Social and psychological determinants of behavioral changes in girls and women in STEM education and STEM employment

REPORT

Accelerator Lab of the United Nations Development Program (Uzbekistan) within the Gender mainstream initiative

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Authors and research team:
Victoria Alekseeva, Marietta Karamyan.

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List of abbreviations

HEI – higher educational institution

IDI – in-depth interview

NGO – non-governmental non-commercial organization

UN – United Nations

PP – Resolution of the President

Media – mass media

UP – Decree of the President

FGD – focus group discussion

SDGs – Sustainable Development Goals

STEM – Science, technology, engineering, mathematics

Introduction

Modern education systems and the labor market are facing global challenges. They are associated with dynamically changing demands on knowledge, competencies and quality of personnel training, the emergence of new professions and the expansion of the range of specialties in the existing professional spheres. These professions include those related to science, technology, engineering, and mathematics (STEM).

The STEM plays one of the key roles in achieving the SDGs included by the UN General Assembly in the overall 2030 Agenda for Sustainable Development[1]. The 17 interconnected goals focused on solving social, economic and ecological problems aim to improve people's quality of life. The development of STEM education and STEM employment definitely promotes the creation of sustainable and inclusive communities and the achievement of «Quality Education», «Gender Equality», «Industry, Innovation and Infrastructure», and «Reducing Inequalities» goals.

STEM development is under close attention of international organizations and states. The reason for this is not only the potential of science and technology to constructively transform communities, but also the gender gap that characterizes the field. Given the need to engage everyone in achieving the SDGs and to ensure women and girls' full and equal access to and participation in science, the UN General Assembly designated February 11 as the International Day of Women and Girls in Science in 2015[2].

International organizations note the global underrepresentation of women in STEM. The UNESCO report (2021), for example, emphasizes that women make

1 Transforming our World: 2030 Agenda for Sustainable Development. Resolution adopted by the General Assembly on September 25, 2015// United Nations Conference on Trade and Development website. URL: https://unctad.org/system/files/official-document/ares70d1_ru.pdf (accessed on 14.09.2022).
2 International Day of Women and Girls in Science// Resolution A/RES/70/212 of UN General Assembly 22 December 2015.

up only 28% of engineering graduates, 40% of computer science graduates and 22% of professionals working in artificial intelligence[3]. According to data from the Statistics Agency under the President of the Republic of Uzbekistan, the proportion of women who are graduates of science, technology, engineering and mathematics programs in higher education is increasing in the Republic of Uzbekistan. In 2017, for example, it was 32.6%; in 2021, it was 40.2%. According to 2023 data, in 2022, the proportion of female graduates of higher education programs in natural sciences, mathematics and statistics, social security, information and communication technologies, engineering, mechanical processing, and construction in Uzbekistan was 27.3%[4].

The International Labor Organization report indicates that there are significant gender differences in Uzbekistan regarding areas of study by specialty in higher education institutions. In 2018, 42% of female higher education graduates worked in education, while 45% of male higher education graduates worked in science, technology, engineering and math[5]. These data highlight the need for more opportunities in science and innovation for women. In this regard, international and national measures are being taken to engage girls and women in STEM education and to ensure their employment in relevant fields.

The systematic approach of the Republic of Uzbekistan in the area of engaging girls and women in STEM is expressed in the improvement of the legal and regulatory framework, infrastructure development, and program implementation to support women and girls. Thus, the Concept of Development of the Higher Education System of the Republic of Uzbekistan emphasizes the importance of the development of STEAM-fields (exact sciences, technologies, engineering, arts, and mathematics) in general[6]. The National Program to Increase the Activity of Women in All Spheres of Economic, Political and Social Life of the Country for 2022-2026, adopted in 2022, emphasizes the goal of creating additional conditions for women's education, further increasing the role of women in science[7], and measures have been developed to support women's education in higher,

3 Schneegans S., Lewis J., Straza T. UNESCO Science Report. The race against time for smarter development - executive summary. UNESCO Publishing House, Paris, 2021. P. 60.
4 Proportion of graduates of science, technology, engineering and mathematics programs in higher education who are women// Official website of the Statistics Agency under the President of the Republic of Uzbekistan. URL: https://stat.uz/ru/ofitsialnaya-statistika/social-protection (accessed 1.06.23).
5 Women and the World of Work in Uzbekistan. Towards Gender Equality and Decent Work for All. M.: International Labor Organization, 2020. P.104.
6 Decree of the President of the Republic of Uzbekistan «On approval of the Concept of development of higher education system of the Republic of Uzbekistan until 2030». No. UP-5847 dated 08.10.2019.
7 Decree of the President of the Republic of Uzbekistan «On measures to further accelerate work on systemic support for families and women» No. UP-87 of 07.03.2022.

specialized secondary and professional educational institutions[8].

Examples of measures regularly taken in Uzbekistan to overcome gender differences in girls' and women's access to higher education, their employment, and engagement in STEM are such programs as «One Million Uzbek Coders» and the Technovation Girls Uzbekistan competition[9].

International and national measures to bridge the gender gap in STEM are based on a variety of research data, including the good performance of girls in mathematics in communities where economic, political, educational opportunities are equally available to women and men[10].

TECHNOVATION Girls Uzbekistan

Technovation Uzbekistan and NGO "Tech4Impact"

An international technology competition for girls that has been held in Uzbekistan since 2016. The goal of the competition is to solve socially important problems in communities using technologies.

Program Coordinator in Uzbekistan: non-governmental non-commercial organization Tech4Impact (https://tech4impact.uz)

Website: http://www.technovation.uz

Specific research publications have noted the importance of developing and applying new approaches to studying women's representation in STEM education and STEM employment. This is necessary due to the gender gap that exists between STEM education and STEM employment. In other words, women have more challenges in getting jobs in STEM than they do in getting an education in a relevant field[11]. The World Bank study on gender discrimination in hiring in Uzbekistan, for example, showed that gender stereotypes act as a factor in discriminating against men in professions where women are predominantly employed, and against women in professions where men are predominantly employed[12]. Occupational segregation can result in a woman's likelihood of obtaining a high-paying position in the IT field being quite low.

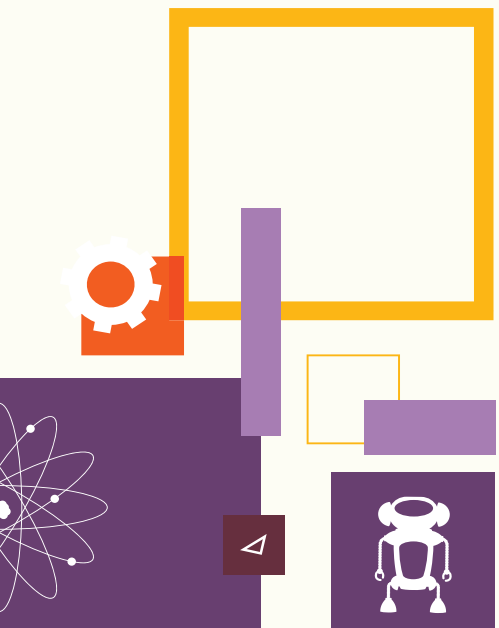
8 Resolution of the President of the Republic of Uzbekistan «On measures to support women's education in higher, specialized secondary and professional educational institutions» No. PP-323 of 18.07.2022.
9 Websites: One million uzbek coders. URL: https://uzbekcoders.uz, Technovation Girls Uzbekistan. URL: http://technovation.uz.
10 UNESCO. 2022. Global Education Monitoring Report – Gender Report: Deepening the debate on those still left behind.
11 Shtyleva L. V. What causes the gender gap in mathematics education and STEM employment of Russian school graduates? // Vestnik of Lobachevsky University of Nizhny Novgorod. Series: Social Sciences. 2018. No. 3(51). P.166-173; Kalabikhina I. E. New approaches to measuring women's representation in STEM-education and STEM-employment in Russia // Woman in Russian society. 2017. No. 1(82). P. 5-16.
12 Muradova S., Zeitz U. Gender Discrimination in Hiring. Evidence from an audit experiment in Uzbekistan, 2022// The World Bank Open Knowledge Repository. URL: https://openknowledge.worldbank.org

On the one hand, it seems important to develop new criteria for women's representation in STEM employment, such as indicators of women's representation in new technological segments, in the creation of interdisciplinary scientific areas, in new forms of technology organization and promotion. On the other hand, a natural question arises, «What factors contribute to STEM-educated girls and women remaining in the professional field?»

This study deals with the research of social and psychological determinants of behavioral changes in girls and women in STEM professions in Uzbekistan. The report is divided into six sections reflecting the features of the research organization and its findings. ***The first section «Engaging Girls in STEM Professions: a Brief Literature Review»*** presents the results of an analysis of publications that focus on identifying factors for engaging girls and women in STEM education and STEM employment, exploring their experiences in STEM, and developing strategies for engaging them in STEM professions. ***The second section «Research Methodology»*** reveals the methodology and methods of the study, provides justification of the study sample. ***The third section «Social and Psychological Determinants of Behavioral Changes in Girls and Women in STEM Education and STEM Employment»*** reveals the findings of the study of social and psychosocial factors of STEM identity and STEM engagement, and motivation for choosing STEM professions. ***The fourth section «Stereotypes and Professional Identity and Engagement»*** analyzes how the degree of professional inclusion of the study participants is conditioned by traditions and their susceptibility to stereotypes. ***The fifth section «Assessment of Future Prospects»*** examines the findings of studying female participants' plans for the future and factors of their pursuit of STEM careers. ***The sixth section «Conclusions and Recommendations»*** presents the social and psychological potential of creating conditions for girls' engagement in STEM education and STEM employment based on the findings of the study.

In general, the report includes data from one of the first studies of the factors of girls' and women's engagement in STEM education and STEM employment in Uzbekistan. It is based on a literature review of research publications, analysis of information presented in the Uzbekistan media and obtained through FGDs and IDIs with girls, women, their parents and spouses, and data from a sociological survey.

The report has several limitations, including the need to improve statistics on gender equality in STEM, the lack of similar studies in Uzbekistan to conduct a comparative analysis, and the concentration of HEIs with specialization in STEM, organizations and enterprises in Tashkent. In this regard, there is a need for further systematic examination of the factors that contribute to the engagement of women and girls in STEM.



1. Engaging girls in STEM professions: a brief literature review

The relevance of the discussion on the education and employment of girls and women in STEM is reflected in the research and practical popularity of the topic. For example, a fairly cursory Google search for "Girls and women in STEM professions" gives about 44,600,000 links, while the APA PsychNET website search for "Women in STEM fields"[13] gives 2,905 links, including specific publications in scientific journals. These figures indicate a large volume of information related to the discussion of the social and socio-psychological aspects of women's engagement in STEM professions.

Current publications discuss the issues of STEM education and employment, the influence of social, economic, cultural and psychological factors on girls' choice of profession, social and educational practices of their engagement in STEM and keeping them motivated, practices of supporting STEM employment of women at the level of state social policy[14].

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Content analysis of publications on the problem of social and socio-psychological aspects of women's engagement in STEM professions allows us to identify several scientific and practical directions of its study:

1. identifying factors that influence the engagement of girls and women in STEM education and careers;
2. exploring role models as factors of girls' and young women's engagement in STEM;

13 American Psychological Association Search Platform

14 For example: STEM Education for Girls and Women. Breaking Barriers and Exploring Gender Inequality in Asia. UNESCO, 2020. 257 p.; Cracking the code: girls' and women's education in science, technology, engineering and mathematics (STEM). UNESCO, 2017, 85 p., illus.; Women in Professions of the XXI Century: Trends, Problems, Prospects: Proceedings of the All-Russian Scientific Conference with International Participation. Moscow, March 3, 2020. Ivanovo: Ivanovo State University, 2020.180 p.; Women in Science and Education: Trends and Prospects: Proceedings of the Interregional Correspondence Scientific and Practical Conference (Ufa, February 11, 2021) // Editor-in-Chief A.V. Yangirov. Ufa: Publishing house of IRO RB, 2021. 92 p.; Women and STEM in the Digital Age: Employment Policy in the Megapolis // E.K. Zakharova, T.A. Mkhitaryan, O.B. Savinskaya. Savinskaya [Edited by O.B. Savinskaya] // ANCO «Council on Governance and Development». M.: OOO «Variant», 2017. 88 p.

3. identifying girls' and women's experiences in STEM professions, education, and employment;
4. developing strategies to engage girls and young women in STEM professions.

In order to plan the study and develop its toolkit, publications on the development of various scales for identifying features of identity, engagement in the profession, and gender stereotypes were also studied.

The first area of research is to identify factors that influence the engagement of girls and women in STEM education and careers, the understanding of which is important in this research project. The studies focus on the factors of girls' decision making about STEM education, the extent of their engagement in their studies. The researchers emphasize both social and psychological factors, both peculiarities of choice during education and career building, as well as understanding the factors of choosing "male" professions in general and specific professions (e.g., in the scientific sphere, in the internal affairs bodies)[15].

The researchers propose to identify negative and protective factors when examining the factors that influence women's participation in STEM[16]. The negative factors include the working environment of the organization, the policy of which promotes gender stereotyping, gender-based career building and a 'Chilly climate' atmosphere in general. Specialized literature considers factors related to gender discrimination in hiring, promotion, access to equipment, and scientific isolation in general as negative determinants.

