THE ROLE OF MODERN INFORMATION TECHNOLOGIES IN EDUCATION AND TEACHING FOREIGN LANGUAGES: GENDER ASPECT

O PAPEL DAS TECNOLOGIAS DA INFORMAÇÃO MODERNAS NA EDUCAÇÃO E NO ENSINO DE LÍNGUAS ESTRANGEIRAS: O ASPECTO DE GÊNERO

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Abstract. The article outlines ambiguous role of information technologies in today education landscape within gender aspect. In particular, correlations between gender disparity in STEM and gender biases towards digital technology are analyzed, including based on statistical data of various countries, which allow revealing that among STEM disciplines the most evident gap exists in Computer Sciences. Using content analysis of literature, it was also found that women perceive themselves as less competent than men in terms of mastering technology, while this phenomenon has its primary roots in teachers' bias concerning gender-mediated abilities for information technology. Bearing in mind the vicious circle of gender biases towards information technology both in teachers and students at every level of educational system, it is suggested to address the experience of corporate sector, that accumulated more experiences and best practices in the application of digital technologies for enhancing DEI, some of which, with specifying their potential application in education, are described in the paper.

Keywords: information technologies, education, gender, bias, diversity, STEM

Resumo. O artigo descreve o papel ambíguo das tecnologias da informação no cenário educacional atual, sob a ótica do gênero. Em particular, são analisadas as correlações entre a disparidade de gênero nas áreas STEM e os preconceitos de gênero em relação à tecnologia digital, com base em dados estatísticos de diversos países, os quais revelam que, entre as disciplinas STEM, a maior lacuna está presente nas Ciências da Computação. A partir da análise de conteúdo da literatura, constatou-se também que as mulheres se percebem como menos competentes do que os homens no domínio da tecnologia, sendo esse fenômeno originado principalmente nos preconceitos dos professores quanto às habilidades mediadas por gênero em relação à tecnologia da informação. Considerando o círculo vicioso dos preconceitos de gênero em relação à tecnologia da informação, tanto por parte de professores quanto de estudantes em todos os níveis do sistema educacional, sugere-se recorrer à experiência do setor corporativo, que acumulou mais experiências e boas práticas na aplicação de tecnologias digitais para promover diversidade, equidade e inclusão (DEI), algumas das quais são descritas no artigo, com indicações sobre seu potencial uso na educação.

Palavras-chave: tecnologias da informação, educação, gênero, preconceito, diversidade, STEM.

1. INTRODUCTION

To date, more than two-thirds of nations have achieved gender equality in elementary school attendance. In many nations, female secondary enrollment rates outnumber those of male students. In more than 100 nations, female tertiary enrollment rates exceed male rates by more than 5 percentage points. Between 1995 and 2018, female enrolment increased by 180 million, accounting for 55% of the overall growth in elementary and secondary education. As the educational landscape evolves, new potential areas of inequity emerge. In particular, the increasing penetration of information (digital) technology into education at all levels has resulted in a new gender gap, which is particularly noticeable in higher education.

Jaccheri et al. (2021) correctly state that women are underrepresented in computer science (CS) fields at all levels, from undergraduate and graduate studies to involvement and leadership in academia and industry. Increasing female participation in the profession presents a significant issue for academics, policymakers, and society. Although the problem has been addressed for many years, progress has been difficult to assess and compare across nations and institutions, and it has always been gradual, despite the energy and drive for change that exists in numerous countries.

Higher education statistics for various European nations, collected over the last 15 years, confirm that substantial female underrepresentation in higher education in CS in Europe has long been a concern. The investigation into female participation revealed that at the Bachelor level, in Austria, Belgium, Germany, Finland, Denmark, the Netherlands, Switzerland, Ireland, Italy, Latvia, Lithuania, Poland, Spain, and the United Kingdom, 80% or more of students enrolling or graduating from Informatics Bachelor programs are men. Similarly, while the difference is significantly lower in Bulgaria, Romania, Greece, and Estonia, women do not account for more than 30% of bachelor students (Ro et al., 2021). Except for Bulgaria, Romania, Turkey, and Estonia, all other countries have less than 25% of women graduating from CS Ph.D. programs, which equates to less than a handful of women in some cases, given the small total number of Ph.D. graduates in many countries (Sharma et al., 2021).

