Equity in Bytes: An In-Depth Analysis of Gender Disparities in the ICT Sector Across Albania and Western Balkans Countries - Insights, Challenges, and Strategies for Promoting Inclusion and Empowerment

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Abstract – Gender inequality is a prevalent problem encountered by industrialized and developing nations around the globe. It is imperative for governments, organizations, and individuals to actively promote equality between genders and provide women with the necessary resources and opportunities to actualize their capabilities to address and rectify gender disparities fully. Many individuals accept that innovation is a male-ruled field, which deters women from chasing after professions in the Information and Communications Technology (ICT) area. This article addresses the student gender imbalance in choosing ICT courses in Albania and the wider Western Balkans region. The issue at hand is the low presence of women in this rapidly expanding sector, impeding economic capacity and societal advancement. The objective of this study is to identify and understand the factors that are influencing this disparity between genders. The study is focused on analysing the number of registered students in bachelor's and master's courses in computer science in different public and private universities.

We use a mixed-methods methodology by analysing university registration information from the past five academic years (2018-2023) and a structured survey of 10 questions. The data is gathered from academic institutions in Albania, Kosovo, and North Macedonia, offering a thorough picture of gender representation in computer science. The paper provides valuable perspectives on the obstacles encountered by women, examines the cultural and sociological elements that contribute to gender disparity, and suggests methods to promote inclusion and empower women in the ICT sector.

Keywords – Gender inequality, women's potential, innovation, ICT, gender stereotypes.

1.   Introduction

The ICT industry has been widely acknowledged as a significant contributor to economic growth, innovation, and social transformation during a time marked by swift technological advancements [1]. This industry will significantly impact how the contemporary world develops and competes worldwide. The following article thoroughly examines the gender disparity between Albania's ICT sector and the broader Western Balkan area. Even with the notable technological progress and the growing need for digital competencies, women encounter substantial obstacles that hinder their fair involvement and representation in the sector. The lack of ability to provide women with fair and equitable treatment not only restricts women's economic potential but also hampers societal growth and hinders the generation of innovative ideas [2]. Comprehending the various aspects contributing to the gender disparity within the information and communications technology industry is paramount.

Furthermore, it is imperative to undertake a thorough investigation of several methodologies that can effectively promote gender parity within this field.

The imperative to rectify gender disparity within the ICT sector is crucial to fostering both economic and social progress [3]. Research has indicated that augmenting the involvement of women in this particular industry can yield substantial economic expansion and generate employment opportunities [4]. Furthermore, promoting gender equality within the ICT sector can stimulate innovation and propel technological progress, resulting in societal benefits on a broader scale [5].

Educational institutions should prioritize the interdisciplinary character of informatics, particularly highlighting its significance in fields such as social sciences, healthcare, and arts [6]. This strategy can attract young women with a strong interest in these fields, encouraging their active participation in computer science.

Advocating for the representation of exemplary women and providing guidance for career choices: It is crucial to acknowledge the accomplishments of women who work as educators and researchers in computing to address the difficulties they experience due to being a minority in this sector [7]. Moreover, giving students unambiguous details regarding career trajectories and educational prospects in computing is crucial.

This paper analyses women's obstacles and difficulties in ICT in Albania, North Macedonia, and Kosovo. The objective is to identify strategies that promote gender equality and establish inclusivity. Additionally, the research will explore successful initiatives from other countries that have successfully increased female participation in the industry, providing valuable insights for policymakers and stakeholders in Albania and the Western Balkan region.

Our goals include adopting a comprehensive approach to understanding, addressing, advocating, and strengthening areas to mitigate gender gaps in Albania, Kosovo, and North Macedonia university enrolments. Our goals are as follows:

1. ***Identify trends in gender registration:*** The primary aim of this study is to discern and examine patterns in gender enrollment within institutions of higher education across various locations within the Western Balkans. Through a comprehensive analysis of these patterns, we aim to acquire a nuanced comprehension of the discrepancies in enrollment and engagement among male and female students. This knowledge plays a fundamental role in developing fair and just solutions.

2. ***Mitigate Disparities with Customized Interventions:*** Our goal is to address gender inequality by building on existing patterns. It is acknowledged that distinct obstacles and needs may exist in any region. Hence, we aim to customize solutions to tackle these particular concerns effectively. Through tailoring interventions, it is possible to develop specific methods for different locations' unique situations and cultural contexts.

