



Young women’s barriers to choose IT and methods to overcome them – A case study from Hungary

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Abstract. Women’s scarcity in the STEM, especially in the IT sector is pronouncedly evident. Young women are obstructed from entering and remaining in IT by a broad range of social, educational, and labor market factors. In our paper, we would like to analyze the main barriers girls face in choosing IT, while also proposing potential methods to help them overcome these obstacles. In the second part of the paper, we will present a case study to illustrate in detail how the combination of the above methods can be put into practice to address and tackle the complex set of barriers girls face. We will first introduce a Hungarian annual program, Girls’ Day (“Lányok napja”), specifically aimed to promote STEM to girls, then we will present two specific events organized for the 2020 edition of the program and designed with the above principles in mind. The interactive presentation, exposing girls to female role models of the field in a gamified way, and a game development exercise, building Scratch programming skills, have attempted to provide young women both with positive perspectives and experiences in IT, which are instrumental in helping them to surmount entrenched obstacles and raise their interest in the field.

Key words and phrases: gender, women, IT, education, teaching methodology.

MSC Subject Classification: 97P10, 97U30.

Introduction

After more than a year of lockdowns, online family gatherings, digital education, and distance work, there is little doubt that the world has become immensely digital. The COVID-19 pandemic which crippled the world economy in 2020, and

it is likely to seriously impact 2021 and the years to come, has made it clear that science and technology are the best investments of the future, and actually, of the present as well. Without digital solutions, our work processes and social life would have become impossible. The return to normalcy is up to how well we can maximize our capacity in science and technology, in short, in STEM¹.

Even before the pandemic, the IT sector was struggling with a significant shortage of qualified workforce both internationally (European Commission, 2017; International Labour Organization, 2019), and specifically in Hungary (BellResearch, 2016). In the past years, however, the demand for IT specialists has doubled. According to a recent study done by the Association of Hungarian Informatics, Telecommunication, and Electronics Professionals, in the next two years 44,000 IT professionals could be employed in Hungary (IVSZ, 2021). The supply, though, is expected to lag behind, at about 18,000 professionals. Currently 9,000 tech jobs remain unfilled, and with the rapidly growing demand, the gap is bound to significantly increase (IVSZ, 2021). Changes are necessary so that our global need for IT professionals can be met.

An obvious approach to solving the shortage in the tech sector is by attracting more people to the field. Women's scarcity in the IT sector is pronouncedly evident. In the EU28 zone, female IT specialists constitute only 16.5% of the workforce (Eurostat, 2019). Women's low presence in IT is conspicuous not only in the labor market but also in higher education. UNESCO's large-scale study reveals that only 30-40% of STEM majors are women; in Hungary this number is as low as 23% (Ramirez et al., 2015). According to interviews made with high school girls (Papp & Keszi, 2013; Nagy, 2014), their reluctance to choose IT as their university major originates from their experiences in high school IT classes. Other studies point out that the problems go back to as early as elementary school age (Dick & Rallis, 1991).

It must be pointed out, however, that it is not only school that is to blame. Young women are obstructed from entering and remaining in the IT sector by a broad range of social, educational, and labor market factors (Paukstadt et al., 2018). In our paper, we would like to analyze the main barriers girls face in choosing IT, while also offering some potential solutions to the given obstacles. In the second part of the paper, we will present a case study to illustrate in detail how these methods, combined, can be put into practice to address and overcome the complex, social-educational-workforce barriers girls face. We will first introduce

¹STEM = Science, Technology, Engineering, Mathematics

a Hungarian annual program, Girls' Day ("Lányok napja"), specifically aimed to promote STEM to girls, then we will present two specific events organized for the 2020 edition of the program and designed in mind with the principles we are to showcase. The interactive presentation, exposing girls to female role models in the field in a gamified way, and a game development exercise, building Scratch programming skills, have attempted to provide young women both with positive perspectives and experiences in IT, which are instrumental in helping girls to overcome entrenched obstacles and raise their interest in the field.

Girls' barriers to choose IT

In the past 50 years, an increasing number of disciplines, such as philosophy (Beauvoir, 1969), psychology (Kovács, 2017), linguistics (Huszár, 2009), social sciences (Butler, 2007), and pedagogy (Sperling and Winthrop, 2016), have turned their attention to the analysis of gender relations. Even in STEM, more and more studies have come out addressing the repercussions of gender inequality in the field (Crutzen, 2005; Mansour and Wegerif, 2013; Frehill and McGraw Cohoon, 2015; Rosser, 2017). The imbalance is present as much in education (Ramirez and Kwak, 2015), as in the labor market (Kirkup, 2002), which poses not only social problems but economic and technological issues as well. Women's scarcity in the IT sector, a prestigious and well-paid field, widens the existing wage gap between the genders (European Commission, 2020), but it also contributes to the shortage of qualified workers in the field and jeopardizes the professional accuracy of technology due to a lack in diversity (Buolamwini and Gebu, 2018). It is, therefore, crucial to uncover what keeps women away from the field and how to remedy the problem.