The similar issue is found in STEM (science, technology, engineering, and mathematics) education, which, as is well known, is one in which teaching and learning are primarily focused on information technology. The imbalanced gender ratio in STEM education not only impedes the growth potential of female students, affects the educational development level of STEM education, and contradicts the concept of equality that society values. The unequal representation of female and male students in STEM education reflects the issue of “gender segregation”, which has a detrimental influence on the concept of fostering gender equality in society (Bilyk et al., 2021, 2022; Kryshtanovych, M. et al., 2021; Kryshtanovych, S. et al., 2021, 2022; Liakhovych et al., 2023; Zyazyun et al., 2022).

Women have long been underrepresented in STEM, both at universities and in industry. Statistics are disturbing, particularly in nations that value variety, such as the United Kingdom (see Fig. 1).

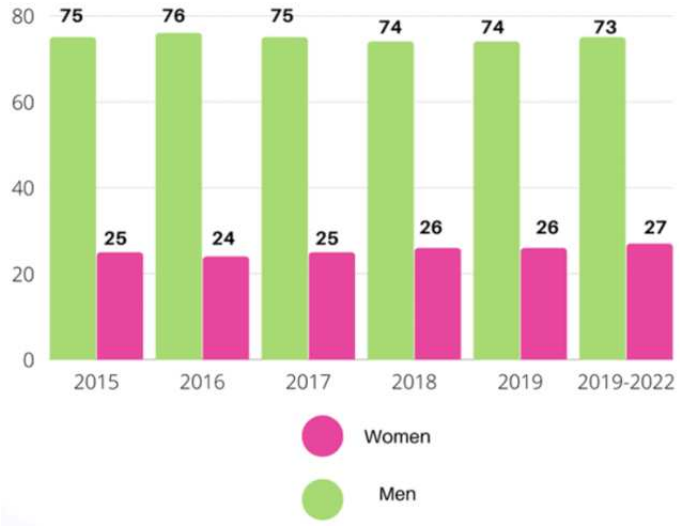


Figure. 1. The ratios of men and women in the field of STEM in UK (STEM Women, 2023)
Source:

The most evident gap exists in Computer Sciences, as well as in Engineering and Technology (this field today is also based predominantly on digital technologies) (see Fig. 2).

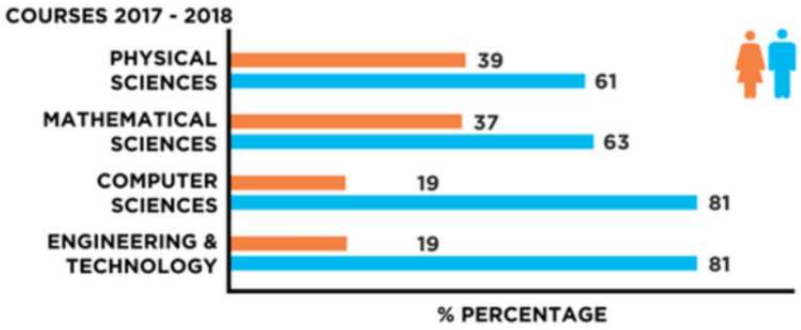


Figure. 2. Subject breakdown – female students, UK (STEM Women, 2023)

At the undergraduate level, there are some noteworthy imbalances in STEM disciplines, with a large percentage of female and non-binary students enrolling in topics such as Psychology and Allied to Medicine (e.g., nursing), which are frequently among the lowest-paid professional paths. Women and non-binary persons are substantially underrepresented in basic STEM topics (with the exception of Physical Sciences, where representation is approaching 50/50). This also applies to the presence of women and non-binary persons in the UK workforce in STEM-related professions, particularly in leadership positions (Ro et al., 2021).

Thus, a paradoxical situation appears: information technologies, intended for enhancing the quality of education and improve social capital, became a factor negatively influencing gender equality in education. With this in mind, it seems highly relevant task to investigate the overall role of information technologies in education within gender aspect, considering information/digital technologies not also as a part of curriculum but as teaching and learning tool.

