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The Role of Women in the Digital Age: Balancing professional and personal challenges during the COVID-19 pandemic

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Abstract: The paper presents the analysis of data collected with a survey on COVID-19 impact on STEM including engineering and Information and Communication Technologoes (ICT) professionals from different regions that have different cultures and focuses on the effect on women or other marginalized groups. Four major geographic areas are considered – Europe, Asia, North and South America. Particularities in Western, Eastern and Balkan regions in Europe are identified and compared with other geographic regions. Specific models for balancing professional and personal COVID-19 challenges adopted by women and other groups are pointed out and discussed with a focus on past, present, and future. The study will help employers, Higher Education Institutions (HEIs), and authorities to define better policies for supporting women and other marginalized groups in pandemic and other situations that bring office at home and require intensive use of digital technologies. Hints for game changes in the post-COVID 19 period are proposed.

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Keywords: STEM professionals, COVID-19 pandemic, marginalized groups, women challenges, lockdown impact.

1. INTRODUCTION

Since December 2019 the world has been confronting an episode of a novel irresistible infection known as Coronavirus, pronounced as a pandemic by the World Health Organization (“WHO Announces COVID-19 Outbreak a Pandemic”, 2020). Everybody was found unprepared. Governments started to take extreme measures affecting the population and businesses in an unusual way. Mandatory social distances drove big changes to professionals working in different fields. New arrangements from organizations caused problems in time management, lack of resources, and other social and psychological discomforts while individuals tried to manage the balance between private and work life (Machado et al., 2021). Women, as described by United Nations, are one of the groups that suffer more in times of crisis (COVID-19 Pandemic Response, 2020.). They are more challenged in the workplace and are more prone to abusive behaviours especially when it is the case of working in low-paying jobs with a lot of insecurities. As schools and childcare institutions were closed because of COVID-19, females faced new challenges and pressure between fulfilling childcare obligations and work responsibilities. In this situation, different organizations (COVID-19: How Business Can Support Women in Times of Crisis, 2020), call for new measures to be taken by businesses to support female workers and lessen the burden. On the other side, a different point of view is given by (Zepeda, 2021), where women have played an important role in discovering new opportunities during this pandemic. Despite awareness increased still a lot needs to be done.

On the other hand, future professionals in Science, Technology, Engineering, and Mathematics (STEM) seem to have been not so much negatively impacted by the COVID-19. Different businesses in Information Technology and a lot of experts working in computer science have gained more revenues during this pandemic time than ever (Wakabayashi et al., 2020).

Different studies are done to collect data about the impact of this situation on STEM jobs. (Machado et al., 2021) writes about the impact of COVID-19 on software engineers’ professionals and the differences between genders. (Forakis et al., 2020) study another dimension of the impact of COVID-19 to STEM young professionals and if there is a change in their academic plans and careers.

The collected data will shed light on what are the consequences, for both males and females, in STEM professionals during the pandemic time, challenged by difficulties at online work and lockdowns. The aim is to present results that will be valuable for different organizations and institutions to improve their policies and better understand the situation.

This paper is organized as follows; in the second section, the methodology used to collect and analyse the data is explained. In the third section, the results are visualized and explained, and in the last section suggestions and future orientations are given.
2. METHODOLOGY

To collect data for our research, a questionnaire survey was conducted. Surveys are research methodologies to collect data for the purpose “…to describe what exists, in what amount, and in what context” (Isaac, S., et al., 1997). The survey was developed following the European Data and Protection policy. A list of questions was prepared and was reviewed by a group of professionals, part of the Diversity and Inclusion Working Group in IFAC Technical Committee TC 9.5. Technology, Culture and International Stability (TECIS). After all the comments, improvements were done and the questionnaire was finalized with 23 questions (Appendix A), including demographics, working experiences, the infrastructure needed to work online, and questions about the insecurities caused by the lockdown. Since the questionnaire was distributed to different countries, English was used as a unified language. As a means of communicating the questionnaire and collecting the data, Google Form online tool (https://forms.gle/rxawF85Qdh5tDuW26). The survey was distributed electronically through email, social media, and outreach of persons for a period of 3 months between December 2020 and the end of March 2021. A total of 212 responses were recorded and 16 of them are discarded due to the missing data and being out of the context of this research (non-STEM professional). The results and the analysis of the final 196 responses are presented in the next section.