Several studies have attempted to explore women's underrepresentation in STEM, systemizing the factors that keep young women from choosing IT as their university major, and consequently as their profession (Dick and Rallis, 1991; Adya and Kaiser, 2005; Gadassi and Gati, 2009; Papp and Keszi, 2013; Nagy, 2014; Paukstadt et al., 2018). Reviewing the literature on the career barriers of girls, we can identify several models and theoretical frameworks. For our present analysis, we will apply Paukstadt et al.'s (2018) classification, which lists six major issues as girls' barriers in IT. These are:

- (1) Traditional role patterns / gender stereotypes
- (2) Low self-esteem / lack of encouragement

- (3) Non-attractive IT learning environment
- (4) Lack of touchpoint with IT
- (5) Negative image and stereotypes of IT jobs
- (6) Lack of info and awareness of IT jobs

We further divided these categories into three main groups, labelling them as mainly *Social*, *Educational*, or *Labor Market barriers*, in order to be able to more efficiently address them. The main barriers of young women, therefore, are the following:

- (1) Social barriers
 - (a) Traditional role patterns / gender stereotypes
 - (b) Low self-esteem / lack of encouragement
- (2) Educational barriers
 - (a) Non-attractive IT learning environment
 - (b) Lack of touchpoint with IT
- (3) Labor market barriers
 - (a) Negative image and stereotypes of IT jobs
 - (b) Lack of info and awareness of IT jobs

Social barriers

The most fundamental barriers that keep girls from the tech field are social factors. Myriads of studies have shown that gender stereotypes affect one's behavior, outlook, communication, and interactions (Butler, 1988; Ballaster et al., 1991; Baxter, 2010; Eckert & McConnell-Ginet, 2013). In addition, it has also been revealed that professional and career choices are also affected by entrenched social stereotypes (Szlávi, 2020). Traditional role patterns connect STEM fields, and more generally, abstract and physical disciplines to masculinity, while humanities, communication, and service career paths to femininity (Paukstadt et al., 2018).

One's social environment, such as parents, peers, school, and the media, reinforces these stereotypes, even if often it does so unconsciously. Due to the pervasive nature of these stimuli, they constitute an especially hard barrier for girls to overcome. The approach IT professionals can take to help lift this barrier is mainly by "fixing the knowledge" (Bonder, 2005). Bonder's widely used terminology calls the field's attention to the need of shifting its mentality about

gender roles and their relation to IT. What educators can do is first to get conscious about their own stereotypes, then help students do the same. In addition, purposefully promoting the tech field to girls would also be necessary.

According to Paukstadt et al. (2018), another key barrier to choosing IT as a career is girls' self-confidence. OECD's (2005) survey shows that young women have a low self-esteem when it comes to STEM fields. It is an obvious consequence of the previously explained, entrenched gender stereotypes that label IT as unfeminine (Papp & Keszi, 2013). Girls' conviction that they are not good at math and logical thinking can be challenged and disproven if educators are aware of the need to give girls an extra push, building their self-confidence and comfort with IT.

Presentations about or by role models could be an effective way to overwrite young women's internalized distance from IT. According to research, it is best to start giving external encouragement to girls from as early as elementary school (Dick & Rallis, 1991) because by the time they reach high school, girls have already developed signs of resistance towards STEM fields.

Educational barriers

The second group of factors that keep girls from choosing IT is centered on their educational experiences, mainly in elementary school and high school. According to the survey a Hungarian technical university conducted to explore the reasons behind high school girls' reluctance to choose IT majors, it was primarily due to their negative experiences at STEM classes (Papp & Keszi, 2013; Nagy, 2014). In fact, Paukstadt et al. (2018) reveal that generally young women find their IT learning environments to be unattractive. What this means is that, due to the above mentioned gender stereotypes connecting tech to masculinity, IT classes are male-oriented and male-dominated (Craig et al., 2007). This results in topics which are uninteresting and unwelcoming for girls. According to the authors, IT classes need to change their focus if educators wish to engage girls more. Teachers should choose topics that interest young women, that is, topics that are less abstract and theoretical but are practical and have some sort of social value (Babin et al., 2010). For example, environmental issues and Green IT tend to be stimulating for girls, or even projects that are business-oriented work well, as they show real-life purpose and involve communication, cooperation, and group work, which girls tend to like (Heo & Myrich, 2009; Fisher et al, 2015).