2. LITERATURE REVIEW

Gender studies' content is multi- and cross-disciplinary, since gender study is undertaken in a variety of empirical and theoretical contexts. However, one common thread is that gender

theory and methodologies are predicated on a thorough and dynamic examination of power dynamics in research, society, and culture. Judith Butler (1994) described gender research as a discipline without “proper objects” of study, implying that gender studies may and should investigate nearly everything.

Lundberg and Werner (2018) correctly argue that given the discipline's interest in power and critical creative thinking, educational approaches and curriculum in gender studies necessitate ongoing growth as well as a continuous focus on power awareness. Gender studies teachers and students strive to be introspective, utilizing their experiences to question hierarchies, discover unfair systems, networks, and behaviors, and create alternative structures, particularly within their own discipline. Researchers working in the field of gender studies who are active in subjects other than gender studies also conduct such work. This holds true not simply for the discipline's subject matter and related research, but also for the way it is taught in the classroom. Equal opportunity legislation in higher education guarantee that no student is treated differently. In order to give students in higher education equitable chances, teaching methods must ensure that all students may voice their opinions without excluding any particular group or person. This law can be viewed as a springboard for conversations on the evolution of the kinds of instruction, not just the subjects covered (Henderson, 2014).

The gender-sensitive teaching philosophy takes into account and acknowledges the influence of gender factors on student-teacher interactions, student-to-student interactions, and instructional tools and content (Beckman Soares da Cruz et al., 2024). The goal of gender-sensitive education is to facilitate male and female students' learning equally (Drew & Canavan, 2022). Quite sound array of studies is devoted to exploring gender differences in language learning and gender-specific methods of teaching foreign language (Sunderland, 2000; Yao, 2011; Voyer & Voyer, 2014; Li et al., 2024).

However, fast dissemination of newest information technologies in educational landscape, including in foreign language teaching, makes evident modifications and changes in gender ‘fabric’ of pedagogy, creating both new opportunities and new challenges. Experimental studies (i.e., Salami & Spangenberg, 2024) and The Technology Acceptance Model (TAM) (i.e., Daaqili, 2022), designed to explain and understand individual behavior using ICT, are employed by researchers within studies in this domain. However, these researches are mostly scattered and narrow-focused, considering specific disciplines or being strictly country-based. IT technologies and STEM, as a rule, are viewed separately in this issues landscape. Thus, more integrative approach is needed.

3. METHODOLOGY

The theoretical and methodological basis of the study is a comprehensive analysis of the essence and structure of the information component of the educational process. The methodological basis of the study includes the theories of educational process management, theories of personality and activity, research in the field of modeling and designing pedagogical and managerial activities, as well as theoretical provisions on the effectiveness of management in the event of instability, heterogeneity and insufficiency of resources. The study also uses an analysis of the socio-cultural functions of education in a situation of total informatization. The general framework of the study is a systems approach, and the fundamental tool is content analysis.

4. RESULTS AND DISCUSSION

As it was stated above, women’s underrepresentation in science, technology, engineering, and mathematics (STEM) sectors has piqued the interest of the public, academics, and policymakers. While the gender gap in STEM is extensively addressed and acknowledged, its

relative magnitude across many disciplines, technology, and engineering is less clear. Unfortunately, one of the most badly affected fields is computer science (informatics, computer engineering, computing, and information technology). Chemistry and biology have significantly more balanced gender distributions, but women are underrepresented in Computer Science (CS), Engineering, and Physics. This severe imbalance has persisted for a long time, with no meaningful change noted in recent years in either Europe (European Commission, 2018) or the United States (Wang et al., 2021). The gender gap in CS research (the number of male and female writers) is expected to remain open for at least 100 years if no particular steps are adopted.

However, the roots of problem lie even deeper – in the use of digital technologies as a teaching/learning instrument.

