by Danguolė Rutkauskienė, President of National Distance Education Association from Lithuania.

Most participants did point out positive shifts and changes in recent years, particularly regarding the increase in the number of discussions on the public domain, which has helped to bring greater focus on the women shortage in the IT sector. Gintarė Dzindzelėtaitė, Social Project Manager at Devbridge firm in Lithuania, described her experience as follows: "I have been working in the ICT community for 8 years now and the trend is very good - the number of women in the company is growing very fast, not only in IT but also in management positions. That's very good to see and I don't feel any discrimination at all".

These shifts have been fueled by the greater debate on the public sphere regarding gender in the workplace, but also by the current shortage of ICT digital experts in the EU job market. However, not all the participants shared the same perspective on gender equality in the ICT industry. They point out that changes require action in the context of equality of pay and career advancement possibilities: "Women still do not assume leading roles in IT companies and have lower wages when compared to men in the same position.", as pointed out by Maria Helena Monteiro, Professor at the University of Lisbon in Portugal.

4.1 Effective Approaches

The discussions on the factors that influence the low involvement of girls in the sector were also accompanied by the sharing of perspectives on possible approaches and factors that could increase girls' interest in ICT. Firstly, as previously highlighted, having visible female role models sparks girls' interest in ICT careers and helps them to picture themselves pursuing these fields. Secondly, one of the effective ways to increase girls' interest in ICT could be the creation of opportunities for practical application of IT technologies, products and tools. Creativity in the classroom, in particular, could increase their interest in ICT, as it shows practical applications beyond "hard coding". Some practical examples with ICT technologies mentioned in the discussions were:

- programming with Scratch - this would be an initial introduction to programming and showing that programming is not as complex as is often thought;
- showing how visual objects (like robotics) can be used, enabling them to move objects around, make characters perform certain actions, etc.
- augmented reality - using visual environments to create advertisements, interactive publications, school newspapers, promotional material;
- artificial intelligence - to code something tangible using special libraries, e.g. image recognition, artificial intelligence by making music, painting;
- Internet of Things, 3D design and many other technologies.

Thirdly, as mentioned before, the integration of ICT into mentoring (e.g. teachers) and non-formal education is key. When educators talk to girls about ICT subjects and actively encourage them, girls become more attracted to these disciplines. Finally, one of the main aspects that fosters interest in ICT is real life applications. Girls become more interested in ICT once they're able to conceive what they can do with these subjects, how they can be applied to real-life situations and how relevant they might be to their future. The main reason why girls give up ICT halfway through is when they see no practical benefits. Therefore, it is important to teach girls to not only play, but to also use technology in a meaningful way, whether exploring or creating: "There are countless spheres and areas in the ICT sector. There is no need to write code, girls can [also] do other things and discover themselves from a social and humanitarian perspective", as remarked by Viktorija Mačiūnė, quality assurance engineer and developer at Zyro.com in Lithuania.

When asked who has a responsibility to make these important steps happen, most participants answered that the responsibility must be both individual and collective. This especially regarding the cultural legacy both in the family and in society regarding fixed gendered expectations. However, major steps in educational policy must be taken regarding training for teachers and creating updated school curricula, as well as expand student's opportunities for digital skills development and encouraging creativity, innovation, and entrepreneurship from a very young age.

Lastly, the shift from coding as the central locus of ICT education to the use of low code platforms has been and will further be an important step. "We are witnessing an evolution from "hard skill" languages to intuitive systems, which do not require deep prior knowledge. Low code systems can quickly show results, which can generate extra excitement and boost creativity", as pointed out by Renata Danielienė. This does not mean the neglect of coding in ICT education. Free programming languages such as Python are already in use in middle schools and allow for development of skills highly sought in the marketplace. For younger children, especially in primary schools, Scratch language can be more relevant as it allows build scenarios, stories, and games.

This shift also opens broader possibilities for the exploration of topics that may tend to be more interesting for girls. There are no learning differences between girls and boys but, as girls generally tend to be more communicative, they are more present in the social media. As such, opening possibilities for greater focus on digital marketing, self-branding, and content creation, in combination with cybersecurity concepts such as safe online behaviour, may be the best path forward. In the end, the various educational

programs must foster entrepreneurship, career pathways that may lead to financial autonomy and opportunities for thriving beyond gender traditional roles.

4.2 Insights from Case Studies

The insights given by the experts in the RT discussions already provide key orientations to tackle the factors keeping girls from developing interest in ICT. In light of these, concrete action relies on the ability of actors to learn from other projects that have sought or still seek to tackle the issues at hand. As such, this reflection is complemented by the analysis of 30 case studies, proposed by the project partners. These were analyzed on the criteria of use of innovative technology, promotion of creativity and usability for training material, being placed on a classification of three levels, from somewhat satisfies (1), to satisfies (2) and greatly satisfies (3).