The other discouraging factor connected to girls' educational experience is that they lack touchpoints with IT. With uninteresting tasks in their IT classes,

girls restrict their use of IT to communication primarily. As a consequence, they are not aware of the diversity and the broadness of what IT can offer. To remedy the issue, girls need more practical experience with IT (Fisher et al, 2015), for example through games or simulations, or by introducing them to various business software and actual projects. The goal is to help young women develop tech skills and embrace the idea that IT does not have to be abstract and theoretical but it can be tangible and serve a purpose.

Labor market barriers

The third aspect that obstructs girls' involvement in the tech area is related to the specificities of the IT labor market. The traditional view of a person working in IT is the "male geek", again mainly due to traditional gender stereotypes (Anderson et al., 2008). A person sitting in front of a computer alone goes against traditional feminine gender roles that tend to favor social activities and communication. This restricted and unrealistic view of IT can be challenged if students get a wider and more profound insight into what IT career paths actually mean. Underlining the diversity, creativity, and communication components of tech jobs can make IT attractive for young women as well.

Generally, as several authors point out, students lack adequate info and awareness of the IT job market (Calitz et al, 2011; Paukstadt et al., 2018). In order to make the tech field welcoming for a wider audience, it is necessary to increase the flow of information and transparency about the diversity of IT jobs, specifically about what they actually mean, what skills are necessary, and what one's prospects are. Therefore, career days, institutional visits, and expert presentation could be very instrumental.

Approaches to overcome barriers

As the above mentioned studies have shown, girls and women stay away from STEM fields mainly due to social, educational, and labor market barriers, not because of their lack of skills and competences. As society needs more women in IT, removing these barriers would be essential, and educators are instrumental in this process. However, these barriers cannot be separated from one another, as they affect girls and women simultaneously, reinforcing each other, so we need complex solutions to overcome them. We divided the possible methods into two

groups according to whether they are targeted primarily towards giving the participants perspectives regarding IT (namely that this field is attractive, diverse, and open for them), or experiences regarding the field (namely that they find IT activities to be exciting, fun, and doable). In our view, both are needed to override the complex system of barriers young women face.

Giving perspectives

The first group of methods consists of activities that aim to provide insights into the world of informatics, especially from a woman's perspective. These include conventional or interactive presentations interspersed with short quizzes or activities (such as Kahoot! quizzes and interactive Kahoot! presentations), which have the advantage that they can be widely used from primary school to higher education (Rumbus, 2020). It is important to start directing girls' attention towards IT careers as early as in primary school.

In addition to informational quizzes and presentations, we can add to our curricula various other methods, such as group conversations, as well to present female role models in our classroom. For example, in her case study, Szlávi (2021) introduced first-year computer science students to the diversity of the IT world, presenting the variety of topics, identities and life stories in the field, using TED Talks connected to IT. Students had discussions about issues like gender, inclusion, and tech values, among others. We can also show inspirational movies in the classroom followed by conversations or fun activities. For example, Lócska & Kovács (2018) examined how watching the movie *Hidden Figures* affected the attitudes of high school students towards mathematics. According to their research, the famous Hollywood movie has increased students' enthusiasm for STEM fields. Incidentally, the film presents the success stories of three female STEM researchers, one of them being a programmer, so it may be particularly suitable for motivating young women to get into STEM and particularly IT.

Visiting institutions and research centers can also effectively raise girls' interest in STEM. These methods are used, for example, in Researchers' Night (European Researchers' Night, 2021; Kutatók éjszakája, 2021) and Girls' Day (Girls in ICT Day, 2021; Lányok Napja, 2021). Both are a series of international events held annually in Hungary too, and both aim to make STEM fields seem attractive, especially for young people. In addition, the priority of Girls' Day is to provide girls a true picture of STEM professions and to convince them that those careers are suitable for women too.

The above mentioned methods can positively affect participants' perceptions of IT in general, as well as IT career paths, particularly for women. By introducing female role models and success stories, they can demonstrate that numerous women have been able to succeed in the field; therefore, gender stereotypes that connect IT to men are challenged. Besides overwriting social obstacles, these experiences can also give young women a more realistic picture of the wide range of IT areas in which they can find a profession and what exactly these professions involve. As a result, these methods, aimed at giving positive perspectives to young women in the IT field, can be effectively used to address and overcome their social and labor market barriers that we have detailed before.

Giving experiences

While we need to show girls that it is worth considering IT as a career path, it is also necessary to provide them with first-hand experiences in doing IT. The second group of methods comprises activities in which girls can try their hand at IT and gain positive experiences. These activities can be regular, such as school classes and free or paid courses, or occasional, such as events, organized by companies or foundations, specifically to popularize science.