According to Mercader and Duran-Bellonch (2021), the uneven situation of female professors in higher education is a fact, with digital technology contributing to their exclusion. The primary goal of Mercader and Duran-Bellonch's research was to examine the integration of digital technology in education from a gender viewpoint. The study used a multiple case study design and a quantitative approach. The sample included 527 instructors from four Spanish institutions. The instrument used was a self-administered survey. The findings corroborate both forms of segregation and the fact that female instructors see themselves as being less digitally adept than their male colleagues; strangely, the data also demonstrate that the former utilize information and communication technology in the classroom more than the latter. Finally, the authors emphasize the importance of further researching the relationship between digital breach and gender in higher education, as well as taking steps early in the educational process to counteract female instructors' tendency to underestimate their digital competence.

Indeed, other studies have found that women believe they are less skilled than males when it comes to learning technology. They consequently tend to place themselves at lower degrees of mastery, whereas males place themselves at the greatest level (Fernández et al., 2018). At the same time, according to Martínez-Cantos and Castaño (2017), female lecturers underestimate their digital competency while using more instructional technology than their male counterparts.

Furthermore, women believe that the present hurdles to integrating technologies in higher education necessitate institutional action. It could be interpreted as follows: It may be read that women still feel they must follow the external signals emanating from the institutional authority organs, therefore believing the integration of digital technologies to be conditional on the supervision of their teaching performance and incentives for the use of ICTs; as a result, women would continue to be more dependent than males (Mercader & Duran-Bellonch, 2021).

At the same time, in the use of digital technology in foreign language learning is not characterized with evident gender gap. Bećirović et al. (2021) conducted a quantitative research to examine how high school students in Bosnia and Herzegovina utilize technology and how teachers assist them in learning English as a foreign language (EFL). The questionnaire, which has seven subscales, was used to gather data on how teachers affect students' self-directed use of technology for language acquisition. The findings indicate negligible gender and EFL GPA disparities and demonstrate that participants' experiences with technology-based language learning (TBL) are generally pleasant and that teachers play a substantial role in TBL.

At the same time, Ibrahim et al.'s (2021) study focused on the forced and fast shift to an online learning environment in the context of foreign language learning in times of COVID-19 pandemic. Figure 3 displays the findings of a study intended to identify shifts in students' attitudes on online education throughout the COVID-19 pandemic. As a result, Figure 3 demonstrates that whilst male participants' assessments of e-learning comfort was essentially constant, female respondents' assessments significantly declined (from 3.70 to 3.14 on a five-

point Likert scale). However, both male and female research participants manifested a considerable decline in usefulness score (from 4.10 to 2.98 and from 3.80 to 2.26, respectively). Although the curriculum, instructional materials, and learning content did not change virtually, the introduction of e-learning and the transition from a traditional classroom setting with a teacher to one that is entirely digital led to variations in the evaluation of their usefulness. It is also reasonable to believe that the first strong good impression was just a reflection of the respondents' exaggerated expectations regarding online education and digital technologies (Furtado da Silva et al., 2024).

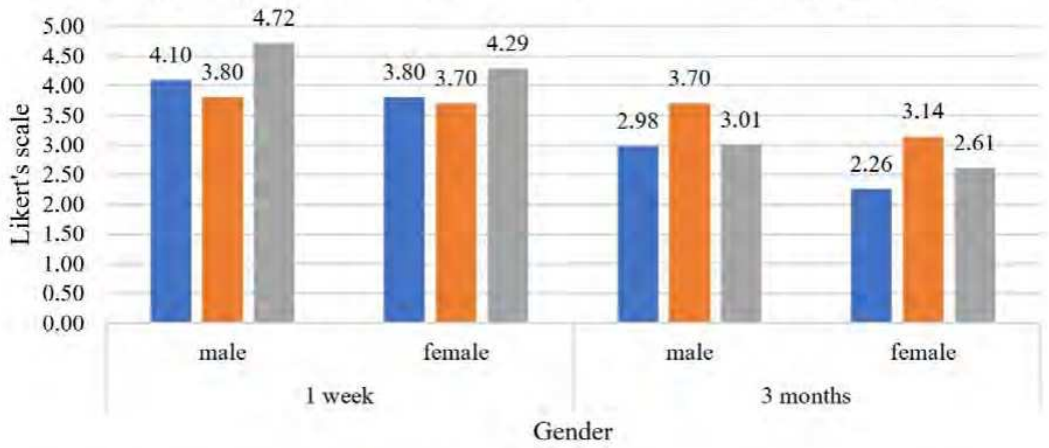


Figure 3. Changes in learners' perception of e-learning (by gender) (Ibrahim et al., 2021)