Peculiar factors that protect girls and women from negative environmental

15 For example: A.L. Brushkova, I.G. Prokhorova. Gender Equality in Science: Achievements and Problems. // Vestnik RGGU. Series «Philosophy. Sociology. Art History». 2021. No 1 (part 2). P. 209–217. DOI:10.28995/2073-6401-2021-1-209-217; Solovey A.P. Women in academic science: based on the results of sociological research // Problems of activity of a scientist and research teams. 2017. No. 3 (33). URL: https://cyberleninka.ru/article/n/zhenschiny-v-akademicheskoy-nauke-po-rezultatam-sotsiologicheskih-issledovaniy (accessed: 10.09.2022); Kozina I.M. Professional segregation: gender stereotypes on the labor market // Sociological Journal. 2002. No. 3. P. 126-136; Chemankova E. D. Women as police officers: how profession is chosen // Sociological Studies. 2019. No. 4. P. 126-132. DOI 10.31857/S013216250004593-5; Hassell K.D., Archbold C.A., Stichman A.J. Comparing the Workplace Experiences of Male and Female Police Officers: Examining Workplace Problems, Stress, Job Satisfaction and Consideration of Career Change // International Journal of Police Science & Management. 2011. Vol. 13. No. 1. P. 37–53.

16 Settles I. H. Women in STEM: Challenges and determinants of success and well-being//Psychological Science Agenda. https://www.apa.org/science/about/psa/2014/10/women-stem. October, 2014.

influences are a strong sense of scientific or gender identity, a sense of being treated positively by others, a positive gender public opinion, the possibility of influence in an organization or professional environment, and the presence of mentor-leaders[17].

A qualitative study of factors influencing girls' enrollment in HEIs in STEM-related fields in Kazakhstan used a systematic approach. An attempt was made to find an answer to the question: "What factors at micro- (individual), meso- (family and institutional), macro-levels influence the decision to enroll in STEM specialties?"[18]. For example, the author attributes to individual decision-making factors the self-efficacy of the individuals, expressed in confidence in their choices and resilience to the barriers faced by girls in the transition to higher education. Family decision-making factors identified in the study included family members working in STEM fields, support from family members, especially from the father or older brother, the closeness of the girls to the father in families with no boys and their doing men's housework with their fathers, and the girls' assumption of the role of breadwinner in families where mothers demonstrated the role model of an active woman. The school culture, teaching style, the presence of peers interested in STEM, and STEM-related activities were identified as school factors. The author of the study considers macro-factors to include gender expectations, the structure of the region's economy and labor market, and regional cultural particularities (e.g., support for girls' choices in northern and eastern regions as opposed to the less industrialized, more populated and traditional southern regions).

A systematic approach has been used in other studies of factors influencing women's participation in STEM[19]. For example, personal ability, academic preparation, parental support, and the presence of female role models have been found to contribute to the choice of girls and women in STEM-related fields. The determinants of the small number of women in these professional spheres are considered by researchers to be low levels of perceived commitment among

17 Jack D.C. Silencing the self: Women and depression. Cambridge: Harvard University Press, 1991; Settles I. H., Cortina L. M., Stewart A. J., Malley J. Voice matters: Buffering the impact of a negative climate for women in science//Psychology of Women Quarterly. 2007. No 31. P. 270-281; Settles I. H. Women in STEM: Challenges and determinants of success and well-being//Psychological Science Agenda. https://www.apa.org/science/about/psa/2014/10/women-stem. October, 2014.

18 Almukhambetova A. & Kuzhabekova A. Factors Affecting the Decision of Female Students to Enrol in Undergraduate Science, Technology, Engineering and Mathematics Majors in Kazakhstan// International Journal of Science Education. 2020. 42:6. P. 934-954. DOI: 10.1080/09500693.2020.1742948.

19 Mukhwana A.M., Abuya T., Matanda D., Omumbo J., Mabuka J. Factors which Contribute to or Inhibit Women in Science, Technology, Engineering, and Mathematics in Africa. The AAS, Nairobi. 2020; Gilbreath L. C. Factors Impacting Women's Participation in STEM Fields. UVM Honors College Senior Theses. 65, 2015. https://scholarworks.uvm.edu/hcoltheses/65; Sithole A., Chiyaka E., McCarthy P., Mupinga D., Bucklein B., Kibirige J. Student Attraction, Persistence and Retention in STEM Programs: Successes and Continuing Challenges//Higher Education Studies. 2017. 7. 46. 10.5539/hes.v7n1p46.

women, academic barriers (e.g., the complexity of academic subjects), difficulties related to finding a job and employment, gender stereotypes, and fears of not conforming to social norms and expectations[20].

The analysis of the peculiarities of career building by women in Belarus shows that the strategy of professionalization in academic science is characterized by women's focus on combining professional and gender roles[21]. Women's interest in research activities and the opportunity to contribute to science are the key motives for choosing an academic career. Career orientations of women are characterized by monetary and qualification character (e.g., decent remuneration for results, maximum salary for work, opportunity to implement their own research topics, ideas, and plans).

The researchers also focus on the choice of professional activity in law enforcement agencies and military sphere[22]. For example, the study conducted by E.D. Chemankova (2019) shows that the desire to help people, prestige, social benefits, and job security are important motives for choosing the profession of a police officer. Other factors that influence the choice of a police career are childhood dreams, family continuity, i.e. labor dynasties, salary, and stability[23]. A number of authors propose to use such factors as arguments to motivate girls and women and attract them to STEM careers[24].

Using a systems approach, scientists identify and study the psychosocial factors of STEM education and related career choices[25].

20 Mukhwana A.M., Abuya T., Matanda D., Omumbo J., Mabuka J. Factors which Contribute to or Inhibit Women in Science, Technology, Engineering, and Mathematics in Africa. The AAS, Nairobi. 2020.
21 Solovey A.P. Women in academic science: based on the results of sociological research // Problems of activity of a scientist and research teams. 2017. No. 3 (33). URL: https://cyberleninka.ru/article/n/zhenschiny-v-akademicheskoy-nauke-po-rezultatam-sotsiologicheskih-issledovaniy (accessed: 10.09.2022).
22 For example: Kozina I.M. Professional segregation: gender stereotypes on the labor market // Sociological Journal. 2002. No. 3. P. 126-136; Chemankova E. D. Women as police officers: how profession is chosen // Sociological Studies. 2019. No. 4. P. 126-132. DOI 10.31857/S013216250004593-5; Hassell K.D., Archbold C.A., Stichman A.J. Comparing the Workplace Experiences of Male and Female Police Officers: Examining Workplace Problems, Stress, Job Satisfaction and Consideration of Career Change // International Journal of Police Science & Management. 2011. Vol. 13. No. 1. P. 37–53.
23 Chemankova E. D. Women as police officers: how profession is chosen // Sociological Studies. 2019. No. 4. P. 126-132. DOI 10.31857/S013216250004593-5
24 For examplez: Malysheva M.M. Natural and technical sciences for women in the 21st century // Narodonaselenie. 2016. No. 3 (73). URL: https://cyberleninka.ru/article/n/estestvennye-i-tehnicheskie-nauki-dlya-zhenschin-v-xxi-veke (accessed: 16.09.2023).
25 Reilly E., Awad G., Kelly. M., Rochlen A. The Relationship Among Stigma Consciousness, Perfectionism, and Mental Health in Engaging and Retaining STEM Women// Journal of Career Development. 2019. 46. 443-457. 10.1177/0894845318784745; Clark S. L., Dyar C., Maung N., London B. Psychosocial Pathways to STEM Engagement among Graduate Students in the Life Sciences// CBE life sciences education. 2016. 15(3), ar45. https://doi.org/10.1187/cbe.16-01-0036; Lamb R., Annetta L., Vallett D., Firestone

For example, a comparative study of the psychosocial determinants of student engagement in STEM involved males and females. This study revealed that perceived supervisor support contributed to higher levels of female students' STEM identity related to the meaning of STEM to them and consequently self-efficacy[26].

In the context of social cognitive theory of careers, scientists are making attempts to search for psychosocial factors in STEM career choices[27]. Clear goal setting, self-efficacy of the individual, and understanding of outcomes were found to act as predictors of STEM career choice in a comprehensive study. A student whose personality profile matches a possible STEM choice is characterized by high indicators of 21st century skills (e.g., critical thinking, problem solving), mental rotation, participation in serious educational games, and several science and math courses taken. One of the features of this profile is that it belongs to the male gender. In other words, the results of this study imply the need to create conditions for the formation of such properties in girls.

Researchers are interested in the reasons why women stay employed in certain STEM-related organizations. Depression, awareness of stigma, perceived inadequate salary were found to influence women's intention to quit their jobs, and high perfectionism standards were found to be predictors of greater occupational engagement[28].

The researchers identify not only the gap between men and women in math achievement, and gender stereotypes, but also differences in self-esteem between men and women among the reasons for the disparity in the proportion of women and men in natural and exact sciences[29]. Thus, a study conducted

J., Schmitter-Edgecombe M., Walker H., Deviller N., Hoston D. Psychosocial factors impacting STEM career selection//The Journal of Educational Research. 2017. 111. 1-13. 10.1080/00220671.2017.1295359; Saucerman J., Vasquez K. Psychological Barriers to STEM Participation for Women Over the Course of Development//Adultspan Journal. 2014. Vol. 13: Iss. 1, Article 4. Available at: https://mds.marshall.edu/adsp/vol13/iss1/4 ; Lebedeva N.V., Kuzmina Yu.V. Self-concept as a possible predictor of STEM careers: adaptation of the questionnaire to measure five factors of self-concept [Electronic resource] // Modern Foreign Psychology. 2018. Vol. 7. No. 3. P. 53–63. doi:10.17759/jmfp.2018070305.

26 Clark S. L., Dyar C., Maung N., London B. Psychosocial Pathways to STEM Engagement among Graduate Students in the Life Sciences// CBE life sciences education. 2016. 15(3), ar45. https://doi.org/10.1187/cbe.16-01-0036.

27 Lamb R., Annetta L., Vallett D., Firestone J., Schmitter-Edgecombe M., Walker H., Deviller N., Hoston D. Psychosocial factors impacting STEM career selection//The Journal of Educational Research. 2017. 111. 1-13. 10.1080/00220671.2017.1295359.

28 Reilly E., Awad G., Kelly. M., Rochlen A. The Relationship Among Stigma Consciousness, Perfectionism, and Mental Health in Engaging and Retaining STEM Women// Journal of Career Development. 2019. 46. 443-457. 10.1177/0894845318784745.

29 Lebedeva N.V., Kuzmina Yu.V. Self-concept as a possible predictor of STEM careers: adaptation of the questionnaire to measure five factors of self-concept [Electronic resource] // Modern Foreign Psychology. 2018. Vol. 7. No. 3. P. 53–63. doi:10.17759/jmfp.2018070305.

by N.V. Lebedeva, Yu.V. Kuzmina (2018) showed that self-esteem can act as a possible predictor of STEM careers in women. The mathematical self-esteem of female study participants was negatively correlated with their humanitarian self-esteem and self-esteem of their relationship with their gender.

Thus, the literature analysis shows that a systemic approach that identifies micro-, meso-, and macro-level factors is important for understanding the factors of girls' and women's engagement in STEM education and STEM employment.

Studying role models as factors in girls' and young women's engagement in STEM represents a promising, third area of research not only on the determinants of engagement but also on the development of engagement strategies[30]. The pilot study participants were 12-16 year old girls met with female leaders from STEM companies to discuss various aspects of their work. The number of meetings attended by each study participant was 3. This provided an opportunity to see three female role models characterized by different personality traits, physical appearance, sociodemographic and professional characteristics, and consequently increased diversity and inclusiveness[31]. The study based on the expectancy-value model of achievement motivation showed the effectiveness of an intervention based on the presentation of role models. This presentation impacted positively on math enjoyment, math success expectations, and STEM aspirations, and negatively on gender stereotypes.

The study of the influence of female role models on perceptions of science was conducted with female chemistry and engineering students[32]. The relationship between implicit perceptions and women's aspirations for STEM careers was found. Notably, the perception of female professors as positive role models led to the identification of science as more feminine than masculine and to a decrease in the stereotypical understanding of science as masculine.

Notably, role models can play not only a positive role, being expressed in hidden curricula, conditional division of spheres (including scientific) into male

30 For example: Rickard K., Crowther A. (eds). Women staying in the STEM workforce: an economic imperative for Australia, Professionals Australia, Melbourne, viewed 21 Oct 2022, <https://www.lgea.org.au/Scientists/News/2021_women_in_stem_report.aspx>; Radina N.K., Semenova L.E., Kozlova A.V. Development of science as a personal project: female and male students about the prospects of the development of Russian science // Social Psychology and Society. 2022. Vol. 13, no. 4. P. 68-69 DOI: 10.17759/sps.2022130405; Young D., Rudman L., Buettner H., Mclean M. The Influence of Female Role Models on Women's Implicit Science Cognitions//Psychology of Women Quarterly. 2013. No. 37. P. 283-292. 10.1177/0361684313482109.

31 González-Pérez S., Mateo s de Cabo R., Sáinz M. Girls in STEM: Is It a Female Role-Model Thing?// Frontiers in psychology. 2020. 11, 2204. https://doi.org/10.3389/fpsyg.2020.02204.

32 Young D., Rudman L., Buettner H., Mclean M. The Influence of Female Role Models on Women's Implicit Science Cognitions//Psychology of Women Quarterly. 2013. No. 37. P. 283-292. 10.1177/0361684313482109.

and female, in gender differentiation of professional communities and their gender asymmetry[33]. For example, education feminization is expressed in the quantitative increase of women, strengthening of their influence and formation of profession implementation models. In other words, women who receive STEM education can only see opportunities for realization of their potential as teachers in schools[34].

To overcome such problems, it is advisable to study gender specifics of perceptions of STEM professions, to develop a gender-sensitive pedagogical culture among teachers, to train teachers in teaching methods that promote children's interest in STEM professions, and to hold career guidance events[35]. A number of studies show that school profile lessons do not change gender bias towards occupations for most girls. Their overcoming is facilitated by the organization of various field classes aimed at acquaintance with professions in demand in the labor market, and informing about STEM professions, character of work, and career prospects.