3. ***Enhancing gender inclusivity in higher education:*** Our objective is to enhance comprehension regarding the significance of diversity and gender inclusivity to promote social justice, education, and various other aspects of society. Our initiative aims to actively involve lawmakers, educational establishments, and the broader public in recognizing the advantages of a diverse and fair higher education system through our advocacy for gender inclusion.

4. ***Empowering Regions:*** Our research encompasses empowerment as well as identification and advocacy. The fourth objective is to provide strategies and practical tools to empower regions to attain gender balance in education. We aim to provide areas with the necessary knowledge and tools to implement policies and practices that promote gender inclusivity in their universities and institutions effectively. This empowerment initiative seeks to foster transformative processes at the regional level, establishing inclusive and accommodating environments for individuals of various backgrounds.

5. ***Advocate for Women in ICT:*** The objective of this research is to enhance the position of women in the ICT industry through the provision of pragmatic insights and implementable suggestions. To address gender disparities in ICT, this study analyzes university admission criteria for women. The attainment of this purpose is of utmost importance in furthering the inclusion of women in a discipline that possesses substantial prospects for both economic expansion and innovative advancements.

The paper is organized as follows: Section 2 describes the background and related works. The methodology is explained in Section 3, and the findings are presented in the following session. Section 5 continues with discussion and suggestions. The paper concludes with session 6.

2. Background and Related Work

Gender inequality in the ICT industry is a significant global concern. The 2019 survey undertaken by the European Institute for Gender Equality reveals a significant lack of female representation in ICT, irrespective of geographical location [8].

This phenomenon is observed in various fields related to electronic commerce, encompassing software engineering, network management, and data analytics. Gender disparity significantly influences economies and societies, surpassing the boundaries of specific contexts.

In their paper [9], the authors conducted a study that revealed that the inclusion of gender diversity in the ICT sector yields beneficial outcomes in promoting innovation and creativity. The exclusion of women in the ICT workforce hampers its growth and development potential, leading to the loss of their unique perspectives and abilities [10]. Moreover, it is essential to acknowledge that the gender disparity in ICT exacerbates the preexisting wage disparities, as women in these professions frequently experience lower compensation than their male colleagues [11]. The gap in earnings mentioned above exacerbates the broader economic disparity based on gender.

In their research [12], the authors argue that this phenomenon poses a substantial obstacle for young women who want to pursue a career in the ICT industry. The occurrence of marginalization poses a significant impediment to the progress of women and their capacity to achieve their goals [13]. The topics under discussion transcend national boundaries and encompass many global situations.

In their paper [14], the authors have explored the potential and competition women's entrepreneurial innovation could bring to Indonesia and Lumpur. They argue that it is essential to provide academic policies to the government to enhance the development of women's entrepreneurship, leading to an economic increase and the welfare improvement of their families.

Furthermore, in their paper [15], the authors argue that to increase students' interest in technically oriented fields of study, such as PC skills, operation of appliances, and electrical circuits, it is necessary for a curricular reform of teaching the subject of technology. They have presented the conceptions of the new curricula reform in Slovakia and its impact on the content of the technology subject.

Meanwhile, research has indicated that gaps based on gender emerge at an early stage within the educational pipeline in Albania and the Western Balkans.

There is a conspicuous discrepancy in informatics education, with a significant underrepresentation of female students and teachers. This disparity is indicative of more extensive societal concerns and has an impact on the variety of viewpoints and expertise within the area. Multiple causes contribute to this discrepancy. Societal preconceptions, curriculum biases favoring male perspectives, and the absence of female role models in informatics

foster an environment that deters female involvement [16].

According to [17], there is a need for more female representation in ICT-related educational programs in those countries. The phenomenon of underrepresentation can be ascribed to many variables, encompassing social preconceptions, the absence of female role models, and insufficient support networks [18]. The study underscores the necessity of implementing focused initiatives to promote increased female participation in information technology and computer sciences courses.

In the professional world, gender inequality is still present. In the field of ICT, in particular, women face stereotyping, discriminatory practices, and few opportunities for career advancement. Ramhorst *et al.* [19] conducted a study that empirically supports gender bias in multiple dimensions of the labour market, encompassing recruitment procedures, promotion determinations, and salary negotiations. Several reasons contribute to the restricted representation of women in leadership roles within ICT firms in the region.