According to a Saudi Arabian academic scholar Mohamad Khasawneh (2024), male and female language learners employ digital technologies differently in order to meet their language learning objectives. His study's goal was to examine how gender differences and technological adaption relate to language acquisition among undergraduates studying foreign languages. In order to accomplish the goal of the study, a quantitative research approach was used in the article, and data from a total of 394 undergraduate students studying foreign languages was compiled. The results demonstrate that gender variance affects language learners' opinions of the efficacy of technology (mean score = 2.80), acceptance of technology (mean score = 4.10), and usage of technology (mean score = 3.50). The study comes to the conclusion that language users' adoption of technology is influenced by gender variance.

Thus, the data on gender aspects of digital technologies' role in education, in particular with regard to STEM discipline and foreign language learning, are ambiguous.

Elsa Velasco (2019) feels that future instructors continue to believe the stereotype that girls are not competent at technology. The author underlines that elementary and secondary school instructors in training have internalized gender preconceptions, which may discourage their prospective female pupils from choosing scientific and technical occupations. These are the early findings of a study conducted by the Internet Interdisciplinary Institute's Gender and ICT (GENTIC) research group at the Universitat Oberta de Catalunya. Velasco (2019) shows data indicating that in Spain during the 2016/2017 academic year, just 26% of individuals enrolled in engineering were women, a ratio that has remained unchanged for a decade. Electronic engineering has the lowest female representation, with just 13% of students being women, followed by computer engineering with 15%. Although the gender gap in science has narrowed, women remain a minority in several fields, such as physics, accounting for just 28% of those enrolled.

One of the variables that contribute to gender stereotypes among boys and girls is their own instructors. There are research that show that instructors have distinct attitudes about boys and girls. Teachers who hold these ideas likely to encourage guys to learn more science than girls,

sometimes unintentionally. This adds to prejudiced professions. Stereotypes influence not just motivation, but also the perspective that young females have of their own skills and the outcomes they achieve (Azad, 2021).

Researchers from the Universitat Oberta de Catalunya investigated the extension of gender stereotypes, not only among students pursuing a bachelor's degree in Primary Education and a master's degree in Teacher Training - Secondary Education, Language Teaching, and Vocational Training, but also in the training they received. As part of the ESTEREO project, they conducted in-depth interviews with twenty-four students of both genders from Barcelona institutions. The preliminary findings indicate that instructors in training have still internalized gender prejudices about boys' and girls' talents. The majority of students pursuing bachelor's and master's degrees in education, both male and female, believe that girls have better skills in education, social sciences, and humanities than boys do in numbers, technology, computer science, experimental sciences, and all abstract and technical tasks. According to the researchers, the most shocking aspect is that they are unaware of these preconceptions and how they might impact students' perceptions of their own talents, interests, and grades (Velasco, 2019).

Plumm warned in 2008 that technology itself (e.g., computer software programs, computer lab space) could be a type of learning material that perpetuates or promotes gender bias in the classroom by including male lead characters in the majority of software programs or by having limited computer lab space, making it difficult for everyone to have a chance to use technology on a daily basis. The introduction of technology into classrooms that have previously been resistive to improvements toward gender parity is likely to divert attention away from the quest of bias-free classrooms and worsen an already challenging situation (Plumm, 2008). These conclusions may still be applicable today.

Meanwhile, today it is practically impossible to imagine education process without information technologies, and precisely it is the domain in which solutions for gender parity in education should be searched for.

First, ICT can help to create learning settings in which students may actively solve real-world issues. There are several instances of multimedia programs and simulations that use text, images, music, animation, and video to depict real-life situations. There are also various initiatives that showcase challenges encountered outside of school that professionals assist in resolving through internet contact. One benefit of such programs is that true and realistic challenges may be used in the classroom. Given previous research on gender and learning, which reveals that girls and women frequently prefer a method of learning in which they can feel personally connected to the subject matter or, at the very least, see the utility of what they are supposed to learn (Borokhovski et al., 2018), characteristics such as authenticity and realistic in ICT applications can be assumed to contribute to gender inclusivity.