Three popular fields of introductory programming and coding are robotics (Bernát, 2015), creating animations (Bernát, 2020) and game development (Bernát, 2017). As mentioned earlier, girls tend to prefer topics that are less abstract and theoretical but are practical and have some sort of social value (Babin et al., 2010). Therefore, within all three fields, the focus should be on creative activities connected to topics that interest girls. More and more educational programmable robots are designed specifically for girls (Engadget, 2017; UBTECH, 2021): they can be programmed to play melodies, perform a dance, or even play roles in a story. Within the field of creating animations, by drawing and programming characters, girls can tell stories of any genre or theme. Within game development, they can create their own video games in genres that are most attractive to them (Newzoo, 2017; Polygon, 2017).

Thus, in all three fields, girls can work on practical projects — not theoretical ones as historically offered — alone or in a team, and they can be engaged in topics that impress them — instead of the typically male-centered themes. This way they can overcome the main educational barriers discussed earlier. In addition, they can gain rewarding experiences; thereby their confidence in their abilities increases which can contribute to overcoming social barriers as well. Various studies also support that robotics (Master et al., 2017; Screpanti et al., 2018), creating

animations (Kelleher & Pausch, 2007), and game development (Carmichael, 2008) can specifically increase girls' self-confidence and interest in informatics.

Case study

In order to help young women overcome these barriers and get attracted to the tech field, we need to combine the above methods, giving them both encouraging perspectives and pleasant experiences in the field. Several projects were launched in the past decades with the specific aim to popularize science to girls. One of them is "Girls' Day" (Lányok Napja), a Hungarian annual event, inspired by similar Europe-wide initiatives (see for example the original initiative in Germany, Mädchen-Zukunftstag, 2021). In the present section, we will introduce the Hungarian version of the project and two specific programs organized in its frames, in order to illustrate how the methods we described above can be put into practice.

Girls' Day

Girls' Day is an international program and campaign, running annually from the early 2000s, with the aim of promoting STEM fields to girls in elementary school and high school. In Hungary it has been organized since 2012, by the Association of Women in Science (NaTE) (Lányok Napja, 2021), typically in April but in 2020, due to the COVID-19 pandemic, it was rescheduled for October and the online space. Every year dozens of higher education institutions, research institutes, and corporations offer to host and organize programs for girls within the frames of this one-day event. In 2020, participants could choose from the programs of about 60 institutions. The number of girls interested in taking part in the event steadily grows every year; recently approximately 200 students have participated annually².

Detailed statistics are available on the website of the program regarding the number of participants, schools, and institutions, as well as the professions featured in the events of the last four years. To point to one of the most tell-tale statistics, in the last 9 years 12,500 participants could get inspired by the programs. Based on the feedback, the interactions were valuable and inspirational

²In 2020, however, there were somewhat less registrations, probably due to its online nature.

on both ends, for the girls as participants and the (typically female) professionals as organizers.

The Faculty of Informatics of Eötvös Loránd University has been among the host institutions for several years now. For the 2020 (online) edition, the Faculty offered a half-day series of programs on Microsoft Teams. After the informational presentations about the University and the Faculty, came multiple interactive, gamified sessions, designed specifically by the above described methodology addressing young women's barriers in IT.

In the upcoming two sections, we will present two of these programs in detail, explaining the design, the implementation, and the feedback. The first program is an interactive Kahoot! presentation/quiz about female role models in tech, while the second one is a game development exercise involving Scratch.

Interactive Kahoot! presentation

As explained earlier, there are multiple — social, educational, and labor market-related — barriers that obstruct young women in choosing IT. Several of them stem from gender stereotypes that label IT to be unfeminine and girls to be unskilled at logical thinking and the abstract (Nosek et al, 2009; Szlávi, 2019). As we saw above, as one of the main means to address and challenge the social barriers of their career choice, young women should be introduced to role models. Getting to know successful women in the field can make girls see that IT is not unfeminine and that they are also capable of succeeding as IT professionals (Margolis & Fisher, 2002).

Regarding the design of an event aimed to inspire girls through the stories of role models, interactivity seemed like a crucial element. Interactive learning has proven to be more efficient in IT contexts (Naps et al., 2002) and the active engagement of girls in the IT field was a key requirement, so the format of an interactive presentation was chosen. As opposed to a traditional presentation, in which participants passively absorb the info, an interactive, competitive, and gamified setting involves participants in the unfolding and processing of the stories, as if they were part of them.