The Gender Equality Index for Albania in Figure 1 demonstrates a significant gender disparity. This discovery affirms the necessity for stakeholders, including government entities, the commercial sector, civil society, and individuals, to recommit and intensify their efforts towards complete gender equality.
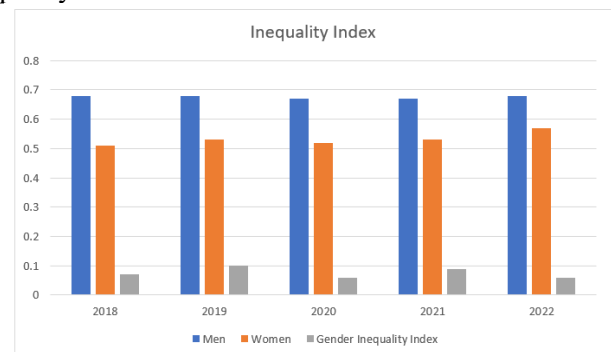

Figure 1. Index of gender inequality in Albania's labor force, Source: INSTAT [15]

A critical component of gender inequality in business is access to ICT jobs and entrepreneurial prospects. Female entrepreneurs face various challenges in establishing their ICT-related enterprises, including obstacles in networking, resource accessibility, and securing venture financing. The underrepresentation of women in startup ecosystems in Albania and the Western Balkans indicates the digital gender divide [20]. Despite these problems, the need to address gender inequality in ICT business is becoming increasingly apparent.

As shown by the National Strategy for Women and Girls in ICT in Albania, the fundamental objective of government efforts is to enhance female participation in this field [21]. Furthermore, many organizations and non-governmental entities have implemented mentorship initiatives, scholarship opportunities, and awareness drives to promote women and girls' involvement in the ICT domain [22].

Norms and customs from different cultures and societies affect the ICT business, making it harder for women to advance. Men and women traditionally play different societal roles, which may make women less likely to work in male-dominated fields like ICT. Resolving these cultural obstacles is necessary to attain gender equality within the industry. Although notable advancement has occurred, considerable obstacles exist across many education, employment, and business domains. It is vital to comprehend the issues above and the corresponding actions designed to tackle them to develop productive methods for empowering women in the ICT industry within the area.

3. Methodology

Our study used two methodologies to analyse the data: data collection and survey. The data utilised in this study were obtained from two primary sources, mainly university registration records during the last five academic years (2018-2023) from different public/private universities and a structured survey with ten questions. The survey sample of active female students in various cities/countries was selected using a multi-stage random sampling method, totalling 147 female students: 59 respondents from Kosovo, 65 from Albania, and 23 from North Macedonia. Qualitative descriptive research and a comparative analysis were applied to this research. Incorporating these sources facilitated a thorough examination of gender portrayal and implementation within the Computer Science Department at academic institutions.

A. Data Collection - University Registration

This research leveraged university registration to access administrative data that offered valuable insights into the gender distribution among students in different academic programs. Data were obtained from universities in the three regions to create a comprehensive dataset. The key steps in this data collection process included:

1. *Data Access:* Formal permits and agreements were obtained from each university in all three countries to access and utilize registration index data, including public data.
2. *Data Extraction:* The process of data extraction involved retrieving quantitative data from the university registration databases.

This data encompassed several variables such as student numbers, gender, academic program, and enrollment status and year.

3. *Data Cleaning:* Data cleaning is a rigorous process in which the extracted data is thoroughly scrutinized and verified to eliminate any discrepancies, instances of missing information, or erroneous records. This procedure effectively guaranteed the high standard and precision of the dataset.

B. Survey

The data were gathered using a structured survey to capture quantitative and qualitative information alongside the university registration indexes. The previously mentioned procedure was executed to augment the current registration data and furnish additional contextual information. The survey comprised multiple sections.:

- *Demographics:* This section comprised inquiries aimed at gathering demographic data, with a particular emphasis on gender.
- *Academic Program:* Participants were requested to indicate their present academic program within the Computer Science Department, distinguishing between undergraduate and graduate degrees.
- *Future Plans:* The survey sought information regarding participants' aspirations to pursue further education beyond their present academic program.
- The survey participants were requested to furnish self-reported information concerning the gender composition of students enrolled in their various academic programs. The participants were explicitly instructed to provide data regarding the gender distribution of students enrolled in their respective programs.
- The study employed survey questions to examine participants' perceptions regarding the gender of the Computer Science Department head and the university rector in leadership roles.
- *Institution Status:* Participants were instructed to indicate the classification of their educational institution (public or private).
- *Additional remarks:* A section was included for qualitative observations and recommendations about gender diversity and representation in the department and university.