New ICT apps can also be utilized as tools to aid in problem-solving or the learning process. Complex abstract ideas and relationships, like force and motion in physics, intricate mathematical operations, or genetic notions, may be seen and actively manipulated by simulations in these curricular areas.

The simplicity with which students may edit their own work and professors can provide feedback to students is a third way that ICT contributes to the teaching-learning process. Students are also inspired to reflect by this. The same is true of learning environments that enable and encourage collaboration among students and foster feedback among them (e.g., groupware, utilized in computer-supported collaborative learning [CSCL]) (Gnambs, 2021). The concept of collaborative or cooperative learning, which has a long history of study on the influence of group composition and differential effects, frequently serves as the inspiration for these ICT applications. Furthermore, one of the few gender differences consistently found in research on gender and learning styles is the desire for females to collaborate with one another

(Daaqili, 2022). However, student disparities with regard to CSCL have not received much attention thus far.

Finally, the ability of ICT to create links between the educational institution and the outside world is another way that it contributes to the "new" learning processes. ICT makes a wealth of information accessible. Additionally, the Internet facilitates contact and engagement not only with students and the teacher in the classroom but also with other classes and institutions, including those in foreign nations.

Sutton finished his 1991 overview of ten years of study on the disparities in computer use in K-12 education by race/ethnicity, gender, and socioeconomic class, noting that much more research needed to be done in this area. He noted that more research is needed to fully comprehend the complexities of disparities in computer use in schools, to look at race, class, and gender at the same time, and to determine which intervention programs are effective and what aspects of these successful programs contribute to their success (Sutton, 1991). Nearly ten years later, Volman and van Eck (2001) conducted an analytical review of the research on gender disparities and computers in elementary and secondary school that was published in the 1990s. In addition to providing potential for gender-equitable education, new ICT applications in education also carry the possibility of new hurdles and concealed messages, according to Volman and van Eck's (2001) concerning findings. The authors claim that using CSCL, simulations, and other groupware tools enables the creation of an effective learning environment. The research demonstrates how gender-inclusive education is characterized by elements like "taking differences between students into account", the value of collaboration in such a learning environment, and the emphasis on communication and reflection. However, new disparities might appear at the same moment. Research included in Volman and van Eck's (2001) literature analysis demonstrates that girls are less knowledgeable about ICT than boys. According to the worldwide IEA, in the great majority of nations, boys outperformed girls on an exam measuring functional knowledge and abilities in information technology.

Students opposed to the sex stereotyping of computers in the 1990s and much more so today; females, in particular, do not believe that computers are "something for boys". However, girls are less likely than males to continue using ICT in the classroom in the future.

Tondeur et al. (2016)'s work answers a request for more research on how gender disparities manifest in the next generation of computer users. To investigate the link between gender, computer access, attitudes, and usage in both studying and daily activities, a comprehensive survey comprising 1138 university students in Flanders, Belgium, was carried out. The findings indicate that women generally have a less favorable opinion of computers. Their views on using computers for learning, however, are no different from those of males. Similarly, using a computer for pleasure purposes is inversely correlated with being a woman, although there is no correlation between gender and computer use for academic purposes. Based on the findings, the authors contended that attitudes toward computers are context-dependent constructs and that it is crucial to consider the context-specificity of computer attitudes and usage when addressing gender inequalities.

It is clear that a comprehensive, qualitative approach that considers the attitude of teachers as well as a complex array of sociocultural attitudes and practices is necessary for research on the interaction between gender and technology. However, the conclusion about context-mediated role of information technologies in education within gender aspect seems meaningful, which necessitates addressing and benchmarking approaches and practices not only in educational sector, but also in other domains.

The corporate sector is one potential location where useful solutions may be discovered and adopted. Given the increased emphasis on Diversity and Inclusion (D&I) in the contemporary business environment, data analytics is a vital instrument for gauging performance in these domains. A recent McKinsey & Company study found that companies

with 25% more gender-diverse executive teams have a 25% higher chance of profitability than those in the bottom quartile. This discovery presents a fascinating story. By using data analytics, organizations may keep an eye on a variety of factors, such as employee demographics, retention rates, and engagement levels. In addition to providing helpful information, Glassdoor reports that 67% of job seekers place a high priority on diversity when selecting an employer, which bolsters the business case for D&I initiatives (Ray, 2018).