One of the several options to create such an interactive game is Kahoot!³. Kahoot! is a freely available, game-based learning platform, which can be accessed from a browser or through a mobile application. The main principle of

³To read about similar platforms, such as Socrative, Google Forms, or Redmenta, see Rumbus (2020).

the platform is gamification, which entails that teaching-learning, and basically, information sharing, is more effective if we involve game-like elements, such as (1) competition, a (2) fun setting, and (3) modern, age group-specific technology. As for the competitive setup in Kahoot! games, each quiz question is rewarded by a score of up to 1,000 points, depending on the accuracy of the reply and its speed (that is, whoever is the fastest to answer correctly will receive the most points). After each question, Kahoot! provides feedback about the distribution of correct and incorrect answers, as well as about who is leading the score. What is more, at the very end of the game, the names of the three best players are illustrated on a podium. Regarding the visual settings of Kahoot! games, we have to point to the optional use of funny, automated nicknames (such as “Curious unicorn” or “Charming cheetah”), the colorful background which changes with the season (like Halloween or Christmas), and a wide selection of background music (like “Adventure” or “Funk”). Finally, even its technological options make Kahoot! attractive to a young audience: it can be played on smartphones, tablets and iPads, as well as on PCs and laptops.

The platform, operating since 2013, has more than 1.2 billion users; due to the COVID-19 pandemic and the consecutive global trend of digital education, registrations grew by 23% in 2020 compared to the previous year (Kahoot! AS reports first quarter, 2020). In the spring of 2020, Premium services became available free of charge for educators for the duration of digital education.⁴ Kahoot!, especially the Kahoot! quiz, is widely known among students in the Hungarian public education system too, as it is easy to use, both for players and quiz creators. To take part in a quiz, students do not need to register, they only need a smartphone or a similar device, access Kahoot! (kahoot.it from a browser, or the Kahoot! app), type in the unique game pin shared by the moderator (Figure 1), and submit their answers on the display of their devices while observing the questions on the moderator's shared screen⁵ (Figure 2).

The game designed for Girls' Day is an “interactive presentation”⁶ which integrates the three main functions of Kahoot!, the “quiz”, the “poll”, and the “slide”. The planned duration of the game was 20-30 minutes, and it contained 22 pages, approximately half of which was informational content, while the other

⁴In practice this meant that Premium was free until October 1, 2020, since from the Fall term of the 2020/2021 academic year, digital education became less widespread in public education than in the previous term.

⁵The texts on the screenshots have been translated to English in order to suit the language of the paper.

⁶Interactive presentations are currently available only by yearly subscriptions for Premium+.

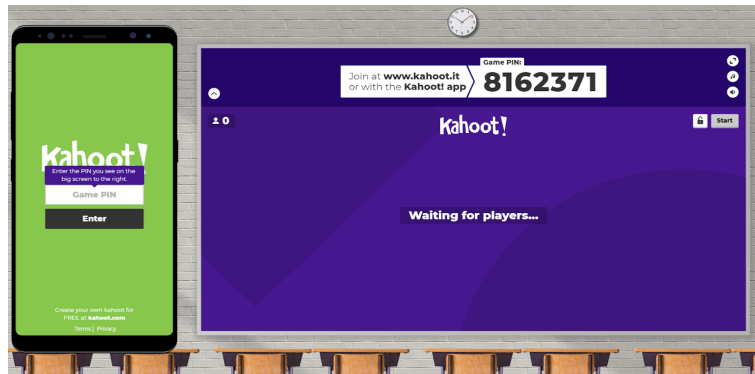


Figure 1. The opening screen of a Kahoot! game (on the left: the player's smartphone display, on the right: the moderator's computer screen)

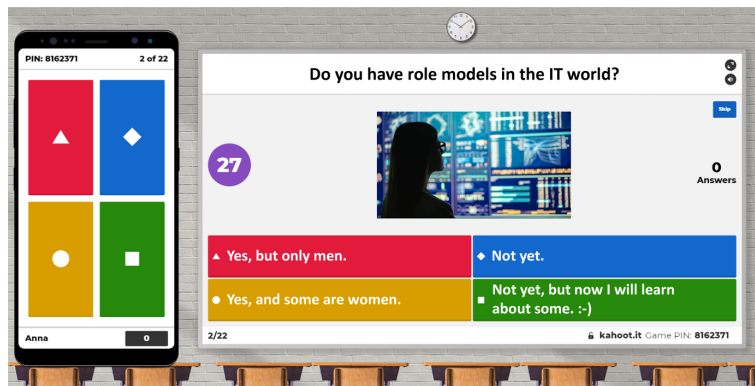


Figure 2. The player and moderator surface of a Kahoot! game (on the left: the player's smartphone display, on the right: the moderator's computer screen)

half were interactive challenges; that is, the game was built up of “slides” (info sharing) and “polls” / “quizzes” (active processing), respectively. The concept was that participants should get some new information, just like in a traditional presentation, but they should actively take part in the processing of the information thanks to built-in activities. As a consequence, the game was structured in a way to reflect this dialogue between presentation mode and activity: after

a couple of minutes of information sharing by the moderator, some follow-up activity would come, and then presentation mode again, followed by activities, and so forth. The dynamic shifting between passive and active was meant to keep participants engaged and give them a sense of accomplishment.