Thus, the analysis shows not only the role of positive female models in developing girls' and women's motivation to learn and build STEM careers, but also the need to use them in programs to build interest in STEM professions.

To understand engagement in STEM, it is important to ***identify girls' and women's experiences in STEM professions, education, and employment, which represents the third area of research[36].*** While recognizing the complexity of

33 For example: Savinskaya O. B., Mkhitaryan T. A. Technical disciplines (STEM) as girls' professional choice: achievements, self-esteem, and hidden curriculum// Woman in Russian society. 2018. No. 3. P. 34-48; Shvetsova A.V. Professional development barriers of young scientists in the gender-differentiated scientific community // Woman in Russian society. 2021. No. 1. P.83-93; Shtyleva L. V. Gender component of pedagogical culture and the problem of orientation of girls at STEM education and STEM professions// Woman in Russian society. 2018. No. 3. P. 49-66.

34 Zaichenko N.A., Savelyeva E. A. Gender Discourse in the Perceptions of Educational Relations Participants in the St. Petersburg Schools // Interaction. Interview. Interpretation. 2020. Vol. 12. No. 3. P. 50-74. DOI: https://doi.org/10.19181/inter.2020.12.3.3.

35 Shtyleva L. V. Gender component of pedagogical culture and the problem of orientation of girls at STEM education and STEM professions// Woman in Russian society. 2018. No. 3. P. 49-66; Kolesnikova E. M., Kudenko I. A. Interest in STEM professions at school: problems of career guidance//Sociological Research. 2020. No. 4. P. 124-133. DOI 10.31857/S013216250009117-1; Kolesnikova E.M., Kudenko I.A. Schoolchildren about STEM-professions: general and gender-specific representations // Vestnik RUDN. Series: Sociology. 2021. Vol. 21. No. 2. P. 239-252.

36 For example: Knight D., Corner K., Louie B., Shoals A., Cabrales C. Successful women engineering

STEM-related professions, researchers focus on studying the experiences and concerns of women of the appropriate professions and often link them to social and gender stereotypes. For example, a study conducted by O.Longe et al (2019) found that female engineering technology students see an engineer as their possible marriage partner. They believe this will help them stay in the profession due to their spouse's support and his understanding of the professional requirements. Such views may be related to female students' perceptions of women's participation in engineering as limited by gender (e.g., low availability of jobs for women engineers, male dominance in the profession)[37].

Women's experiences are studied in the context of both the barriers to realizing STEM careers and the means to build them. Using the term 'STEM journey', researchers have found many similarities in women's individual stories. Negative gender characteristics of the labor organization, social sexism and gender stereotypes, expectations related to women's responsibilities (motherhood, finding a work-family balance) are highlighted as examples of barriers. Women's positive experiences in STEM are facilitated by their abilities, the approval of managers, and a supportive atmosphere in the labor organization and in the family[38].

Continuing the discussion on work-life balance, it is important to pay attention to the way it is perceived by women engaged in STEM, their experiences and concerns[39]. It was revealed that the lack of equal opportunities for career development among women with higher engineering education and being employed in the rocket and space industry leads to misunderstanding and a sense of work-family imbalance. There are differences in perceptions of work-family balance between women with and without children. Women with children find it difficult to keep this balance,

students: A survey assessment to guide our efforts to boost women's retention. ASEE Annual Conference and Exposition, Conference Proceedings, 2010; Longe O., Imoukhuede O., Obolo A., Ouahada K. A Survey on the Experiences of Women in Engineering: An Institutional Study. 2019. 1-6. 10.1109/AFRICON46755.20199133875.

37 Longe O., Imoukhuede O., Obolo A., Ouahada K. A Survey on the Experiences of Women in Engineering: An Institutional Study. 2019. 1-6. 10.1109/AFRICON46755.20199133875.

38 Prieto-Rodriguez E., Sincock K., Berretta R. et al. A study of factors affecting women's lived experiences in STEM//Humanit Soc Sci Commun. 2022. 9, 121. https://doi.org/10.1057/s41599-022-01136-1.

39 For example: Grigorieva N.S., Chubarova T.V. To leave impossible to stay: life strategies of women who left STEM professions // Woman in Russian society. 2018. No. 4 (89). URL: https://cyberleninka.ru/article/n/uyti-nelzya-ostatsya-formirovanie-zhiznennyh-strategiy-zhenschin-smenivshih-stem-professii (accessed: 10.09.2022); Podolskaya A.A. Perception of work-life balance by women working in STEM industries (a rocket and space industry case study) // Monitoring of Public Opinion: Economic and Social Changes. 2019. No. 3 (151). P. 192-210.

and as a result, they often mention their spouse's engagement in household and child-raising issues[40].

The typical pattern of women leaving the profession after STEM education is related to the stereotype that STEM jobs are not for women. Women's experiences in the profession and their backgrounds are linked to the experience of increasing stereotypes about the role of women in the technical branches of science and economics. The stereotypical view is not typical at school, intensifies when receiving higher professional education, and becomes clear when getting a job and building a career[41].

Thus, the degree to which girls' and women's experiences in STEM education and employment are positive depends largely on the gender stereotypes of the people around them (family, teachers, employers, colleagues).

The fourth research area highlighted in this literature review is the development of strategies to engage girls and young women in STEM professions. It is important to note that proposed strategies tend to be systematic and based on evidence that includes empirical data and implementation practices. At the same time, the special literature reviews specific practices of organizing education for girls and provides examples of various projects and programs aimed at educating children.[42]

A systemic approach to planning and implementing interventions that foster girls' and women's interest and engagement in STEM education appears to be effective. It is based on an ecological model considering all the factors that may affect girls' and women's participation in STEM and reveals the need to implement actions at 4 levels such as individual, family and peer, school, and social[43]. In particular, the individual intervention level includes practices to build linguistic, spatial, and numerical skills, develop positive STEM identities, connect with role models, and develop confidence, self-efficacy, and motivation.

40 Podolskaya A.A. Perception of work-life balance by women working in STEM industries (a rocket and space industry case study) // Monitoring of Public Opinion: Economic and Social Changes. 2019. No. 3 (151). P. 192-210.
41 Savinskaya O.B., Lebedeva N.V. Why women leave STEM: the role of stereotypes // Woman in Russian society. 2020. No. 2. P. 62-75.
42 For example: STEAM Education: Theory and Practice. Eds. Khine M., Areepattamannil S. Springer Nature Switzerland AG, 2019. 192 p.; Bertrand M.G., Namukasa I.K. A Pedagogical Model for STEAM Education// Journal of Research in Innovative Teaching & Learning. 2022. URL: https://www.emerald.com/insight/content/doi/10.1108/JRIT-12-2021-0081/full/pdf; STEAMS practices in education. Collection of STEAMS best practices in education Part 2. STEAMS practices in preschool education: [Collection]/ compilers E.K. Zenov, O.V. Zenkova. Moscow State Pedagogical University, Moscow: Publishing house «Pero», 2021. 306 p.
43 Cracking the code: girls' and women's education in science, technology, engineering and mathematics (STEM). UNESCO, 2017, 85 p., illus.

The social level necessitates the development of legal and regulatory acts and the implementation of various programs to support the participation of girls and women in STEM education and employment, the promotion of positive images of women in STEM in the media, and the creation of intersectoral cooperation aimed at bridging the gender gap in STEM education and employment[44]. Examples of social-level practices include government investment in STEM development, grants, competitions, programs, the creation and promotion of new STEM professions, and the expansion of STEM education opportunities[45]. At the same time, to create motivation for girls to receive STEM education, the following arguments are offered: greater opportunities to receive grants and scholarships to continue education in master's or postgraduate programs in technical and natural science specialties, employment opportunities, salary, as well as a small competition when entering technical specialties at HEIs, and the possibility to more easily retrain as a specialist in humanities disciplines after studying technical disciplines[46].

Indeed, the ecosystem model action framework provides an opportunity both to analyze the factors that facilitate and hinder girls' and women's engagement in education and employment and to plan and implement specific activities to ensure their participation in STEM. The ecosystem approach also takes into account the age-specific characteristics of a woman's life cycle, which determine the receipt of preschool, school, and higher education, the choice of a profession and career building, and the creation of a family and the birth of children[47]. For example, while analyzing girls' and women's

44 Cracking the code: girls' and women's education in science, technology, engineering and mathematics (STEM). UNESCO, 2017, 85 p., illus.

45 Zadvornova Yu. S. Analysis of foreign experience in the involvement of women in STEM (USA as an example)// Woman in Russian society. 2018. No. 3. P. 67-73.

46 Malysheva M.M. Natural and technical sciences for women in the 21st century // Narodonaselenie. 2016. No. 3 (73). URL: https://cyberleninka.ru/article/n/estestvennye-i-tehnicheskie-nauki-dlya-zhenschin-v-xxi-veke (accessed: 16.09.2023).

47 For example: Yang K., Awad K., Gramaglia M., Kelly R., Kopec S., Luzio N., Neptune K., Pfau M., Purviance J. Girls and Women in STEM: A Review of Interventions and Lifespan Developmental Considerations for Increasing Girls' and Women's Partcipation in STEM. Stockton University. URL: https://oudev.stockton.edu/social-behavioral-sciences/documents/YangReview.pdf; Savostina E.A., Smirnova I.N., Khasbulatova O.A. STEM: professional trajectories of the youth (Gender aspect)// Woman in Russian society. 2017. No. 3 (84). P. 33-44.DOI: 10.21064/WinRS.2017.3.3; Sitikenova A.G. Women and STEM education: new perspectives of women's professional employment// Professional orientation. 2018. No. 1. URL: https://cyberleninka.ru/article/n/zhenschiny-i-stem-obrazovanie-novye-perspektivy-professionalnoy-zanyatosti-zhenschin (accessed: 03.07.2022); Dasgupta N., Stout J.G. Girls and Women in Science, Technology, Engineering, and Mathematics: STEMing the Tide and Broadening Participation in STEM Careers // Policy Insights from the Behavioral and Brain Sciences. 2014, Vol. 1(1) 21–29

participation in STEM at different stages of the personal life cycle - childhood and adolescence, becoming an adult, maturity - N.Dasgupta, J.G.Stout (2014) provide examples of various US evidence-based programs that contribute to removing barriers[48]. These include cooperation between schools and science museums, colleges and universities, non-formal educational environments, out-of-school activities and summer camps during childhood and adolescence. In the transition into adulthood and at the maturity stage, researchers highlight increasing peer networking, promoting role models and mentoring, conducting ***blind reviews of applications and work products***, creating an inclusive organizational climate, maintaining work-life balance for employees and female employees, professional development, and developing strategies for ***women to transition back into STEM research careers after a break.***

As strategies to reduce the impact of gender discrimination and segregation in organizations, scientists propose to develop and apply clear, organizationally accepted procedures for reporting negative cases, conducting awareness raising activities on gender discrimination and segregation and their consequences, and ensuring a firm position of managers and administration to prevent such cases. All these measures contribute to a sense of security, identity, and engagement of women workers, both in the work of the organization and in the STEM field in general[49].

Thus, a systemic approach to developing age-appropriate strategies for engaging girls and women in STEM education and employment contributes to effective outcomes.

The final focus of this literature review is identified ***identified as research on the development of various scales for identifying characteristics of identity, engagement in the profession, and gender stereotypes.***

Various methods and methodologies are used in studies investigating social and socio-psychological factors of women's engagement in STEM, their experience in relevant professional spheres, and related gender stereotypes. Their analysis allowed to develop a methodological toolkit to conduct the study under this project. In-depth and semi-structured interviews[50], psychological scales and questionnaires are often used in studies. The emphasis is on the study of

48 Dasgupta N., Stout J.G. Girls and Women in Science, Technology, Engineering, and Mathematics: STEMing the Tide and Broadening Participation in STEM Careers // Policy Insights from the Behavioral and Brain Sciences. 2014, Vol. 1(1) 21–29.
49 Settles I. H. Women in STEM: Challenges and determinants of success and well-being//Psychological Science Agenda. 2014. https://www.apa.org/science/about/psa/2014/10/women-stem.
50 For example: Almukhambetova A. & Kuzhabekova A. Factors Affecting the Decision of Female Students to Enrol in Undergraduate Science, Technology, Engineering and Mathematics Majors in Kazakhstan// International Journal of Science Education. 2020. 42:6. P. 934-954. DOI: 10.1080/09500693.2020.1742948; Savinskaya O.B., Lebedeva N.V. Why women leave STEM: the role of stereotypes // Woman in Russian society. 2020. No. 2. P. 62-75.

1. professional identity, including identity in STEM professions[51];
2. attitudes toward STEM professions, opportunities for realizing motives in education and the professional sphere, and self-assessment of professional demand[52];
3. personal psychological resources that contribute to STEM identity, work engagement, and work-life balance[53]. Examples of psychological characteristics are academic resilience[54], personality ***self-efficacy***[55], ***self-control***[56], and ***grit***[57].

Thus, during the development of the IDI and FGD guide, the analysis of the methodologies used in the studies allowed to formulate questions that would allow the female study participants to analyze their personal resources.

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51 Lockhart M. E., Kwok O. M., Yoon M., Wong R. An important component to investigating STEM persistence: the development and validation of the science identity (SciID) scale//International journal of STEM education. 2022. 9(1). 34. https://doi.org/10.1186/s40594-022-00351-1; McDonald M., Zeigler-Hill V., Vrabel J., Escobar M. A Single-Item Measure for Assessing STEM Identity//Frontiers in Education. 2019. 4. 78. 10.3389/feduc.2019.00078; Ozerina A.A. Development of a questionnaire to assess the professional identity of students // Izvestiya DSPU. Psychological and pedagogical sciences. 2011. No. 2. URL: https://cyberleninka.ru/article/n/razrabotka-oprosnika-diagnostiki-professionalnoy-identichnosti-studentov (accessed: 20.10.2022).