C. Data Integration and Analysis

Integrating data from both sources, such as university registration indexes and the survey, resulted in a consolidated dataset for analysis. This methodology facilitated a thorough analysis of gender representation within academic programs and offered significant contextual understanding by including qualitative perspectives.

The gender distribution among students was examined by conducting descriptive and inferential statistical analysis on quantitative data obtained from university registration indexes. The analysis of survey data, encompassing both quantitative and qualitative aspects, was undertaken to enhance the comprehensiveness and intricacy of the quantitative findings. The qualitative data obtained from the open-ended section "Additional Comments" were subjected to thematic analysis to identify recurring themes and gain insights.

The present study committed to ethical considerations, per established norms, to protect participants' privacy and anonymity. The researchers obtained informed consent from the survey participants and took measures to anonymize personal data, safeguarding the individuals' confidentiality.

Limitations: Recognizing the restrictions and deficiencies inherent in this research undertaking is essential. While the registration data provides a comprehensive overview, it is crucial to acknowledge the potential occurrence of data input errors at the institutional level. The voluntary nature of survey participation introduces the possibility that the sample may not comprehensively represent the entire student population in the region. The study offers significant findings within a specific temporal context, and further inquiries may be warranted to explore enduring patterns.

4. Findings

First, we analyzed gender distribution in academic programs. Examining data obtained from university registration records unveiled notable trends in the gender composition of students within the Computer Science Department across the surveyed academic institutions in Albania, Kosovo, and North Macedonia. Figure 2 presents a visual representation of gender-specific enrollment data in universities in Albania, spanning the years 2017 to 2023.
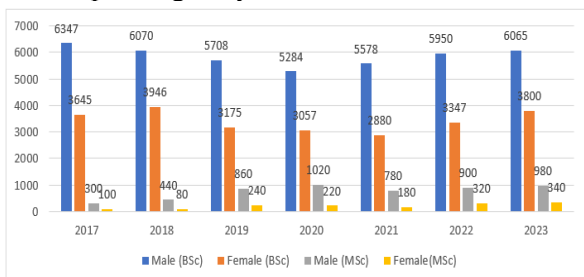

Figure 2. Student registration for CS in Albania

The visual representations depict the distribution of university enrollments in ICT among female and male students, highlighting significant patterns and disparities.

The trends that have been observed hold considerable implications for promoting gender inclusivity and achieving equity within the ICT industry. Figure 3 compares student registration in ICT fields, categorized by gender, in Albania, Kosovo and North Macedonia during 2017-2023.
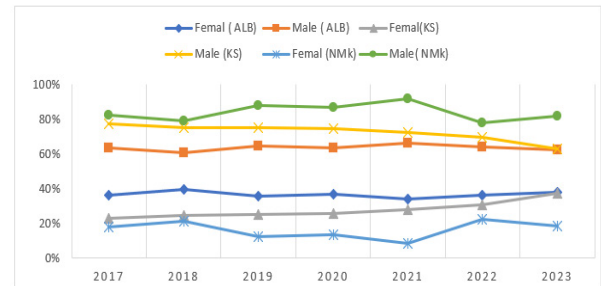

Figure 3. ICT student registration in universities by gender (2017-2023)

We are examining university enrollment data in the Western Balkans from 2017 to 2023, highlighting noteworthy gender disparities within the ICT industry. These disparities manifest inequality between female and male enrollments across three distinct regions. An uneven distribution was observed in Albania and Kosovo, characterized by a lack of proportional representation of female registrations compared to male registrations. This trend suggests a lack of proactive dedication to promoting gender inclusion within higher education. Nevertheless, the provided Figure 4 illustrates a notable and consistent increase in the educational enrollment rate of females, particularly within the past five years.
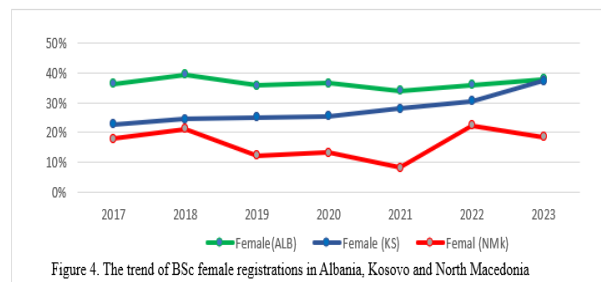

Figure 4. The trend of BSc female registrations in Albania, Kosovo and North Macedonia

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The data unveiled a substantial disparity in university enrollment between genders in North Macedonia, with a notably more significant proportion of male students. This discovery suggests the presence of a notable gender disparity within the country. The observation above draws attention to the noteworthy discrepancy in gender representation concerning enrollment in higher education institutions throughout the region.