For the purposes of this paper, the following list of the case studies was compiled:

1. *Training in 3D Printing, Innovation and Creativity*; **Innovation:** 1; **Creativity:** 3; **Usability:** 3; **Type of Technology:** DP;
2. *Augmented Reality for Business Opportunities*; **Innovation:** 3; **Creativity:** 3; **Usability:** 3; **Type of Technology:** AR;
3. *Entrepreneurial Skills for Woman in a Digital World*; **Innovation:** 1; **Creativity:** 2; **Usability:** 2; **Type of Technology:** Digital tools for project implementation;
4. *Code Week initiative*; **Innovation:** 2; **Creativity:** 3; **Usability:** 3; **Type of Technology:** Visual programming, creative coding;
5. *Challenge on Informatics and Computational Thinking (BEBRAS)*; **Innovation:** 1; **Creativity:** 2; **Usability:** 2; **Type of Technology:** Computational thinking;
6. *Machine Learning for Music and Art*; **Innovation:** 3; **Creativity:** 3; **Usability:** 2; **Type of Technology:** AI (Machine learning);
7. *The basics of 3D modelling and the principles of 3D objects*; **Innovation:** 2; **Creativity:** 3; **Usability:** 1; **Type of Technology:** Computer design, 3D modelling and printing;
8. *Girls Do Code*; **Innovation:** 2; **Creativity:** 2; **Usability:** 1; **Type of Technology:** coding;
9. *Light / Workshop for girls*; **Innovation:** 2; **Creativity:** 3; **Usability:** 1; **Type of Technology:** Programming;
10. *RampaLab*; **Innovation:** 1; **Creativity:** 3; **Usability:** 1; **Type of Technology:** Biotechnology, biology, digital media, wearable technology, sound, environment, robotics, energy, alternative energy, etc.;
11. *ČIPke*; **Innovation:** 1; **Creativity:** 3; **Usability:** 1; **Type of Technology:** AI, Sensorics, Coding;
12. *Digital summer school for girls and boys*; **Innovation:** 1; **Creativity:** 3; **Usability:** 1; **Type of Technology:** Coding, technology engineering;
13. *Robotics*; **Innovation:** 2; **Creativity:** 3; **Usability:** 1; **Type of Technology:** Robotics;
14. *Plug-in Mentoring for Girls*; **Innovation:** 1; **Creativity:** 2; **Usability:** 1; **Type of Technology:** Data, Security, Product, Mobile;

15. *GEN10S Portugal*; **Innovation:** 2; **Creativity:** 3; **Usability:** 1; **Type of Technology:** Programming;
16. *Portuguese Women in Tech*; **Innovation:** 1; **Creativity:** 2; **Usability:** 1, **Type of Technology:** Innovative technologies.
17. *Girls in Tech*; **Innovation:** 1; **Creativity:** 1; **Usability:** 1; **Type of Technology:** Innovative technologies.
18. *Programming and Robotics Clubs*; **Innovation:** 2; **Creativity:** 1; **Usability:** 1; **Type of Technology:** Robotics;
19. *Geek Girls Portugal*; **Innovation:** 1; **Creativity:** 1; **Usability:** 1; **Type of Technology:** Innovative technologies.
20. *Digi Girlz (Microsoft)*; **Innovation:** 3; **Creativity:** 3; **Usability:** 1; **Type of Technology:** Robotics; programming, artificial Intelligence, gaming;
21. *PrograMaria*; **Innovation:** 2; **Creativity:** 2; **Usability:** 1; **Type of Technology:** programming;
22. *Girl in ICT Week*; **Innovation:** 3; **Creativity:** 3; **Usability:** 3; **Type of Technology:** Robotics; programming, artificial Intelligence, gaming;
23. *EX.I.T.E CAMP (IBM)*; **Innovation:** 3; **Creativity:** 3; **Usability:** 2; **Type of Technology:** Robotics; programming, artificial Intelligence, gaming;
24. *Exploiting Ubiquitous Computing, Mobile Computing and the Internet of Things to promote Science Education (UMI-Sci-Ed (H2020 / SEAC))*; **Innovation:** 3; **Creativity:** 3; **Usability:** 3; **Type of Technology:** Ubiquitous, Mobile and IoT (UMI) technologies;
25. *CrowdDreaming: youths co-create Digital Culture (CDDC)*; **Innovation:** 3; **Creativity:** 3; **Usability:** 3; **Type of Technology:** Content based learning, AR, VR;
26. *Videogames 4 Teachers*; **Innovation:** 2; **Creativity:** 3; **Usability:** 3; **Type of Technology:** Educational Videogames and mobile apps;
27. *Boosting Global Citizenship Education using digital storytelling*; **Innovation:** 1; **Creativity:** 3; **Usability:** 2; **Type of Technology:** Online Tools;
28. *Competence development of STE(A)M educators through online tools and communities*; **Innovation:** 1; **Creativity:** 2; **Usability:** 1; **Type of Technology:** Online Tools and communities;
29. *Training the Educators to facilitate the Teaching and Assessment of Abstract Syllabus by the use of Serious Games-CrAL*; **Innovation:** 1; **Creativity:** 3; **Usability:** 1; **Type of Technology:** Online tools, multimedia;
30. *Creative Audiovisual Lab for the promotion of critical thinking and media literacy*; **Innovation**: 3; **Creativity**: 3; **Usability**: 3; **Type of Technology**: 3D design and Printing, digital online tools, Arduino, CAD, Apps.