52 Benek I., Akcay B. Development of STEM attitude scale for secondary school students: Validity and reliability study//International Journal of Education in Mathematics, Science and Technology (IJEMST). 2019. 7(1), 32-52. DOI:10.18404/ijemst.509258; Dominyak V. I. Opportunity to realize motives as a prerequisite for organizational loyalty // Terra Linguistica. 2011. No. 124. URL: https://cyberleninka.ru/article/n/vozmozhnost-realizatsii-motivov-kak-predposylka-organizatsionnoy-loyalnosti (accessed: 21.10.2022); The questionnaire «Professional demand for personality» (PDP): methodological guide / Kharitonova E.V., Yasko B.A. Krasnodar, 2009; Dominyak V.I. How to predict organizational loyalty: an assessment model// Personnel Management, 2006. No. 13. P. 62-68; Dominyak V.I. Organizational loyalty: a model for fulfilling the expectations of an employee from his/her organization. Methodology «Opportunity to realize motives». St. Petersburg, 2006.

53 For example: Cid D., Fernandes M., Carmo M., Dias M., Fidelis A. Psychological Capital Questionnaire (PCQ-24): Preliminary Evidence of Psychometric Validity of the Brazilian Version. Psico-USF. 2020. 25. 63-74. 10.1590/1413-82712020250106; Batool S., Khalil H., Qureshi S. Economic and Psycho-social Determinants of Psychological Empowerment in Women//Pakistan Journal of Social and Clinical Psychology. 2016. Vol. 14. No.1. P. 21-29; Batool S.A., Batool S.S., Fayyaz W. Construction and Validation of Global Psychological Empowerment Scale for Women// Pakistan Journal of Social and Clinical Psychology. 2017, Vol. 15. No.1. P. 3-10; Menon S. T. Psychological empowerment: Definition, measurement, and validation//Canadian Journal of Behavioural Science / Revue canadienne des sciences du comportement. 1999. 31(3). P. 161–164. https://doi.org/10.1037/h0087084.

54 Cassidy S. The Academic Resilience Scale (ARS-30): A New Multidimensional Construct Measure// Front. Psychol. 2016. 7: 1787. doi: 10.3389/fpsyg.2016.01787.

55 Lamb R.L., Vallett D., Annetta L. Development of a Short-Form Measure of Science and Technology Self-efficacy using Rasch Analysis//J Sci Educ Technol. 2014. 23. P. 641–657. https://doi.org/10.1007/s10956-014-9491-y; Tatar N., Yıldız E., Akpınar E., Ergin Ö. A Study on Developing a Self-Efficacy Scale towards Science and Technology//Egitim Arastirmalari-Eurasian Journal of Educational Research. 2009. 36. P. 263-280.

56 Gordeeva T.O., Osin E.N., Suchkov D.D., Ivanova T.Yu., Sychev O.A., Bobrov V.V. Self-control as a personality resource:¬ assessment and associations with performance, persistence and well-being // Cultural-Historical Psychology. 2016. Vol. 12. No 2. P. 46-58. doi:10.17759/chp.2016120205.

57 Yerofeyeva V.G., Nartova-Bochaver S.K. What is «grit» and why it can be a personal resource? [Electronic resource] // Modern foreign psychology. 2020. Vol. 9. No. 4. P. 22–31. doi:10.17759/jmfp.2020090402.

In general, the literature analysis showed that the study of girls' and women's engagement in STEM education and STEM employment should be based on a systemic approach that takes into account both social and psychosocial factors.

2. Research Methodology

Project and study objective: to examine the social and psychological determinants of behavioral change in girls and women in STEM professions to develop recommendations for engaging them in the professional field.

Methodological approaches. The study was based on the ideas of the following approaches: Positive Deviance Approach; ecological systems model; M. Zimmerman's model of psychological empowerment process, which includes 3 components: personal, interpersonal, behavioral[58]; social identity theory, A. Bandura's social cognitive theory.

The methodological approaches raised key research questions:

- How do behavioral changes in female students and those working in STEM manifest themselves?
- What are the characteristics of STEM identity and STEM engagement?
- What social and psychosocial factors influence choice of profession, STEM identity, and STEM engagement?
- Do STEM-related stereotypes perceived by female students and workers affect their identity and engagement?

Study phases, methods, and participants. The study was conducted in 3 stages:

1. preparatory stage, including the use of in-depth interviews and focus group discussions;
2. main stage based on face-to-face survey;
3. stage of recommendations development *(Table 2.1).*

The preparatory phase of the study involved 153 participants.

The methods of the study and information collection were:

1. content analysis of media information, including speeches and interviews of girls and women engaged in science and technology;

58 Rai S.S., Syurina E.V., Peters R.M.H., Putri AI., Irwanto I., Zweekhorst M.B.M. How do Positive Deviants Overcome Health-Related Stigma? An Exploration of Development of Positive Deviance Among People With Stigmatized Health Conditions in Indonesia. Qualitative Health Research. 2022;32(4):622-634. doi:10.1177/10497323211058164

2. focus groups with female students studying and working in STEM;
3. in-depth interviews with female students studying and working in STEM, their parents and spouses;
4. questionnaire;
5. psychodiagnostic scales.

Table 2.1

Study Stages

№	Stage	Types of activity
1	Preparatory phase	• Literature review and content analysis of media • development of guides for FGDs and IDIs • conducting and analyzing FGDs and IDIs • conducting a pilot study and processing the results • development of a questionnaire for a face-to-face sociological survey, including the development and selection of psychological scales and questionnaires
2	Main stage	• sampling of the main study • conducting a sociological survey • processing and interpretation of survey results
3	Stage of recommendation development	• developing recommendations to engage girls in STEM professions

Content analysis of media information, including news on official news channels, interviews of successful girls and women, and publications about their lives *(see Annex 1).* In particular, the analysis of the video "Women in technical professions in Uzbekistan" revealed a number of key themes (categories) that are significant for girls and women actively engaged in science, technology, entrepreneurship. These topics include reasons for choosing a profession, understanding key responsibilities at work, reflection on the place of women in engineering, personal qualities, assessment of achievements, parting words for future generations, and barriers to self-realization in the profession.

Guides for focus groups and in-depth interviews were developed based on the literature review and the corresponding content analysis[59].

59 The results of the content analysis of the FGDs and IDIs are presented in Section 3, Study Findings, and are used to illustrate the quantitative survey data.

Two guides were developed for conducting focus group discussions: 1) with female students in STEM; 2) those working in STEM *(see Annex 2)*. Four focus group discussions were conducted with female students of Inha University in Tashkent city and Tashkent State Technical University named after Islam Karimov, as well as female employees of UzAuto Motors Powertrain JSC *(Table 2.2)*. A total of 29 people participated in the FGD.

Table 2.2

Number of FGD female participants

Participant groups	Number of female participants	Methods
STEM education	First FGD: 7 people Second FGD: 7 people Third FGD: 8 people	Focus group discussion
STEM employment	FGD: 7 people	Focus group discussion
Total	**29 people**	

During the FGD, the collage technique "STEM Planet for Girls and Young Women" *(see Annex 3)*, the Associations technique, the Kun-McPartland "Who am I?" test[60], and STEM professional identity overlap[61] were used.

A total of 4 in-depth interview guides were developed: 1) with female STEM students; 2) with those working in STEM; 3) with parents of female students and those working in STEM; and 4) with spouses of female students and those working in STEM *(see Annex 4)*. A total of 61 in-depth interviews were conducted, although 20 in-depth interviews were initially planned *(Table 2.3)*.

Table 2.3

Number of in-depth interview female participants

Groups of female participants	Number	Methods
STEM education	15	In-depth interview
STEM employment	28	In-depth interview
Parents of those receiving STEM education or employed in STEM	9	In-depth interview

60 Tkhostov A. Sh., Rasskazova E. I. Emelin V.A. Psychodiagnostics of subjective perception of personal identifications: using a modified method «Who am I?» // National Psychological Journal. 2014. No. 2 (14). URL: https://cyberleninka.ru/article/n/psihodiagnostika-subektivnogo-vospriyatiya-svoih-identifikatsiy-primenenie-modifitsirovannoy-metodiki-kto-ya (accessed: 30.09.2022).
61 McDonald M., Zeigler-Hill V., Vrabel J., Escobar M. A Single-Item Measure for Assessing STEM Identity//Frontiers in Education. 2019. No 4. 78. 10.3389/feduc.2019.00078.

Groups of female participants	Number	Methods
Spouses of those receiving STEM education or employed in STEM	9	In-depth interview
Total	**61**	

In addition, a pilot study of the attitudes toward STEM and the identity of girls and women engaged in STEM education was conducted beyond the planned tasks.

The pilot study involved 85 participants between the ages of 16 and 27. The average age was 20.17±1,76. The number of participants was 42 people in HEIs of Uzbekistan, 43 people in the branches of HEIs functioning in Uzbekistan on the basis of cooperation in the education sphere (branch of Moscow State University in Tashkent, INHA University, Turin Polytechnic University in Tashkent). The study was conducted with female students of 1st-4th years, as well as female students of preparatory courses at higher educational institutions. The pilot study was conducted using ***the Associations techniques, Kun-McPartland's "Who am I?" test[62], STEM professional identity overlap[63].***

The Associations technique resulted in the creation of tag clouds, i.e. visual representations of meaningful associations with STEM and with qualities that are important to female respondents *(see Annex 5).*

The content analysis of answers to ***the question of test "Who am I?"*** allowed to identify the following characteristics of the identity of the female study participants. Responses related to personal (47.9%) and educational and professional identity (29.6%) dominate among the responses. In addition, female pilot study participants used the characteristics of group (11.2%), global (4.3%), and communicative (3.5%) identities when describing themselves. Gender (2.2%) and physical identity (1.4%) properties were occasionally observed.

Analysis of research publications, content analysis of the media information, analysis of in-depth interviews, focus group discussions and the results of the pilot study allowed to develop a questionnaire *(see Annex 6).* The questionnaire consists of 217 questions divided into 7 blocks: Social and demographic data about the respondent, Choice and motivation for choosing a profession,

62 Tkhostov A. Sh., Rasskazova E. I. Emelin V.A. Psychodiagnostics of subjective perception of personal identifications: using a modified method «Who am I?» // National Psychological Journal. 2014. No. 2 (14). URL: https://cyberleninka.ru/article/n/psihodiagnostika-subektivnogo-vospriyatiya-svoih-identifikatsiy-primenenie-modifitsirovannoy-metodiki-kto-ya (accessed: 30.09.2022).
63 McDonald M., Zeigler-Hill V., Vrabel J., Escobar M. A Single-Item Measure for Assessing STEM Identity//Frontiers in Education. 2019. No 4. 78. 10.3389/feduc.2019.00078.

Professional identity and engagement in the profession, Assessment of significant qualities, Social support, Stereotypes, Future prospects. Seven psychological scales were included in the questionnaire:

1. 2 scales specifically designed for the study: the STEM-identity Scale and the STEM-engagement Scale;
2. A. Duckworth's Grit Scale (adapted by T.O. Gordeeva, E.N. Osin)[64], The Control and Self-efficacy Scale[65], The Reflexion Scale from the Academic Resilience Scale[66], The Multidimensional Scale of Perceived Social Support (MSPSS) by D. Zimet (adapted by V.M. Yaltonsky, N.A. Sirota)[67];
3. a profession-related stereotyping scale developed based on a study of women's experiences in engineering[68].

Sampling of the main phase of the study. A complex multistage stratified cluster sampling with quota distribution was used to conduct the personal formalized contact questionnaire. The following were used to determine the sample

1. ***uniform stratification*** for 2 target groups (female students and STEM workers) of 200 people each; for 4 regions (Tashkent city, Fergana province, Andijan province and Surkhandarya province) in proportion to the number of all higher educational institutions in STEM-related specialties and the number of enterprises[69];
2. ***sample clustering:*** random selection of districts taking into account the principle of geographical diversity and the probability of selection of target

64 Yerofeyeva V.G., Nartova-Bochaver S.K. What is «grit» and why it can be a personal resource? [Electronic resource] // Modern foreign psychology. 2020. Vol. 9. No. 4. P. 22–31. doi:10.17759/jmfp.2020090402; Gordeeva T. O. Motivation of educational activity of schoolchildren and students: structure, mechanisms, development conditions: dissertation ... of doctor of psychological sciences: 19.00.07. Moscow, 2013. 444 p.

65 Gordeeva T. O. Motivation of educational activity of schoolchildren and students: structure, mechanisms, development conditions: dissertation ... of doctor of psychological sciences: 19.00.07. Moscow, 2013. 444 p.

66 Postylyakova Yu.V. Adaptation of the Academic Resilience Scale (ARS-30) developed by S. Cassidy on a Russian-language sample. Work and Organizational Psychology. 2021. Vol. 6. No. 2. DOI: 10.38098/ipran.opwp_2021_19_2_00; Cassidy S. The Academic Resilience Scale (ARS-30): A New Multidimensional Construct Measure// Front. Psychol. 2016. 7:1787. doi: 10.3389/fpsyg.2016.01787.

67 Zimet G.D, Dahlem N.W, Zimet S.G, Farley G.K. The Multidimensional Scale of Perceived Social Support// Journal of Personality Assessment. 1988. No. 52. P. 30-41; Karvasarsky B.D. Clinical Psychology. Textbook. St. Petersburg: «Piter», 2004.

68 Longe O., Imoukhuede O., Obolo A., Ouahada K. A Survey on the Experiences of Women in Engineering: An Institutional Study// Conference 'IEEE AFRICON'. 2019. 1-6. 10.1109/AFRICON46755.20199133875.