After analyzing the survey data, it became evident that three prominent themes emerged as significant determinants impacting women's hesitancy in selecting ICT studies. This statement provides a comprehensive analysis of women's intricate challenges and barriers when contemplating professional paths within the ICT sector.

Masculine Culture and Lack of Identity Fit: The survey analysis showed that women's perceptions of the ICT field's predominantly male culture are a significant barrier to women pursuing ICT studies. 38 of 147 female participants expressed a sense of dissonance between their identities and the ICT environment. This theme focuses on how stereotypes and cultural norms can make women feel excluded and uneasy.

Many signs point to a masculine culture, such as the use of gendered language, the presence of biased expectations, or an uneven gender distribution among faculty and students. These factors may present challenges for women because they reinforce the notion that the field of ICT is unsuitable or inhospitable to them.

Lack of Early Exposure to the Subject (Computer Science and Coding): The survey findings indicate that a notable aspect pertains to the limited exposure to computer science and coding subjects in the early stages of education, particularly among individuals lacking familiarity with these domains. The female participants demonstrated a limited understanding and preference for ICT fields, as many expressed an absence of exposure to these subjects during their primary or secondary education.

The provision of early exposure plays a pivotal role in cultivating students' inclination and self-assurance in the domain of computer science and programming. Incorporating computer science and coding subjects into early-stage curricula deserves attention from policymakers and educational institutions as a possible approach to addressing existing disparities in academic achievement. The potential benefits of including extracurricular activities, workshops, and outreach programs in educational settings, with a particular emphasis on engaging young students, especially girls, in the field of ICT, are manifold.

Lower Self-Efficacy of Women: The examination of the survey data indicated that 66% of female respondents demonstrated reduced self-efficacy about their ability to excel in ICT studies. The central thesis of this theme posits that women may harbour a perception of diminished competence or capability within the domain, potentially influenced by societal stereotypes and a shortage of accomplished female role models.

More importantly, it is crucial for educational institutions to actively endorse and recognize the achievements of female students in the realm of ICT. This practice can significantly augment individuals' self-efficacy and foster their motivation to engage in higher education within this field of study.

5. Discussion and Suggestions

The results of our research provide insight into the multifaceted determinants that impact women's decision-making about ICT studies and emphasize significant consequences for advancing gender diversity and representation within this domain. This discourse aims to explore the fundamental themes and provide valuable perspectives, suggestions, and approaches for effectively tackling these obstacles.

Based on the results obtained from our survey, it is apparent that women involved in the ICT sector face a significant cultural obstacle. The cultural context poses various barriers that hinder female students from attaining a sense of inclusion, leading to feelings of shame and marginalization. To tackle this matter adequately, educational establishments and industry participants must consider the subsequent elements:

- *Cultural Transformation:* It is essential to start a cultural transformation in the ICT industry. To create a more inviting and inclusive atmosphere, it is necessary to support diversity and equity, fight gender biases, and encourage inclusive language.
- *Mentorship and Role Models:* The visibility of accomplished female role models in ICT and mentorship programs is beneficial to female students. Organizations can launch mentoring programs, and businesses can aggressively support women in leadership positions.

Our research findings demonstrate that the early introduction to these disciplines is pivotal in fostering curiosity and establishing fundamental knowledge. Multiple strategies can be employed to mitigate this disparity proficiently. The inclusion of coding and computer science modules within the primary and secondary school curriculum should be considered by policymakers and educational institutions as a component of broader curriculum reform initiatives. This measure ensures equitable access to fundamental skills for all students, regardless of gender.

Implementing outreach programs and extracurricular activities designed to promote coding and computer science proficiency among young students, with a specific emphasis on girls, holds the promise of nurturing early engagement and bolstering self-assurance in these domains.

According to the data, many women believe they have lower self-efficacy in ICT studies. Societal stereotypes and a lack of representation frequently cause this self-doubt. Strategies for increasing women's self-efficacy in ICT include:

- *Support Networks:* Educational institutions can establish support networks, such as peer mentorship programs, to help women succeed academically and professionally. This assistance promotes self-esteem and resilience.
- *Recognition of Achievement:* Recognizing and celebrating the accomplishments of female students in ICT can boost self-efficacy and inspire more women to pursue the field. Awards, scholarships, and public acknowledgement are all forms of recognition.
- *Parental awareness campaign* regarding the importance of studying informatics: A parent awareness campaign about the importance of studying informatics can emphasize early schooling. To motivate young girls, showcase female computer scientists' success and career prospects. Encourage girls with self-interest in the field through social media campaigns and promotions. This method uses relatable role models and supports community involvement to inspire young females to study informatics.