A few key insights can be drawn from these case studies as a whole. Firstly, most of the case studies (20 of the 30) feature a high level of creativity in different ways. This is, indeed, one of the aspects pointed out in the RT discussions. Because tools and projects are so heavily reliant on this factor, ICT education and ICT in other subjects must also become a driving factor in the tackling of girls and young women in the field.

Secondly, the main areas of action for these case studies seem to tend towards robotics, coding, gaming activities in terms of their use of technology. There seems to

be a shortage of use in practice of other technologies such as AI, AR, VR, IoT, 3D Printing and Cyber Security. Initiatives and concrete actions like the SparkDigiGirls project can use the opportunity to focus on these and develop a new training framework aimed at empowering girls' interest in the tech sector through modern tools offered by Augmented Reality, AI, IoT, 3D, and many others.

5 Conclusion

While there is still much to study and to do regarding the factors keeping girls and young women from developing interests in digital technologies, there are already clear insights that educators can put into practice. Firstly, as this study has laid out, key insights to guide educational practice revolve around demystifying ideas of ICT as: 1) a "male career"; 2) only "hard coding"; 3) a non-creative occupation. Essentially, ICT should be presented and integrated into better curriculums as an open path, with a variety of topics and occupations to be explored by everyone. This particularly requires that educators be provided with better training and resources and that girls be presented with concrete role models.

Secondly, and on the question of variety and open options, girls should be offered a variety of topics in ICT to choose from and that naturally spark their interests. As pointed out, the topics that do so, generally, can be social media, buying and selling, digital music, self-branding, banking and finances, fashion, design, culinary, websites, games, data visualization, sports, digital marketing, cybersecurity and phishing and others. Thirdly, girls should have an understanding of specific technologies that are tailored to those topics. Some of the most effective digital and innovative technologies pointed out in this research are programming with Scratch, AR, AI, 3D printing and design, robotics, IoT, blockchain and cryptocurrencies. This requires educators to be prepared to explore open paths and creative/innovative pursuits with them, but it also means that they ought to have more the resources available to do so.

While these insights are open paths forward, a lot more research and practical work are needed, so that they may be translated into concrete action. Some future work in this direction, which will in part be tackled within the context of the SparkDigiGirls project, includes the urgent need for a curriculum that can meet girl's needs and can lead to an improvement/increase of their creative use of innovative applications and digital tools. Online programs ought also to be developed, focusing on a practical experiential learning model and real-life tasks that could allow girls to explore technologies and come up with exciting ideas and solutions for given problems. Other important steps to be taken include digital female role model campaigns, as well as the development of materials such as guidebooks for the empowerment of youth workers as mentors to pursue girls' creativity using digital applications. These are just a few of the many steps that ought to be taken, but a growing field of research and discussions on this topic are the driving force of what, hopefully, will be significant positive changes in the near future.

References s

1. Lambrecht, A., Tucker, C.E.: Algorithmic bias? An empirical study of apparent gender-based discrimination in the display of STEM career ads. Manag. Sci. **65**(7), 2966–2981 (2019)
2. Neerukonda, M., Chaudhuri, B.: Are technologies (gender-)neutral? Politics and policies of digital technologies. ASCI J. Manag. **47**(1), 32–44 (2018)
3. Marsden, N., Ahmadi, M., Wulf, V., Holtzblatt, K.: Surfacing challenges in scrum for women in tech. IEEE Software (2021)
4. SparkDigiGirls: SparkDigiGirls–Empower Girls Creativity Through Use of Digital Technologies (2021). https://tinyurl.com/4wmu8xsd. Accessed 23 Nov 2021
5. Varley, G.: Women in Tech by Country, European Women in Tech (2019). https://tinyurl.com/sv6awxxx. Accessed 23 Nov 2021
6. Eurostat: Girls and women among ICT students: what do we know? Eurostat (2020a). https://tinyurl.com/4x9hetcf. Accessed 23 Nov 2021
7. Eurostat: ICT specialists in employment, Eurostat (2020b). https://tinyurl.com/5ffn38ds. Accessed 23 Nov 2021
8. Noonan, K., Laffarge, S.: Why Europe's girls aren't studying STEM, Microsoft (2017). https://tinyurl.com/yfyy9784. Accessed 23 Nov 2021
9. OECD: Programme for International Student Assessment–PISA, OECD (2018). https://tinyurl.com/dehc9ate. Accessed 23 Nov 2021