69 Information from the State Committee of the Republic of Uzbekistan on Statistics, including information on demography of enterprises and organizations in the Republic of Uzbekistan as of April 1, 2022; data on HEIs from the website of the Ministry of Higher and Specialized Secondary Education (at the time of sampling) were used to determine the sample.

groups for the study; random selection of settlements taking into account geographical location, probability of identification of target HEIs and resource constraints; distribution of the number of respondents to all settlements of the 4 regions with quota division according to the data on the number of technical HEIs and enterprises for each region.

The study involved 400 female respondents, of whom 208 (52%) were residents of Tashkent city, 80 (20%) of Fergana province, 78 (19.5%) of Andijan province, and 34 (8.5%) of Surkhandarya province.

Of the total number of female respondents, 31.3% were in the adolescent age group, 40% were in the first period of adulthood (22-35 years), and 28.8% were in the second period of adulthood (36-60 years). The average age of the female study participants was 29.13±9.6.

By marital status, the study mainly included unmarried (45.5%) and married (51.5%) female respondents, as well as divorced and living in common-law marriages (3.1%).

Female study participants rated their family's financial situation as excellent (22.3%), good (62.8%), satisfactory (12.5%), poor (1.8%) and very poor (0.8%).

By education factor, girls and women with incomplete higher (47.5%) and higher (48%) education, as well as with specialized secondary (3.8%) and secondary (0.8%) education participated in the study.

The following criteria were mainly considered in analyzing the results:

1. ***The criterion for inclusion of the female study participants in STEM education or STEM employment,*** i.e., whether they are students or employees in STEM.
2. ***Employment criterion:*** 49.6% female students, 39.1% employed, and 11.3% working female students participated in the study. Mostly all the female students who participated in the study were bachelor's degree students (45.1%), while the rest were either master's degree students (3%) or doctoral degree students (1.5%). Among bachelor's program students, 31.8% are first-year students, 23.3% a second-year students, 13.6% are third-year students, and 11% are fourth-year students.
3. ***Criterion of education specialization and employment area*** (for working female study participants) *(Table 2.4).*

Table 2.4

Information on female study participants by area of specialty, %

№	Areas of specialty	Education (sample as a whole)	Employment
1	Natural sciences, math, statistics	29,1	29,6
2	Information and communication technologies	21,9	14,3
3	Mechanical engineering, processing and construction industries	36,2	46,4
4	Agriculture	8,9	9,7
5	Social and human sciences	3,8	-

Areas of specialization were identified on the basis of the State Standard of Higher Education. Classifier of directions and specialties of higher education of the Republic of Uzbekistan[70].

The questionnaire also allowed to collect information on children, education of mother and father, brothers and/or sisters (if any).

Qualitative (content analysis, analysis of collages presented by female FGD participants) and quantitative analysis methods, including methods of statistical data processing (frequency analysis, methods of inductive statistics, correlation analysis) were used at all stages of the study[71].

Thus, the study of social and psychological determinants of behavioral change in girls and women in STEM education and STEM employment was systematic.

70 On Approval of the State Standard of the Republic of Uzbekistan «State Standard of Higher Education». Classifier of directions and specialties of higher education. Order of the Minister of Higher and Specialized Secondary Education of the Republic of Uzbekistan No. 11 dated 19.10.2021.
71 The Kolmogorov-Smirnov test was used to determine whether the distribution of the quantitative indicators used in the study differed from the normal distribution. This test provided the reason to use non-parametric methods of inductive statistics and correlation analysis.

3. Social and psychological determinants of behavioral change in girls and women in STEM education and STEM employment

3.1. Professional identity and engagement in STEM professions

This section presents the results of the study of professional identity and engagement in STEM depending on social factors (education of relatives, employment, region of residence, year of study at HEI for female students, sphere of professional activity and work experience for employed women), as well as female participants' self-assessment of their successes and abilities.

Professional identity and engagement in STEM professions. In this study, the degree of expression of professional identity and engagement in STEM professions acted as a criterion for positive deviance[72].

The STEM identity expression is seen as the degree of self-identification with the professional field. It is manifested in positive emotional experiences related to the profession, fulfilment of professional functions. The criteria of STEM identity are conscious finding of meanings and the perception of a person as a specialist by others. In general, STEM identity is formed in the process of professional self-determination. Low as well as high levels of STEM identity expression were found in every second female study participant (50.5% and 49.5% respectively) *(Figure 3.1.1).*

In this study, STEM engagement is understood as the degree to which an individual is included in a relevant professional field. It is manifested in the individual's awareness of innovations and activities related to the profession. The engagement criteria are positive experiences arising in response to receiving new information, additional knowledge, skills, and the opportunity to participate in professional events.

Engagement is also the actions of increasing one's knowledge, improving one's skills or acquiring new ones. Among the female study participants, 54.5% had low and 45.5% had high engagement levels *(Figure 3.1.1).*

72 Processing of responses to the STEM identity and STEM engagement scales statements allowed to obtain both overall STEM identity and STEM engagement scores and scores for their components, as well as to divide the female participants into groups with low and high levels of expression of these characteristics.

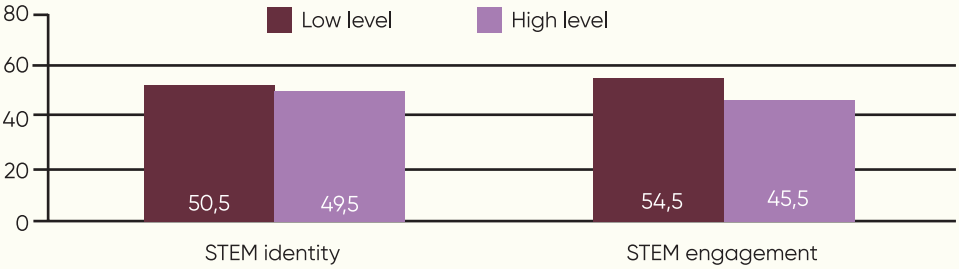


Figure 3.1.1. Level of professional identity and engagement in STEM professions,%

Information from the IDI

Working female student, 22 years old, majoring in computer science and engineering

It was difficult in the beginning... but I thought it was by the will of fate... no other field would bring me so much pleasure... It is a pleasure when everything works out, when the task is difficult, when the tasks are solved. I had to do a test assignment and check the security of a website and was able to do it on my own by finding the correct information. It can be a logical task.... There are many sites with programming challenges... I'm very happy that I did it, that I didn't give up, that I solved it... it's such an emotion, you have to see it. This is my life path, I do want to connect my life with technology.

In general, the analysis showed high positive correlations between both the overall STEM identity and STEM engagement indicators and their components *(see Annex 7)*.

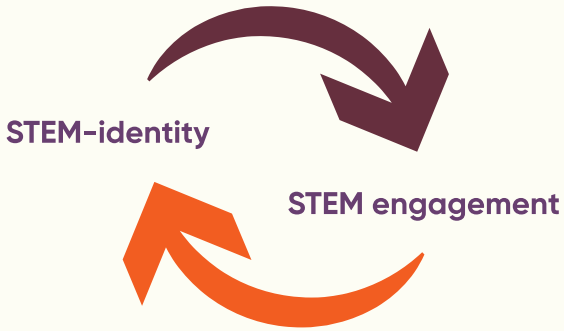


Figure 3.1.2. Correlations between STEM identity and STEM engagement indicators

The degree of professional identity and engagement in STEM professions is generally ***not influenced by the education of parents and siblings.***

Information from the IDI

Mother of a programming specialist, 40 years old, secondary education

My eldest son became interested in programming, he asked us for money for courses, we allowed him and he went to courses, then my daughter also said she wanted to study programming. She told me clearly then, «I want to study in Tashkent». No one influenced her, she said herself, «Mommy, I want to study programming, persuade Dadajon to send me to Tashkent.» Her brother must have inspired her. She and her brother had been going to the same place since they were children, but he went his way, she hers.

It was found that female study participants have a statistically significant level of STEM identity component such as STEM acceptance ***if their siblings have technical education***[73]. In other words, the important thing for the female participants is that teachers, family, friends, and other people consider them experts in science, technology, and engineering, and consult them on relevant issues.

However, STEM identity is not always the result of the influence of parental or sibling education. It appears and is formed against the will of the family, amidst people's misunderstanding of the importance of higher education for a person in general and for a girl in particular.

In general, if STEM identity does not depend on the education of family members, it is influenced by it due to a sense of belonging to a profession, the truth of calling and the right professional choice.

73 Hereinafter, the reliability of differences between different groups of study participants was determined using the nonparametric Mann-Whitney test for two independent samples and the Kraskal-Wallis test for three or more independent samples.

Information from the FGD

Female student, 19 years old, majoring in business logistics

My parents were against it...no one in our family has a higher education. I was told, «You will be labeled, 'Ukigan kiz ekan'.» My mom didn't talk to me for two months. After I entered the university, they saw that I could, that I was able to do it. I won competitions (even before entering), got good prizes... My parents didn't expect that I would be able to... There are no obstacles now, they believe in me.

The very fact of family support helps in achieving goals. Not only parental support, but also spousal support is important for the identity formation of the female study participants as well as their engagement in professional activities at the action level.

Information from the IDI

Mother of a programming specialst, 40 years old, secondary education

I wouldn't change a thing about raising my children and my daughter. I raised her the way I thought was right, I was always told, «You'll regret it, you shouldn't give so much freedom to children, what kind of freedom we are talking about?». I'm not bragging, but we tried to give them everything we could so that each of my children would master at least one profession in the future. And I tried to do everything I could: they had tutors, if they wanted to learn to play chess, I sent them, they won many times in competitions, they were the best-behaved students at school, both of them got grants, what else do I need to be happy?

Information from the IDI

Spouse, 35 years old, higher education. The wife works in IT

... she likes to be fully engaged in what she's doing, it absorbs her. You ask, what are my qualities that help her. I think the fact that we live apart from my parents, also it wasn't common in my family that a woman should only stay at home with the children, etc. I believe my wife should do what she likes to do. As for duties, we have no clear divisions, everyone does what they can around the house.

The factors possibly influencing the professional identity and engagement include employment of the female study participants, region of residence, year of study at HEI for female students, and field and professional experience for employed female study participants.

The analysis of differences in identity and engagement indicators depending on ***employment*** shows that female study participants who both study and work are different from those who only study or work *(Figures 3.1.3-3.1.4).*

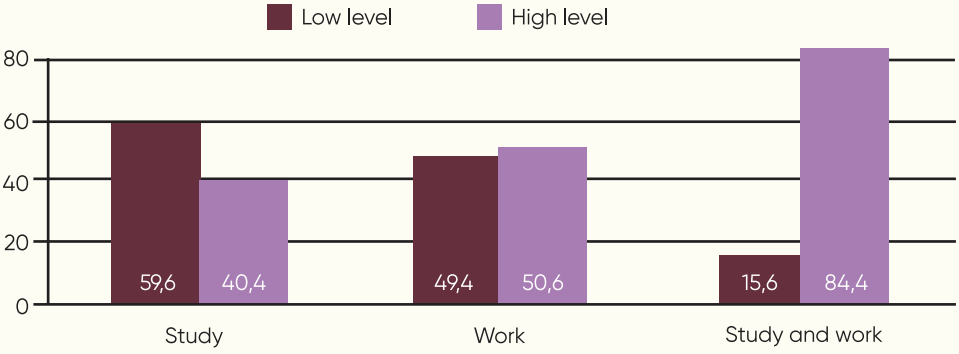


Figure 3.1.3. Level of professional identity in STEM professions depending on employment,%

A high level of identity is observed in the majority of female study participants who both study and work (84.4%) compared to female students (40.4%) and those who work (50.6%) *(Figure 3.1.3).*

Female students are more characterized by low levels of STEM engagement expression (63.1%). Female study participants who both study and work have a higher level (71.1%) *(Figure 3.1.4).* In general, the following tendency was revealed: the more the female respondent is engaged in various professional spheres of activity, the more she has a high level of STEM engagement.

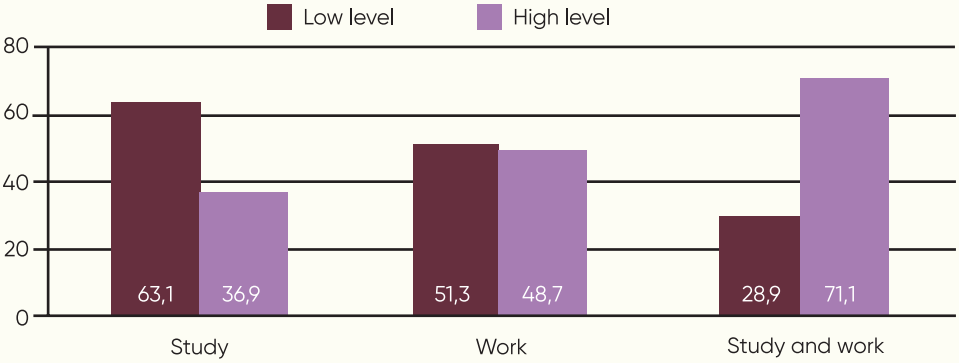


Figure 3.1.4. Level of professional engagement expression in STEM professions depending on employment,%

The professional identity of the female study participants is characterized by awareness of their belonging to the profession and professional community. It is manifested emotionally in the form of feelings of correctness of the choice made, truthfulness of calling, satisfaction due to thoughts about professional prospects *(Figure 3.1.5).* Such results can be explained by the fact that the processes of professional self-determination are activated along with engaging in professional activities. These activities provide an opportunity to put into practice the concerns and meanings given to the STEM.