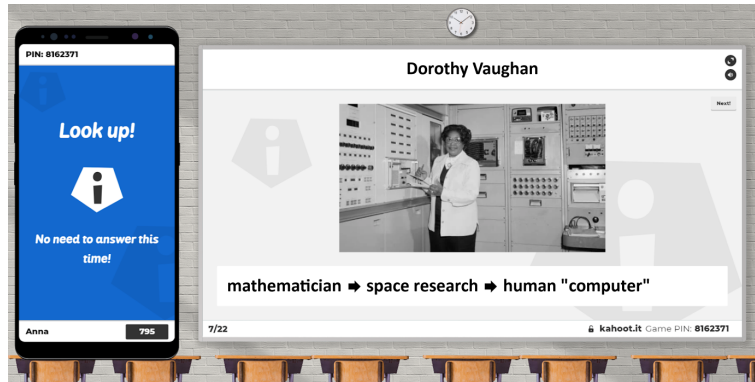


Figure 3. “Slide” in a Kahoot! game (left: player’s display, right: moderator’s screen)

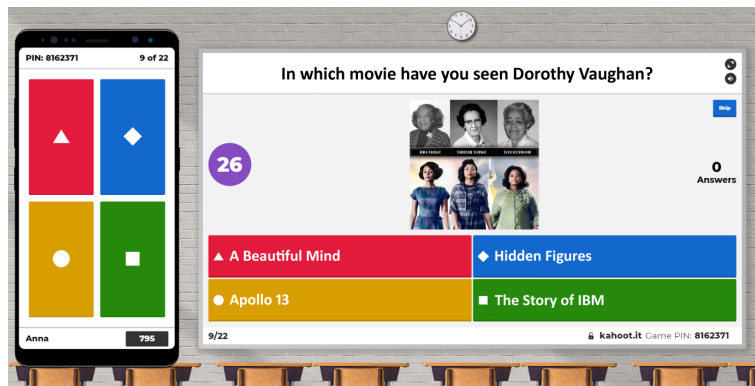


Figure 4. “Quiz” in a Kahoot! game (left: player’s display, right: moderator’s screen)

The goal of the game was to guide girls on a journey of discovery so they could explore the multitude and diversity of female success stories in the tech world. Due to the given time frame, we chose three women representing three different

areas within IT. From the world of science, Dorothy Vaughan, NASA’s programmer/mathematician was picked, because we assumed she could be somewhat familiar to students from popular culture. From the industry, Susan Wojcicki, CEO of YouTube, seemed like a good choice given the popularity of the company she represents. Finally, from gaming, a world that is increasingly trendy among younger people, Sasha Hostyn was selected as she is among the most famous pro gamers.⁷

Each success story was introduced through three slides and three activities (Figure 3-4). After the three stories, participants were presented with a closing activity, whose aim was to reinforce the knowledge they just gained while also underlining the take-away of the activity, which is that women can succeed in tech. First, participants had to answer a double-point, multiple-choice question, reflecting on the three role models of the presentation (Figure 5). Then, to frame the game, the presentation closed as it had started. To increase awareness and facilitate the processing of the experience, participants had to answer the same “poll” question at the beginning and at the very end of the game: “Do you have role models in the IT world?” (Figure 6).

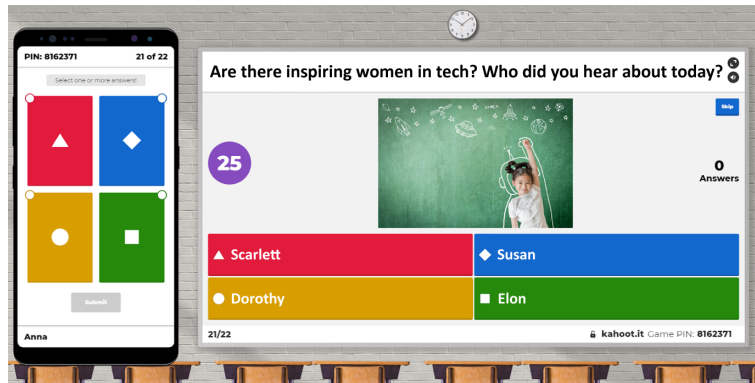


Figure 5. Closing “Quiz” question

The poll question that framed the game was meant to leave a lasting impression on girls, making them see that there are indeed role models around them who they can look up to and get inspiration from when considering or pursuing an IT career. Thanks to this interactive journey into the tech world, participants

⁷As a matter of fact, Sasha Hostyn came out as a trans, which just underlined the inclusion and diversity of the field.

had the chance to meet three women, different in career paths, ethnicity, nationality, and age, but similar in their achievement to conquer the IT world. Through this interactive presentation, girls were shown that the tech world is not only an exciting and diverse place but also one that is open for them as well.