High school teachers and lecturers in universities are vital in enhancing the percentage of women in ICT. We suggest that other strategies to be taken would be:

- Implementing laws that promote diversity and inclusiveness in the educational setting [23].
- Support and encourage inclusive teacher training: Focus on developing workshops and training sessions that provide teachers with practical strategies to create an inclusive and supportive learning environment in informatics. These sessions should cover topics like recognizing and addressing unconscious biases, fostering classroom discussions that respect and celebrate diversity, and incorporating teaching materials that reflect various perspectives. Additionally, schools can establish a mentorship program for teachers [24], pairing less experienced educators with more seasoned ones to share inclusive teaching practices. Regular feedback and evaluation mechanisms can help in continuously improving these training programs.
- *Promote an inclusive classroom culture*: Provide workshops that concentrate on employing interactive and inclusive teaching methodologies. Establish a comprehensive anti-bias policy that guarantees impartial treatment and equitable opportunity for every student.

- *Advocate early informatics exposure and access:* The early exposure and availability of informatics are crucial to fostering interest and skill. Teachers help achieve this goal by teaching students the principles of informatics early on, incorporating these standards into the curriculum, and making the material engaging and easy to understand [25]. Early openness destroys biases and builds fundamental capacities, setting the groundwork for a diverse and inclusive informatics future. Teachers motivate students to achieve in a changing sector.
- *Inspire motivations with approachable and relatable role models*: Teachers can communicate their paths and encounters in the field of informatics, emphasizing both accomplishments and obstacles. The customized approach improves the subject's ability to connect with others and can inspire students to pursue similar paths. Furthermore, educators can exemplify problem-solving, critical thinking, and a passion for informatics through their instructional approaches. Through actively illustrating these attributes, they serve as tangible role models for students to aim to emulate in their respective domains.

Additionally, AI could be a critical resource for teaching STEM fields and coding at high school [26], as gamification elements may help educators design highly effective and exciting lessons for their students.

Our findings emphasize the importance of multifaceted efforts to overcome the obstacles that prevent women from pursuing ICT degrees. Addressing the masculine culture, exposing girls to computer science at a young age, and increasing self-efficacy are all critical steps toward empowering women to excel in the field.

6. Conclusion

Efforts to make the ICT sector more inclusive and diverse must begin with challenging and reshaping the dominant masculine culture. Cultural transformation is a long-term project that includes encouraging equitable language, confronting gender biases, and actively promoting diversity. Mentorship programs and visible female role models can contribute significantly to cultural change.

The research findings provide crucial insights into significant aspects of gender dynamics within the ICT sector. Female enrollment in Albania and Kosovo is inferior to that of males, emphasizing the pressing need for targeted interventions to foster gender inclusivity in ICT-related academic programs. Furthermore, the data clearly shows a significant disparity in gender representation in North

Macedonia, highlighting the broader problem in the area that needs to be addressed urgently.

The paper's findings underscore the imperative for a transformative cultural shift within the ICT industry, advocating for enhanced diversity and equitable practices. By pinpointing the gender disparities and cultural influences within academic programs, the research addresses an immediate concern and urges broader societal implications. Implementing the recommended strategies, such as fostering an inclusive environment and promoting visible female role models, can significantly contribute to reshaping the ICT landscape. A more inclusive sector has the potential to spur economic growth, encourage innovation, and advance overall societal progress. Beyond rectifying gender imbalances, the societal impact extends to challenging and reshaping longstanding norms, fostering an environment where meritocracy and diversity thrive, benefiting the ICT industry and society.

Future studies should prioritize investigating the lasting effects of cultural changes in the ICT industry on gender diversity. Gaining a deep comprehension of how enduring cultural changes impact the dynamics of the sector over a prolonged duration can yield priceless insights. It is essential to assess the effectiveness of early exposure programs in promoting diversity in ICT education to guide the formulation of educational policies. Conducting more studies on the lasting impacts of mentoring programs on the progression of women's careers in the ICT industry is a crucial topic for future exploration. This will guide policymakers and industry stakeholders in promoting long-term change. This research will play a crucial role in formulating evidence-based approaches to foster a more inclusive and fairer environment for all persons in the ICT area.

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