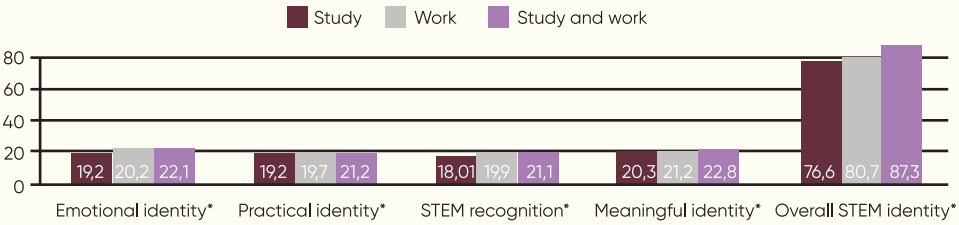


Figure 3.1.5. Peculiarities of professional identity depending on employment (based on average scores)

*reliable statistical differences are marked

At the practical level, the female study participants who both study and work know how to use their knowledge and skills in the profession and are orient-

ed towards generating income through it. According to them, their professional environment, friends, and family see them as specialists and seek their help on professional issues. In general, the profession is meaningful and valuable for them *(Figure 3.1.5).*

Professional engagement is more expressed in those female study participants who both study and work. At the cognitive level, they are more aware of innovations in their speciality, and more often indicate the need for additional professional knowledge and skills *(Figure 3.1.6).*

On the emotional level, they feel inspired when they learn about new things in their specialty and profession, they are happy about the possibility of acquiring additional knowledge and skills, and they enjoy participating in professional community events *(Figure 3.1.6).*

At the behavioural level, respondents who both study and work are more likely to read additional literature and seek additional information on the specialty, to obtain additional training or skills directly related to the specialty or profession in general, and to participate in professional events.

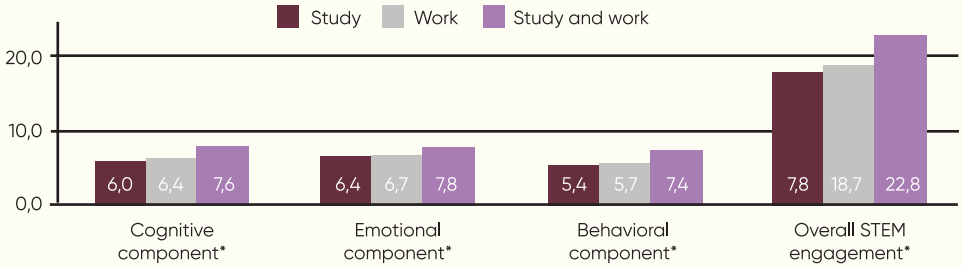


Figure 3.1.6. Peculiarities of professional engagement depending on employment (based on average scores)

*reliable statistical differences are marked

Thus, the female study participants are differentiated by the degree of expression of STEM identity and STEM engagement, the higher level of which is characteristic primarily of those who both study and work, and then of those who work.

The factor of the region of female respondents' residence has a certain influence on the expression of their identity and engagement. Although the number of female study participants from the studied regions is not equal due to the different number of universities, organizations, and businesses related to STEM industries in each region , it is interesting to analyze the regional characteristics

of female participants' expression of professional identity and engagement *(Figure 3.1.7)*.

In terms of percentages, female study participants from Andijan and Fergana provinces showed high levels of STEM identity (71.8% and 56.3% respectively) and STEM engagement (62.8% and 47.5% respectively).

The female residents of Tashkent city and Surkhandarya province are characterized by low levels of STEM identity (39.9% and 41.2% respectively). The low level of engagement is less characteristic of the female study participants from Tashkent city (59.1%) than from Surkhandarya province (70.6%) *(Figure 3.1.7)*.

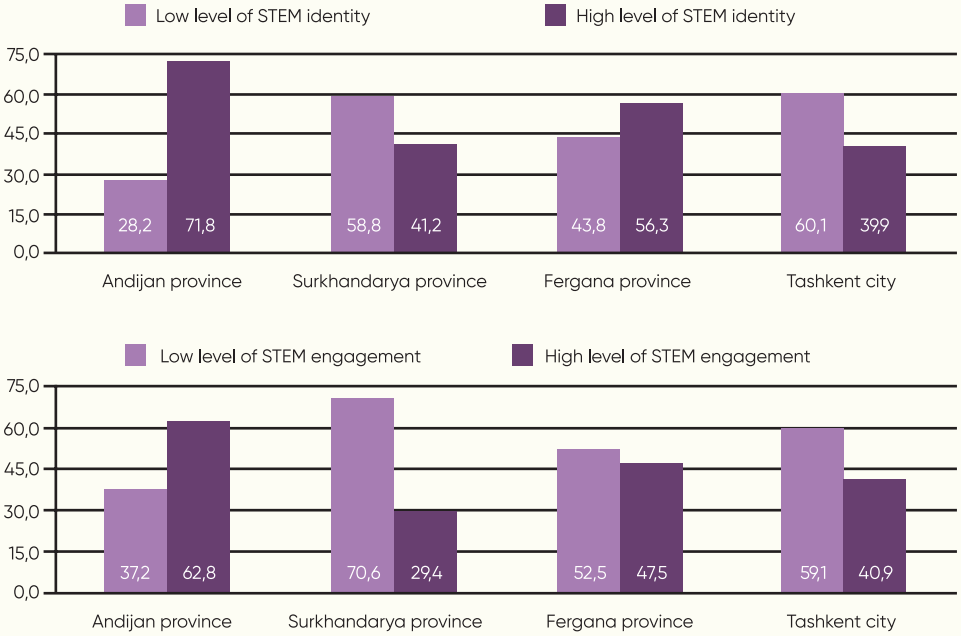


Figure 3.1.7. Levels of expression of identity and engagement by region, %

The highest indicators of STEM identity and STEM engagement were found to be characteristic of female participants from Andijan province than of those from Tashkent city, Fergana and Surkhandarya provinces *(Figures 3.1.8-3.1.9)*[74]. It is significant that lower indicators of identity and engagement are registered among the female study participants from Tashkent city and Surkhandarya province.

Female study participants from Andijan province are more likely to have positive experiences related to their profession (e.g., "I feel satisfied when I think

74 Differences were tested using the Kraskal-Wallis criterion, and the differences are reliable.

about my professional prospects"). They take great interest in completing training tasks or solving professional problems. They believe that those around them treat them as professionals and are clear about what they are studying or working for *(Figure 3.1.8).*

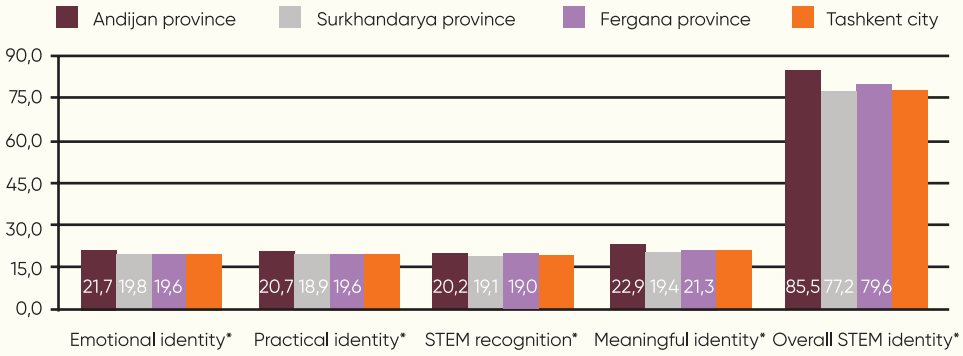


Figure 3.1.8. Peculiarities of professional identity depending on the region (based on average scores)

*reliable statistical differences are marked

As for the peculiarities of the professional engagement of female study participants from Andijan province, they more often pointed out their awareness of innovations in their speciality, their understanding of the need to acquire additional knowledge and skills in their profession. At the emotional level, the positive attitude of the female respondents from the Andijan province is manifested in the feeling of inspiration when learning new things in their speciality, joy, pleasure and enthusiasm from participation in various events, communication with colleagues on professional issues *(Figure 3.1.9).*

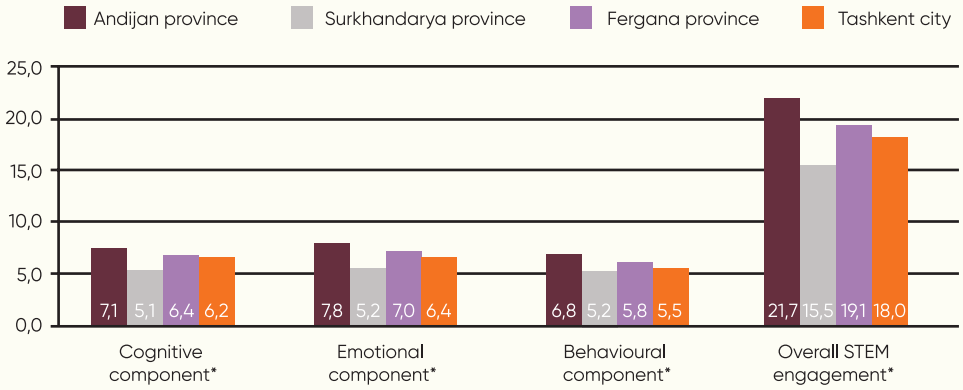


Figure 3.1.9. Peculiarities of professional engagement depending on the region (based on average scores) *reliable statistical differences are marked

The data obtained can probably be explained by the number of higher education institutions related to STEM professions and the number of operating enterprises and organisations in the industry. Thus, there are universities offering various educational services and many industrial enterprises in Andijan province. Andijan and Fergana provinces are ranked third and fourth, respectively, by the number of newly established enterprises and organisations (including small businesses) and their growth rate according to 2022 data. The number of operating enterprises and organisations in the industrial sector is higher in Tashkent city, then in Fergana (10,056) and Andijan (9,512) provinces[75].

A natural question arises: "What factors influence the lower expression of identity and engagement of female respondents from Tashkent city in comparison with female respondents from Andijan region?" It can be assumed that the large number of universities, organisations, and enterprises in Tashkent reduces the need for female respondents from Tashkent to overcome obstacles related to finding a job. This may be the reason why the psychological potential of female study participants from Tashkent city is less, while female respondents from Andijan and Fergana provinces use their psychosocial resources more actively to cope with difficulties[76].

The analysis of the expression of identity and engagement in female students, master's and doctoral students depending on the year of study at the HEI allowed to reveal the influence of gradual self-determination *(Figures 3.1.10-3.1.11).*

The indicators of emotional, practical, meaningful STEM identity and STEM recognition are increased as students transition from one grade level to the next *(Figure 3.1.10).*

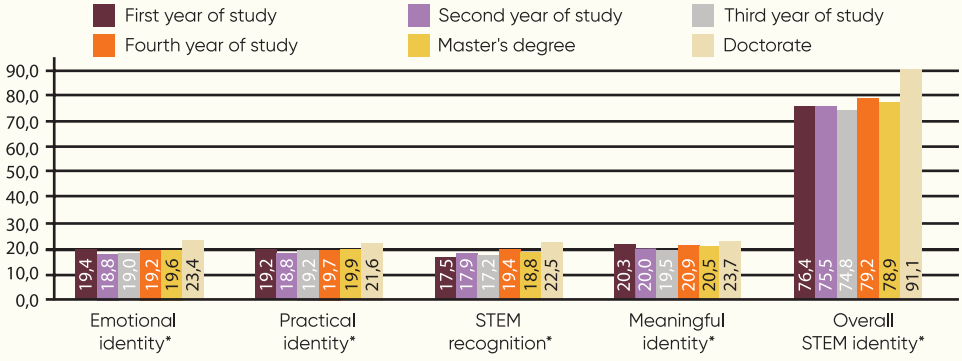


Figure 3.1.10. Peculiarities of professional identity depending on the year of study (based on average scores) *reliable statistical differences are marked

75 Information from the State Committee of the Republic of Uzbekistan on Statistics, including information on demography of enterprises and organizations in the Republic of Uzbekistan as of April 1, 2022.

76 Paragraph 3.3 will discuss the results of comparing female study participants from different regions.

The same pattern is observed for STEM engagement indicators, i.e. the indicators of profession awareness (cognitive component), positive experiences (emotional component) and actions (behavioural component) increase *(Figure 3.1.11).*

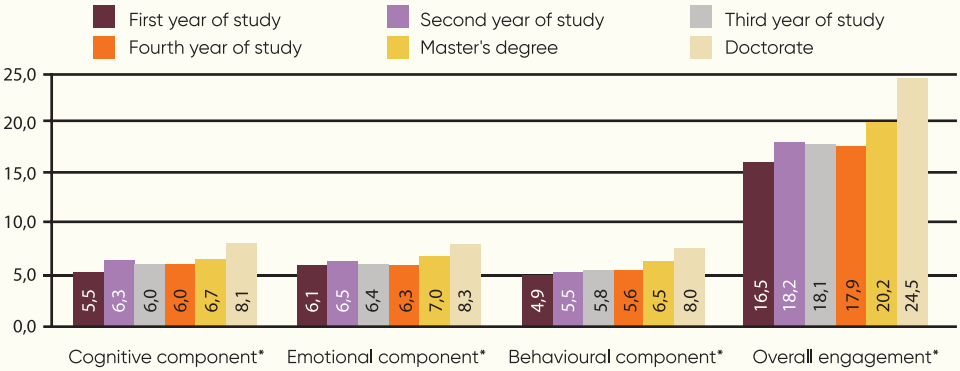


Figure 3.1.11. Peculiarities of professional engagement depending on the year of study (based on average scores)

*reliable statistical differences are marked

The obtained data are clearly demonstrated in Figure 3.1.12. The very fact of consciously continuing education at the master's or doctoral level actualises the emotional and meaningful components of identity and engagement.