The Harvard Business Review's results, which showed that companies using sophisticated analytics to measure their D&I development experienced a 30% rise in employee satisfaction and retention rates in only two years, further solidify the story. Businesses may find gaps and modify their plans by using data-driven technologies to rigorously evaluate their D&I policies. A survey of digital companies, for example, revealed that those actively pursuing diversity measures saw a 40% increase in innovation outcomes, demonstrating how a dedication to inclusiveness cultivates a creative culture (Ray, 2018).

Thus, data analytics can be used in the education when applying group forms of teaching and learning, for example project method, or even designing of presentation by a pair of students. Performance of diverse and gender-homogenous groups can be measured comprehensively, "from every angle", and teacher can design appropriate interventions. This can be done, sure, not only at the level of class, but also at the level of faculty and educational institution as whole.

Virtual reality (VR) has become a game-changing technology in immersive training in recent years, especially for improving empathy in a variety of professional contexts. According to a convincing PwC research, employees who participate in virtual reality training are four times more engaged than those who attend traditional classroom settings, which results in a 75% boost in information retention. Consider a healthcare professional who is immersed in a virtual reality simulation that puts them in the position of a patient who is suffering a chronic illness. In addition to fostering a better comprehension of patient experiences, this gives them the interpersonal skills they need to provide compassionate care. It is evident that empathy-driven simulations are changing a variety of industries, including customer service and healthcare, since 71% of firms report increases in employee performance following VR training sessions (Karras et al., 2024). Therefore, one may hypothesize that virtual reality tools could potentially increase female students' interest in information technology as a learning tool and as a specialized profile.

Beyond only improving skills, virtual reality may also actively foster emotional connections. According to a poll by the Virtual Reality Developers Conference, after participating in VR situations that reflected their own experiences, 83% of participants reported feeling more sympathetic toward underrepresented groups. According to Karras et al. (2024), for example, VR-based police enforcement training programs have shown notable improvements in attitudes toward community interactions, with an astounding 64% of officers expressing increased awareness to social dynamics within local areas. This study demonstrates how virtual reality has a significant influence on interpersonal connections, providing firms with opportunities to foster an empathetic culture that goes beyond the usual confines of conventional training approaches. These findings can be applied in educational institutions to reduce still existing biases towards females' abilities in information technologies.

Furthermore, another crucial area of D&I solutions is listening and engagement software. Organizations may customize survey questions and utilize sentiment analysis to find patterns in the feedback with several of the listening and feedback suppliers (Snihur et al., 2024). Organizations may assess their cultures in real time and spot instances where teams might not act inclusively with the use of other technology in this area. Based on information from workplace communication platforms (including email, chat, and calendar), leadership and employee engagement technologies, such that offered by the vendor Cultivate, may even begin

to assess variations in a manager's communication style (Burrell, 2023). This aids the manager in being more self-aware and determining whether their actions are inclusive and consistent. Accordingly, using such tools in classroom can help the teacher to understand effectiveness and inclusiveness of his/her communication with the students. Since teachers' biased (often - unconsciously) attitudes and feedbacks can have crucially negative influence on female students' perception of the information technologies in learning process and in choice of future profession, such software can become valuable tool.

5. CONCLUSION

Increased diversity and inclusion may be made possible via technology. It offers scalable solutions and data-driven insights that have the power to alter behavior by challenging our preconceived notions and influencing procedures. Yet, it is crucial that the latter continue to develop and that we keep pushing for improvements in the underlying technology to continuously enhance those systems and guarantee results free from prejudice, just as technology continues to advance and promote good change in the diversity and inclusion agenda. The conducted research shows that educational field reached a kind of dead end and cannot get out of the vicious circle of gender biases towards information technology both in teachers and students at every level of educational system. Thus, we believe it expedient and rational to turn to the experience of corporate sector, which accumulated more experiences and best practices in the application of digital technologies for enhancing DEI, especially in gender aspect.

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