3. RESULTS

Europe is the leading continent of this survey with 90.82% of the responses. Most of the respondents live in Balkan countries. 99.5% of the respondents said to love their job at STEM and only 1 responded as no to the same question. Based on the respondents, the majority of the 104 (53.06%) were females. The most common age of the participants was the 29-to-38-year age group (30.61%), and 59.69% of them were employed as non-academic staff, in private organizations or freelancers working in STEM. Most of the participants (155 people; 82 females and 68 males, 5 prefer not to say) said to be working and receiving compensation. In the self-employed category, 6 were females and 5 were males. And only 10 declared to be working informally, 5 males and 5 females. Most of the participants hold a Master degree (51%) and 33% of the participants hold a Doctoral of Philosophy (PhD.) degree. A considerable number of those degrees are held by women. A detailed presentation of other demographic characteristics can be found in Table 1. There are no responses collected from Africa and Australia. A detailed list of all countries and cities can be found in Appendix B.

Non-European countries do not differ from the results taken by European countries. Most of the respondents in these countries are 14 females and 7 males and more than 39 years old, and most of them working in academia (66%). 50% of them said that their job was impacted very much and drastically from COVID-19 lockdown but only 19% of them said it had a decreased impact on their income.

### Table 1. Demographic characteristics

| Gender         | Responses | Percentage |
|---------------|-----------|------------|
| Female        | 104       | 53.06%     |
| Male          | 86        | 43.88%     |
| Prefer not to say | 6       | 3.06%      |

| Age           | Responses | Percentage |
|---------------|-----------|------------|
| 18-28 years   | 51        | 26.02%     |
| 29-38 years   | 60        | 30.61%     |
| 39-48 years   | 45        | 22.96%     |
| 49-58 years   | 29        | 14.80%     |
| More than 59  | 11        | 5.61%      |

| Occupation       | Responses | Percentage |
|------------------|-----------|------------|
| Academic in STEM | 79        | 40.31%     |
| Non-academic in STEM | 117   | 59.69%     |

| Continent    | Responses | Percentage |
|--------------|-----------|------------|
| Europa       | 175       | 89.29%     |
| Asia         | 8         | 4.08%      |
| North America| 5         | 2.55%      |
| South America| 8         | 4.08%      |

3.1 COVID-19 impact on workload and challenges

To better understand their workload, we asked them about the number of working hours. Both females and males, work more than 30 hours per week. 51% of the female respondents declared to work more than 40 hours per week in comparison to 26% of the males.

According to 41% of the respondents, the COVID-19 situation changed their job drastically. Only 10% of them said that there were no changes in their job. As mentioned in the previous section, women are more prone to low-paying jobs, especially in times of crisis.

![COVID-19 impact on income level](image-url)
Our results, shown in Fig. 1, reveal an interesting reality where the situation in the women group didn’t have any big change. Only 5 women declared their income level was decreased by more than 50%. When asked about their worries during this time, 56.63% choose family security, 8.67% chose job assurance and reduction of salary, 6.63% chose mental and physical health as shown in Fig. 2. Females were more worried about family security in comparison to other listed worries, despite their age. Males were more worried about job assurance, reduction of salary, mental and physical health than women.

![Fig. 2 Factors that caused worries during the COVID-19 pandemic](image)

Isolation measures taken by governments caused most of the jobs to shift online. 73% of our respondents said that more than 50% of their work was shifted online and only 10% continued working physically. There were 5 cases where their job was cancelled and stopped during COVID-19 (3%), 4 of these cases were women. Working online came with many challenges and difficulties, such as; problems in adapting to online work, lack of proper resources, lack of social, economic, and is free to express and be creative at work. This analysis reveals that the main problems during working online were different for either gender. For 61% of females, the main difficulty is the balance between various tasks (domestic activities, taking care of the family, and online meetings) during the lockdown. For male respondents, the main challenges were related to their workspace, working hours and the fact that their work continued physically. In general, 22% of the respondents suggest that during the lockdown period there were no difficulties, especially for 65% of males.

### 3.2 COVID-19 support from the employer

Apart from the problems and difficulties, the questionnaire contains questions to collect information about the support and help provided by family and employers. Regarding family support, 71% of the respondents had family support (100% were family members and partners) and 29% had no support at all.