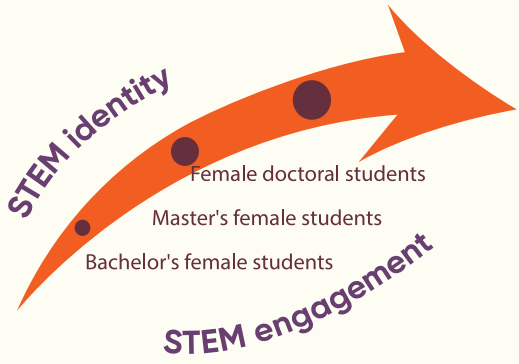


Figure 3.1.12. Expression of STEM identity and STEM engagement by level of education

Further education probably promotes more active inclusion in the professional sphere due to formal requirements, more independent building of individual development paths in the profession.

The specialisation of the professional sphere is a factor that influences the expression of identity and engagement. A higher level of STEM identity was found in female study participants working in science, maths, and statistics

(60.3%) *(Figure 3.1.13).* The low level of STEM identity is characteristic of female respondents whose professional activity is related to information and communication technologies *(Figure 3.1.13).*

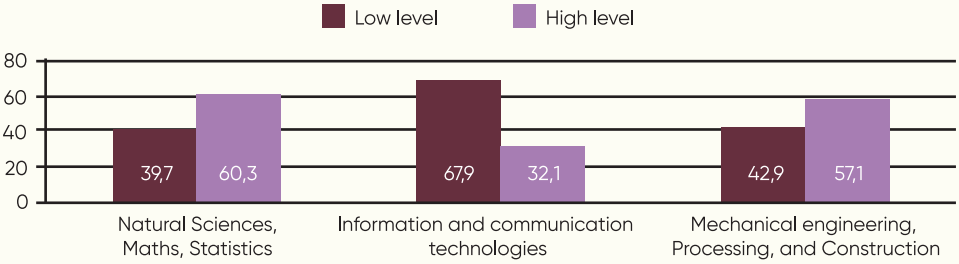


Figure 3.1.13. Level of STEM identity expression depending on the sphere of professional activity,%

Overall STEM identity and emotional identity are more common for women working in "Natural Sciences, Maths, Statistics" and "Mechanical engineering, Processing, and Construction".

High levels of STEM engagement were found in female study participants working in science, maths, statistics (51.7%) and mechanical engineering, processing and construction industries (54.9%) *(Figure 3.1.14).* The demands of these professional spheres probably imply the need for more emotional engagement of the female study participants, evoke more positive experiences, joy, inspiration, enthusiasm. This is supported by an analysis of the differences between female study participants working in different fields, in measures of cognitive, emotional, and behavioural STEM engagement. Emotional engagement is more characteristic of female study participants working in the area of "Mechanical engineering, processing and construction industry".

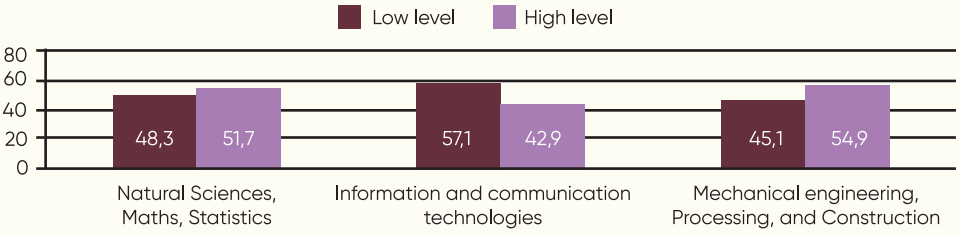


Figure 3.1.14. Level of STEM engagement expression depending on the sphere of professional activity,%

The expression of identity and engagement is influenced by the ***work experience in the professional sphere.*** The more years of work experience, the

more female study participants are characterised by a high level of STEM identity expression *(Figure 3.1.15).*

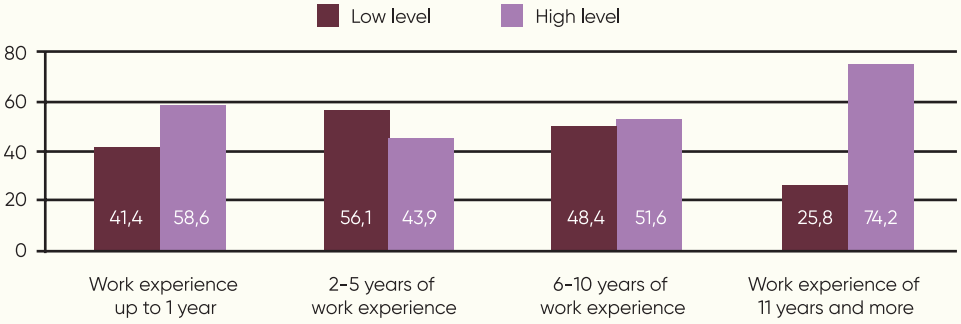


Figure 3.1.15. Level of STEM identity expression depending on the years of professional activity,% (N=192)

The high level of identity expression is observed in 43.9% of the female study participants with 2-5 years of work experience, 51.6% with 6-10 years of work experience, and 74.2% with more than 11 years of work experience.

In general, the same pattern is observed for female study participants with different work experience in relation to engagement. With increasing work experience, female study participants are more likely to have high levels of engagement *(Figure 3.1.16).*

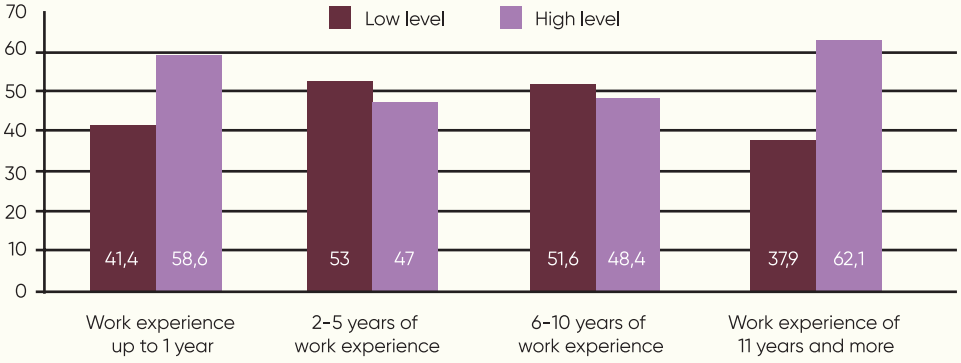


Figure 3.1.16. Level of STEM engagement expression depending on the years of professional activity,% (N=192)

But it is almost equally expressed in both female study participants with up to 1 year of work experience (58.6%) and those with 11 years or more of work experience (62.1%) *(Figure 3.1.16).* The explanation could be that when starting work, a person tries to be as active as possible in performing their duties, which requires improving his/her knowledge, maintaining his/her positive emotions, and implementing specific actions.

The comparison of identity and engagement indicators between working female study participants with different work experience generally confirmed the percentages obtained between female respondents with low and high levels of STEM identity and STEM engagement expression *(Figure 3.1.17).* Female respondents with more than 11 years of work experience as well as those with less than 1 year of work experience are characterized by higher indicators of both overall STEM identity and emotional, practical, meaningful identity and recognition in STEM *(Figure 3.1.17).*

Indicators of overall STEM engagement and its emotional component are more expressed in female study participants with more than 11 years and less than 1 year of work experience, and less expressed in female respondents with 2-5 years and 6-10 years of work experience.

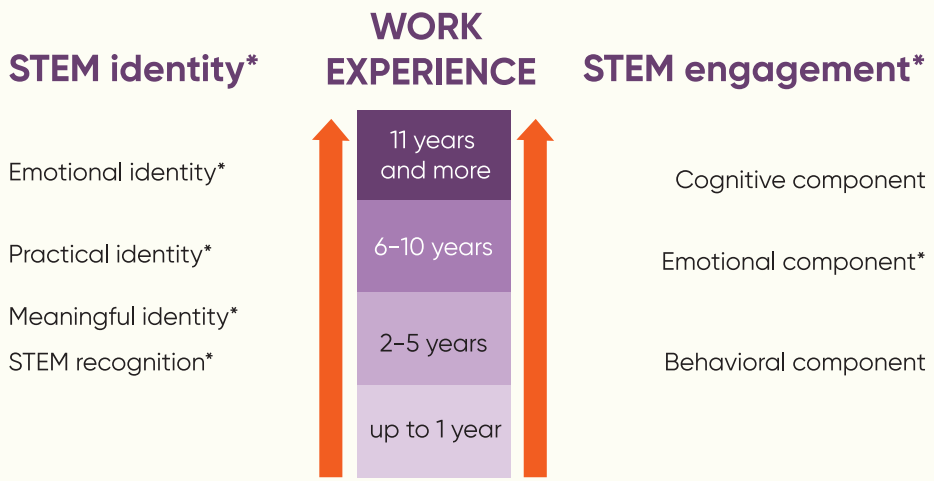


Figure 3.1.17. Expression of STEM identity and STEM engagement characteristics depending on the work experience * reliable statistical differences are marked

Indicators of overall STEM engagement and its emotional component are more expressed in female study participants with more than 11 years and less than 1 year of work experience, and less expressed in female respondents with 2-5 years and 6-10 years of work experience.

Thus, the female study participants are characterized by differentiated expression of professional identity and engagement in STEM. It generally depends on a number of social factors such as the employment of female respondents, their region of residence, the year of study at HEI, the field of professional activity and work experience.

Success and abilities self-assessment. In general, the study revealed a quite high self-assessment by the female respondents of both successes in their chosen field and abilities for study and work *(Figures 3.1.18-3.1.21).* In the total sample, more than a third of female respondents assess very highly both their success (38%) and their abilities for study/work in the chosen field (38%) *(Figures 3.1.18-3.1.19).*

The analysis of differences in self-assessment of successes and abilities shows that female study participants with high STEM identity and STEM engagement indicators assess their successes and abilities quite highly.

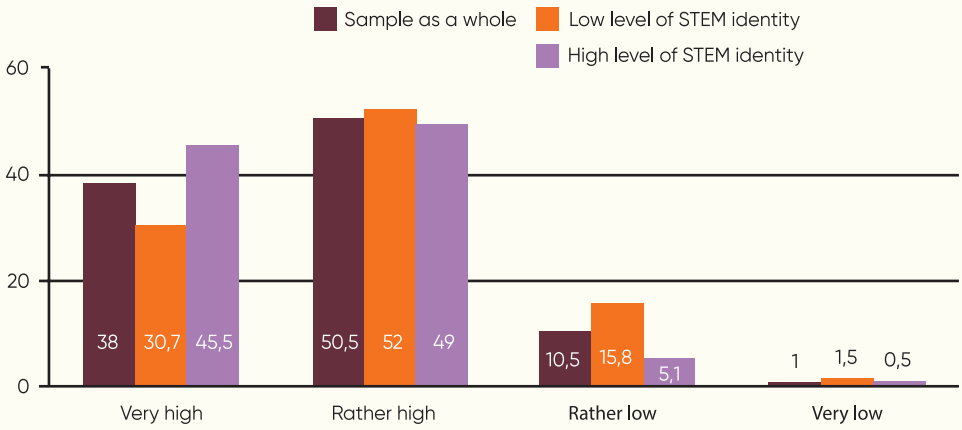


Figure 3.1.18. Self-assessment of success in the chosen field in the sample as a whole and by identity level,%

For example, female study participants with high identity levels were more likely than those with low identity levels to indicate that they assessed their successes (45.5% and 30.7%, respectively) and abilities (44.4% and 29.2%) very highly *(Figures 3.1.18-3.1.19).*

The female respondents with high levels of engagement are more likely to assess their success in the chosen field as very high than those with low levels of engagement (44% and 33% respectively) *(Figure 3.1.20).*

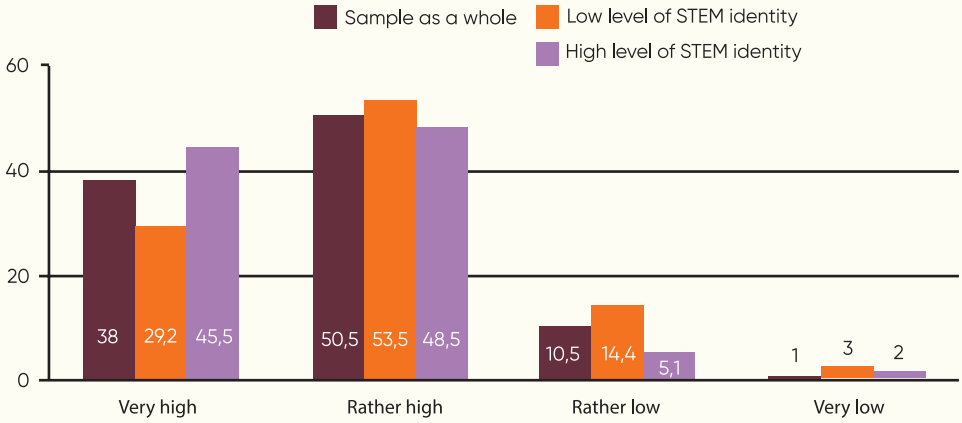


Figure 3.1.19. Self-assessment of abilities for study/work in the chosen field in the sample as a whole and by identity level, %

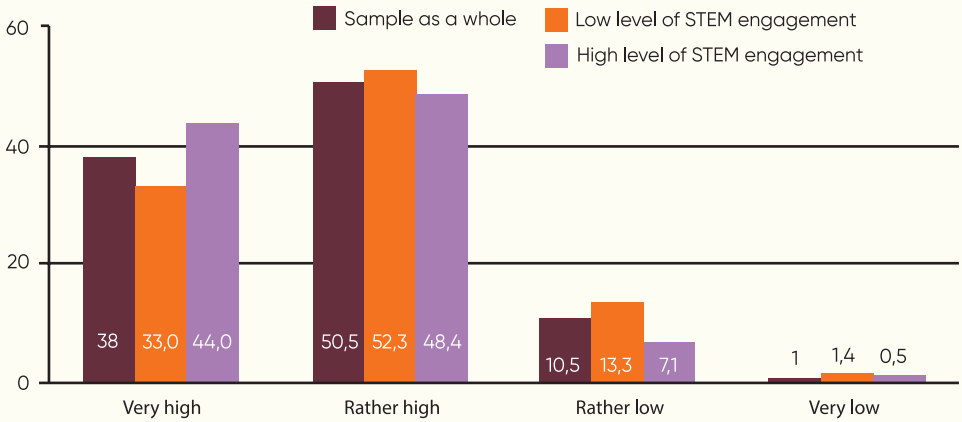


Figure 3.1.20. Self-assessment of success in the chosen field in the sample as a whole and by level of engagement,%