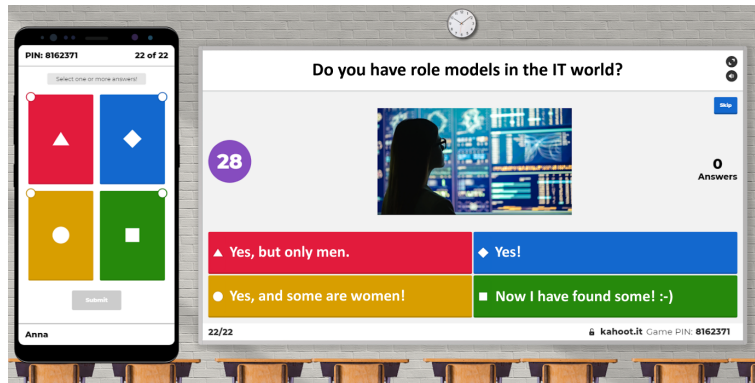


Figure 6. Closing “Poll” question

Game development in Scratch

With a one-hour practical session for upper and high school girls, our main goal was to provide participants with the opportunity to gain their own positive experiences with programming, in addition to promoting our IT faculty. Although Scratch is an educational tool to teach users to program in a simplified and playful way, girls were able to learn and apply many key concepts of object-oriented programming, and therefore, to get real impressions and rewarding experiences.

We did not expect any prior programming knowledge from the participants, only basic computer skills. They did not have to pre-install any applications on their computer either, as Scratch runs in most current web browsers (Scratch, 2021). However, we had asked them to sign up to Scratch's platform, so that they could save their work during and at the end of the session.

Among the possible programming areas, we chose game development because (as opposed to robotics, for example) it can be implemented online, and because in this way interactivity could characterize not only the activity, but also the developed program. We decided to use Scratch because it is one of today's best-known free educational programming environments, and it contains programming

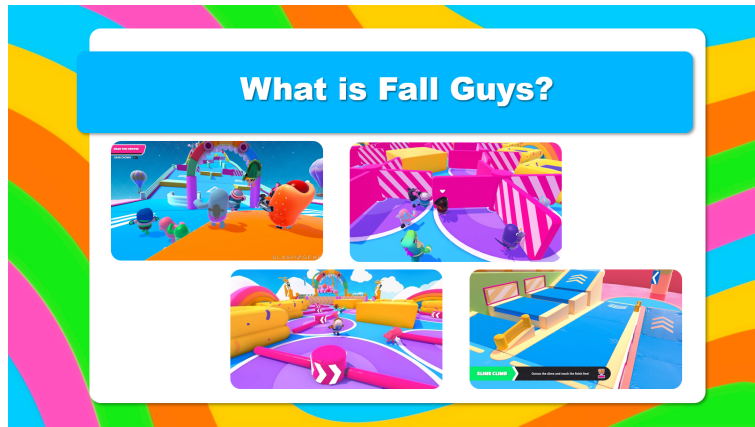


Figure 7. A slide displaying some screenshots of Fall Guys

language elements needed for game development. In addition to the huge popularity of the game, released in August 2020, we chose Fall Guys because it also has the features that can involve a wide range of students, including girls: it is multiplayer, non-violent, and it involves skill (American Association of University Women, 2000).

During the introduction part of the session, we were using a three-slide presentation. On the first slide we recalled the main characteristics of Fall Guys involving the participants (Figure 7). On the second slide, in a screen video we presented a simplified version of the game to be created during the session (Figure 8). On the third slide, we revealed that in software engineering, object-oriented programming is commonly used both inside and outside game development (Figure 9).

In the original three-dimensional game, online players can compare their skills by guiding candy-shaped characters through padded obstacle courses (Figure 7). The girls had the opportunity to create an offline top-view version of this game for one or two players. In the obstacle course shown in Figure 8, the green and the red characters of the players start from the bottom left corner and must reach the finish in the top right corner without falling into the pink sea around the course or touching moving obstacles. If they cannot manage, they must return immediately to the starting position. Whoever crosses the finish line first wins.