Most of the people answered, worked in public institutions, mainly as professors and academics. For most of them (76%), 50% of their job was shifted online. Only a few of them, 8 persons from 107 didn’t receive support from their employer. Most of the persons working in private companies had the support of their employer (78%). Infrastructure support (the most common), flexible hours and health and mental support were the most common answers when asking about what kind of support received from the employer.

![Fig. 3 Difficulties faced during COVID-19](image)
For people working in public institutions, the answers include the most common answer, flexible hours and also infrastructure support and mental / health support.

Meanwhile, most of the employers were aware of the challenges that the workers were facing during the pandemic and lockdown situation. 69% of the respondents were supported by their employer, 15% had no support and just 2% had little support.

Regarding the means and types of support given by employers, Fig. 4 presents a summary. More of the respondents, 49% of all, had flexible working hours, 29% had physical support by providing hardware and software, 7% had mental health support, 4% health and safety audit and 6% of them had other supports like the above-mentioned. Some of the types of support from employers, not mention by the questionnaire are technical tools.

**Fig. 4** The supports offered by the employer

4. CONCLUSIONS

This article revealed the various encounters of males and female working on STEM during the COVID-19 pandemic. We presented the collected data to better understand the situation and the problems faced by STEM professionals with a focus on female challenges since they are considered a marginalized group during the crisis. Most of the participants were from Europe, and more specifically from Balkan countries. There was not an important gap in adaption and challenges between genders during the pandemic time. Flexible hours and infrastructure support given by employers were very helpful during the lockdown. Most of the women requested regulations while operating in the online environment. So, companies, and especially education institutions should work more on developing proper regulations and standards for online work. On the other hand, for males, the biggest challenge was providing and assuring financial stability and in times of crises businesses and especially governments should follow policies to support every employee with financial stability despite the crises and insecurities. Social and economic protections should be a priority in policies developed to react to crises. STEM professionals, in comparison to other professions, are more easily adapted to online jobs and technologies.

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Appendix A. FIRST APPENDIX

COVID-19 impact on STEM professionals

Section 1 - Professional Background

1) Are you part of the IFAC community?
   - Yes
   - No

2) What is your standard of education?
   - High school diploma
   - Technical certificate
   - Bachelor's degree
   - Master's degree
   - Doctor of Philosophy (Ph.D.)

3) Which of the following best describes your employment status?
   - Self-employed
   - Working informally
   - Working intermittently
   - Working and receiving compensation

4) How are you employed?
   - Employer of a public institution
   - Employer of a non-profit organization, foundation, or association
   - Employ of a private company
   - Freelancer
   - Government body

5) What is your job description within the STEM professions?

6) How many years have you been working in the field of STEM?
   - Less than 5 years
   - 5-10 years
   - 11-20 years
   - 21-30 years
   - More than 30 years

7) Do you like your job in STEM?
   - Yes
   - No

8) If No, according to your opinion what is necessary for a change?

9) What is the average number of hours you dedicate weekly to this work?
   - Less than 10 hours
   - 11-20 hours
   - 21-30 hours
   - 31-40 hours
   - More than 40 hours

Section 2 - COVID-19 Challenges on the STEM professionals

10) What was the impact of the COVID-19 lockdown at your company/sector? One refers to there is no impact at all and 5 refers to: drastically changed
   - 1
   - 2
   - 3
   - 4
   - 5

11) What was the impact the COVID-19 crises had on your income from the job so far?
   - It decreased by more than 80%
   - It decreased by between 50-80%
   - It decreased by between 20-50%
   - It decreased by less than 20%
   - They remained within expectation
   - It increased

12) Arrange the following in an importance order, starting from the factor that has caused you most worry. Please keep in mind that 1 refers to the least important aspect and 5 refers to the most important aspect.

| Factor                        | 1 | 2 | 3 | 4 | 5 |
|-------------------------------|---|---|---|---|---|
| Family Security               | O | O | O | O | O |
| Job assurance                 | O | O | O | O | O |
| Reduction of salary           | O | O | O | O | O |
| Mental Health                 | O | O | O | O | O |
| Physical Health               | O | O | O | O | O |

13) Given the following list of problems, please specify the level of difficulty you have experienced. Please keep in mind that 1 refers to "least difficult" and 5 refers to the "most difficult".