The participants were given a starting version of the game which means that it already included all the graphic elements and the movement of some obstacles had already been programmed. However, they created the essential part of the

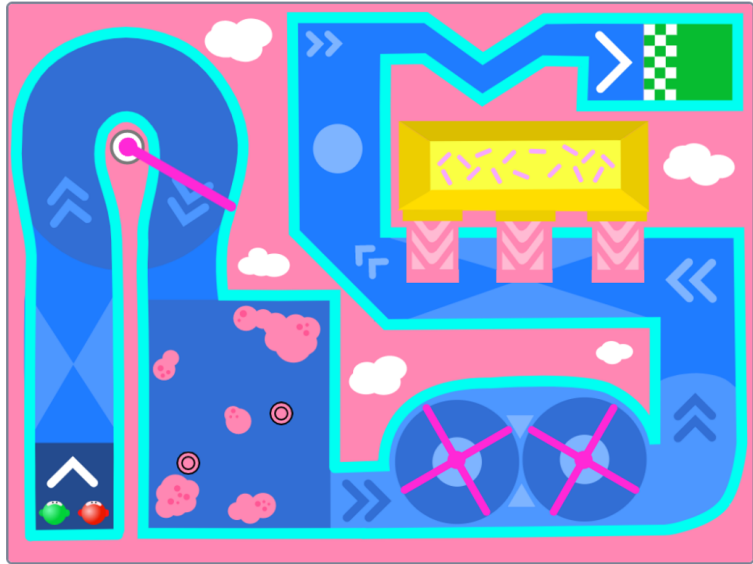


Figure 8. A simplified version of Fall Guys created during the session, which appeared as a screen video in the presentation



Figure 9. A slide revealing that in software engineering, object-oriented programming is commonly used both inside (left) and outside (right) game development

program on their own computer by following the necessary steps on our shared screen. Using programming, they made (in order)

- (1) the purple obstacles rotate around their axes,
- (2) the two characters move under the control of the two players,
- (3) the same characters return immediately to the starting position when falling into the pink sea or touching any moving obstacles,
- (4) the game ends when either of the two characters crossed the finish line.

On several occasions, the participants defined the next reasonable stage of development, and in the last minutes they came up with a number of improvement ideas: for example, that players could collect scattered objects before reaching the finish line, or that the competition could include several different obstacle courses.

Discussion

As explained earlier, young women's barriers to choose IT can be categorized into three main groups: social barriers, educational barriers, and labor market barriers. Socially, it is primarily traditional role patterns and gender stereotypes that keep girls from the tech field by convincing them that STEM is masculine, thus, unfeminine. As a consequence, girls' self-esteem is low in IT and related fields, which discourages them to consider a career in IT. Education also has an impact on young women's reluctance to enter the field: exactly because of the above mentioned stereotypes, IT classes are male-oriented, which results in unwelcoming tasks for girls and leave them with few touchpoints with IT. Finally, when it comes to the job market, girls lack a profound enough awareness of potential tech careers and a realistic view of what an IT professional does.

To overcome these barriers, interventions, such as the Girls' Day project, are required. To address and challenge the social barriers of choosing IT, young women should be introduced to role models, that is, successful women in the field. In our case study, the interactive Kahoot! presentation did just that. To tackle the educational challenges, girls need skills development and an exposure to tasks tailored to their interest, such as the "Fall Guys" game development challenge involving Scratch programming. Such activities are aimed to make young women aware of the skills connected to IT tasks, while also increasing their self-esteem through solving the tasks. Finally, the barriers connected to the IT job market could be addressed by acquainting young women with professionals in the field, giving them an insight of what they do. In the Kahoot! presentation, girls could learn about three women working in different areas of the field, while the

Scratch assignment showed girls what is behind a popular game and how game development works. That is, the combination of these two activities, one focusing on giving perspectives and the other on giving experiences, can help girls overcome entrenched and interwoven barriers.

In addition to the active and seemingly enthusiastic participation of the girls, the success of the interactive presentation and the game programming session is also shown by the fact that several participants stated in the Girls' Day survey created by NaTE that they had liked these two programs of the faculty's event the most.

Conclusions

The aim of our article was to draw attention to the low number of women and girls in the field of information technology and to point out how this situation, causing economic, social, and technological disadvantages, could be changed. According to our research, educators play an essential role in the process of overcoming young women's reluctance to choose IT career paths. Our article made an attempt to show directions for educators, first, by outlining the main, social, educational, and labor force, barriers girls face; then, by presenting two sets of methods, concentrating on giving them positive perspectives and experiences, which may be suitable to overcome these issues. In the second half of the article, we presented in detail two events of the 2020 Girls' Day program, an interactive presentation and a game programming session, which had been consciously designed to address several of the obstacles that keep girls from IT. Our aim was to demonstrate how the methods described in our paper could be applied in a way that girls both enjoy and benefit from them, opening up to the world of IT.

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