| Problem                                      | 1 | 2 | 3 | 4 | 5 |
|----------------------------------------------|---|---|---|---|---|
| Cash flow problems                           | O | O | O | O | O |
| Debt problems                                | O | O | O | O | O |
| Lack of access to financing                  | O | O | O | O | O |
| Reduced workload due to reduced demand       | O | O | O | O | O |
| Lack of digital abilities                    | O | O | O | O | O |
| Lack of other types of abilities or other technical or academic training | O | O | O | O | O |
| The standards and regulations for creative and online work are inadequate | O | O | O | O | O |
| Lack of protection or legal obstacles related to freedom of expression and / or creation | O | O | O | O | O |
| Difficulties in obtaining fair remuneration or competing in the digital environment | O | O | O | O | O |
| Lack of economic and/or social protection    | O | O | O | O | O |

14) What is the percentage of the work you shifted online?
   - More than 50%
   - Less than 50%
15) Please rate the difficulty of finding a balance between working at home and taking care of the family?

- Not difficult at all
- A little difficult
- Difficult
- Very difficult
- Extremely difficult

16) Did you have the support of the family, to face the challenges during COVID-19 working remotely?

- Yes
- No

17) If yes, who supported you during working time at home?

18) Was your employer aware of your difficulties working from home and were they supportive during this time?

18.1) What supports did your employer offer?

- Physical support by providing hardware and software
- Health and Safety audit
- Mental health support
- Facilitating flexible working hours

Section 3 - Personal Information

19) What is your gender

- Female
- Male
- Prefer not to say

20) What is your age?

- 18-28
- 29-38
- 39-48
- 49-58
- More than 59

21) Please, specify your country and city of residence.

22) What is your marital status?

- Single
- Engaged
- Married
- Widow

23) Do you have kids?

- Yes
- No

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| Section 3- Personal Information |
|----------------------------------|
|                                   |
| A detailed list of responses by country and continents | |
| **EUROPEAN COUNTRIES** | |
| Albania (81) | |
| No City (18) | Durres (23) | Tirana (36) | Vlora (1) | Fier (1) | Elbasan (1) | Shijak (1) |
| Bulgaria (22) | |
| No City (2) | Varna (1) | Ruse (1) | Sofia (18) |
| Ireland (15) | |
| No City (2) | Dublin (1) | Kilkenny (1) | Navan (1) |
| Waterford (5) | Clonmel (1) | Wexford (4) | Wicklow (1) |
| Finland (1) | Helsinki (1) |
| France (1) | La Rochelle (1) |
| Germany (1) | No City (1) |
| Austria (3) | Vienna (1) | Graz (2) |
| Bosnia.user And Herzegovina (1) | Bihac (1) |
| Italy (7) | |
| No City (1) | Benevento (2) | Avellino (1) | Parma (1) | Milan (2) |
| Montenegro (3) | Podgorica (2) | No City (1) |
| Croatia (5) | Rijeka (4) | Novi Marof (1) |
| Czech Republic (1) | Prague (1) |
| Kosovo (14) | |
| Pristina (7) | Prizren (1) | Gjilan (1) | No City (4) |
| Moldova (1) | No City (1) |
| North Macedonia (4) | Skopje (3) | No City (1) |
| Poland (1) | No City (1) |
| Romania (5) | No city (2) | Bucharest (1) | Brasov (1) | Codlea Jud (1) |
| Spain (1) | Barcelona (1) |
| UK (1) | London (1) |
| Serbia (5) | Novi Sad (1) | Nis (3) | Belgrade (1) |
| Slovenia (4) | No City (1) | Ljubljana (2) | Novo Mesto (1) |
| SOUTH AMERICA | NORTH AMERICA |
| Brazil (4) | Canada (2) |
| No City (1) | Kingston (2) |
| Belo Horizonte (1) | |
| Rio De Janeiro (1) | USA (3) |
| Joinville (1) | Los Angeles (1) |
| Chile (2) | Lawrence (1) |
| No City (1) | Santiago De Chile (1) | Rockville, Maryland (1) |
| Paraguay (2) | |
| No City (1) | Asuncion (1) |
| ASIA | |
| India (3) | Delh | Goa (1) | Kolkat (1) |
| Lebanon (1) | |
| Beirut (1) | |
| Kazakhst | |
| Pavlode | |
| Russia (1) | |
| Moscow (1) | |
| United Arab Emirates (3) | |
| Abu Dhabi (1) | South Korea (1) | Seoul (1) |

Appendix B. SECOND APPENDIX