A very high self-assessment of abilities for study/work in the chosen field is more common among the female participants with a high level of engagement than among those with a low level of engagement (44.5% and 30.3%, respectively) *(Figure 3.1.21).*

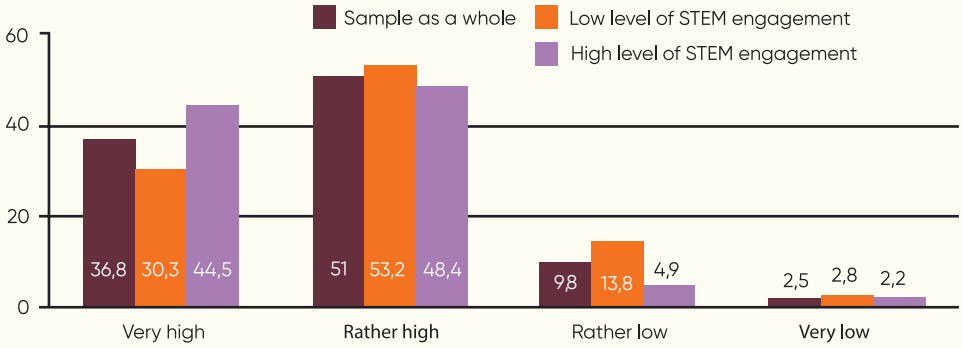


Figure 3.1.21. Self-assessment of abilities for study/work in the chosen field in the sample as a whole and by level of engagement,%

The female study participants who both study and work (51.1%) assess their abilities in the chosen field more highly than female students (33.8%) and working (35.9%) female respondents *(Figure 3.1.22).*

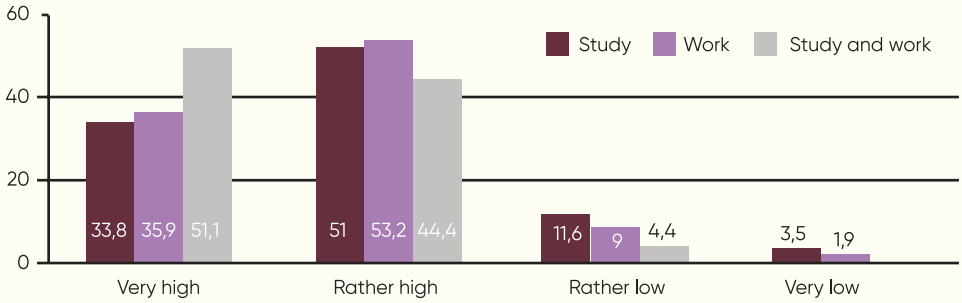


Figure 3.1.22. Self-assessment of abilities for study/work in the chosen field by employment, %

Information from the IDI

Working student, 21 years old, majoring in computer science and engineering

From a professional point of view, I am happy with what I have achieved, I am at a good level given my education and experience...People trust me, they assign me serious projects...I am not sure yet if I want to apply for a master's degree, which is not of much value because it is your portfolio that matters.

Generally, weighted self-assessment is also observed when analyzing IDI and FGD. The interviewees noted that they were aware of both their positive and negative sides. They clearly reflect on the qualities to be improved and build strategies for their development.

Information from the IDI

Working female student, 23 years old, majoring in programming and engineering

I will ponder the pros and cons...I don't make a decision immediately. There are gifted children, I am not like them...I need more time, I need to study, I will sit through and study, I won't say I won't..I will push through and study. Answer to the question about disappointments related to the choice of profession: «There are no disappointments, just when there is a difficult task, you have to work hard. I told you that everything is not always easy for me, I don't have a very good memory, so I need grit, it helps me because I'm stubborn».

The analysis of IDI and FGD with female students and those working in STEM confirms a high positive assessment of their successes and abilities. In general, the first positive memories are related to the first successes and grades in studies, as well as the inexhaustible interest to learn new things. The positive memories of working women are revealed in the search for new things, the possibility of achieving the work goal, high assessment of labor results by the management.

Thus, the female study participants have a differentiated self-assessment of their successes and abilities, which depends on their professional identity, engagement, and employment.

3.2. Choices and motivations for choosing STEM professions

Age and the emergence of interest in STEM. Many studies show the importance of the age when the interest emerges for the formation of a persistent professional interest[77]. Thus, it was revealed that half (54.8%) of the female study participants became interested in their professional sphere in adolescence and young adulthood, and one third (30%) - during early adulthood *(Figure 3.2.1).*

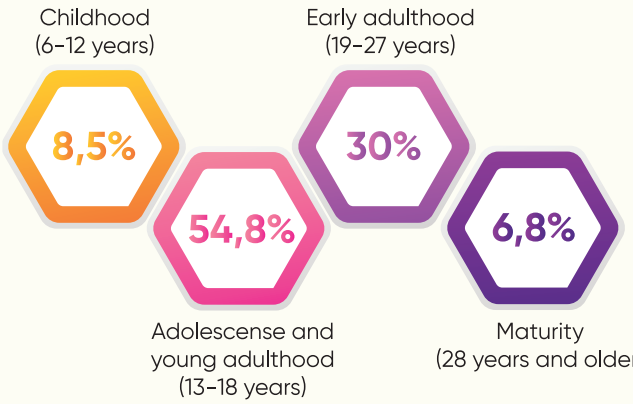


Figure 3.2.1. Periods of interest emergence in the professional sphere, %

The female study participants believe that early adulthood (85.8%), maturity (74.8%) and adolescence and young adulthood (65.3%) are more important for their professional development than childhood (25.8%) *(Table 3.2.1).* The obtained data are generally logical, as the understanding of the chosen profession, realization in it, and formation of key professional skills occur as one grows up.

These data are also supported by the results of using psychodiagnostic methods at the preparatory stage of the study. Thus, the analysis of data

77 For example: STEAMS Practices in Education. Collection of STEAMS Best Practices in Education Part 2. STEAMS practices in preschool education: [Collection]/ compilers E.K. Zenov, O.V. Zenkova. Moscow State Pedagogical University, Moscow: Publishing house «Pero», 2021. 306 p.; Yang K., Awad K., Gramaglia M., Kelly R., Kopec S., Luzio N., Neptune K., Pfau M., Purviance J. Girls and Women in STEM: A Review of Interventions and Lifespan Developmental Considerations for Increasing Girls' and Women's Partcipation in STEM.Stockton University. URL: https://oudev.stockton.edu/social-behavioral-sciences/documents/YangReview.pdf

obtained using the STEM professional identity overlap (STEM-PIO-1)[78] technique showed that female students' prospective self-assessment of professional identity increases. In other words, the assessment of the correlation between the vision of one's self and oneself as a STEM professional changes statistically significantly for each time period: at the beginning of the study, at a given point in time, and after 5 years *(Figure 3.2.2.2)*. .

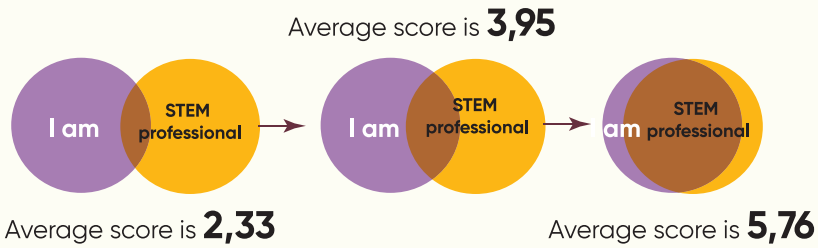


Figure 3.2.2. Increase in self-assessment of professional identity

The data obtained when comparing female study participants with high and low levels of STEM identity and STEM engagement is of interest.

Table 3.2.1.

Assessment of the importance of time periods of one's life for the professional formation,%*

№	Age periods	Very important	Important	Neutral	Unimportant	Completely unimportant
1	Early adulthood (19-27 years old)	52,8	33,0	6,3	2,0	1,0
2	Maturity (28 years and older)	53,8	21,0	6,0	2,3	0,8
3	Adolescence and young adulthood (12-18 years old)	35,3	30,0	16,8	8,5	5,0
4	Childhood (6-11 years old)	11,8	14,0	15,0	21,5	32,8

**- results are ranked based on the sum of "very important" and "important" responses*

Female respondents with high STEM identity are characterized by a higher assessment of the importance of all time periods in their professional formation. Female participants with high STEM engagement tend to assess the importance of adolescence, young adulthood, and early adulthood more highly[79] *(Figure 3.2.3)*.

78 McDonald M., Zeigler-Hill V., Vrabel J., Escobar M. A Single-Item Measure for Assessing STEM Identity//Frontiers in Education. 2019. No 4. 78. 10.3389/feduc.2019.00078.

79 Hereinafter, the reliability of differences between different groups of study participants was determined using the nonparametric Mann-Whitney test for two independent samples and the Kraskal-Wallis test for three or more independent samples.

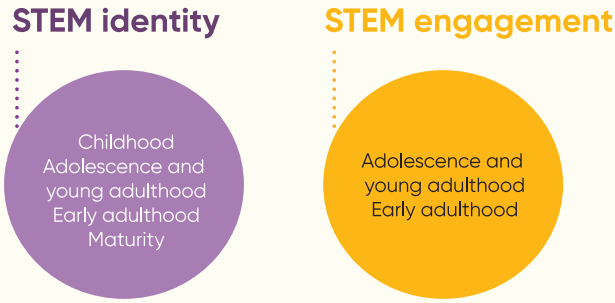


Figure 3.2.3. Assessment of the importance of time periods depending on STEM identity and STEM engagement

Information from the IDI

Master's student, 27 years old, majoring in higher mathematics

I started studying at an academic lyceum in our city (note: regional city), in the area of exact sciences. I can't call myself a persistent mathematician at that moment, I just wanted to be the first always in all subjects. I began to study hard right after entering the lyceum. And... as I said before: I just wanted to differ from others. Exact sciences seemed to be unacceptable for girls, and it made me want to choose it more.

Thus, the study revealed that female participants became interested in their profession during adolescence and young adulthood, as well as in early adulthood. At the same time, the study captures the formation of professional identity as one grows older.

Other people's influence on STEM choices. The ranking of responses *(Table 3.2.2)* to the question about the degree of other people's influence on the female study participants' choice of profession and specialization showed that the most significant figures from the family are equally "father or a man who replaced father" (63%) and "mother or a woman who replaced mother" (62.8%), as well as brothers (37.3%), grandmothers (33.6%) and sisters (33.5%), while from the education system the most significant figures are female teachers (51%) and teachers (42.8%).

Table 3.2.2

Assessment of the degree of people's influence on female respondents' choice of profession and specialization,%*

№	People	Very strong influence	Significant influence	Neutral	Minor influence	No influence
1	Father or a man who replaced a father	37,0	26,0	14,5	6,0	16,5
2	Mother or a woman who replaced a mother	33,8	29,0	16,3	4,8	16,3
3	Teacher (female)	16,0	35,0	14.8	11,0	23,3
4	Teacher (male)	15,3	27.5	18,5	10,8	28,0
5	Brother(s)	16,0	21,3	21,8	10,0	31,0
6	Grandmother	12,3	21,3	17,0	12,5	37,0
7	Sister(s)	13,0	20,5	22,0	9,8	34,8
8	Grandfather	12,5	19,0	16,3	10,0	42,3
9	Spouse or close friend	15,0	14,3	18,5	9,0	43,3
10	Female friend(s)	8,5	15,8	22,3	14,0	39,5
11	Friend(s)	6,5	15,3	22,8	13,3	42,3

*-results are ranked based on the sum of "very strong influence" and "significant influence" responses.

The analysis of IDI with girls and women studying and working in STEM, as well as with their parents, shows that most parents of girls are passionate about their profession. Some parents noted that the choice and motivation to receive education in this field were formed under the influence of discipline instilled in the family and determined by the opportunities to make choices provided by parents. The support was given to the child regardless of the choice.

The key theme of some interviews is the personal example of parents who are engaged in their activities, purposefulness, and the ability to set and achieve goals. This is considered as a factor that influences children's choice and engagement in the profession.

Information from the IDI

Female student, 22 years old, majoring in information technologies and automation

My dad is an engineer; since my childhood, I have seen my dad sitting at the computer, doing something... my dad was always studying, he had stacks of books on his desk all the time. My brother is 3 years older, he works in a different field, he is a developer. My brother wasn't surprised by my choice. He found me a development course, I want to try something new.

Information from the FGD

Female student, 19 years old, technical specialty

When choosing a direction, the key importance was that my brother studied in STEM and recommended me to enter this direction (note: technical specialty). And I got interested in this field, as my brother helps me, explains things to me. My family was not against my choice.

Information from the IDI

Female student, 21 years old, computer and software engineering

I was always good at math, my grandmother is a mathematician...I spent my summers solving tasks, not having fun. My grandmother was always giving me examples...here we are peeling apples, there are 25 of them, and she says to me «25 apples is 5 times 5, that is 5 squared. Or you have to put five together five times.»

It is noteworthy that both parents influence high STEM identity expression and high STEM profession engagement at a statistically significant level, as well as spouse (close friend) at the trend level *(Figure 3.2.4).*

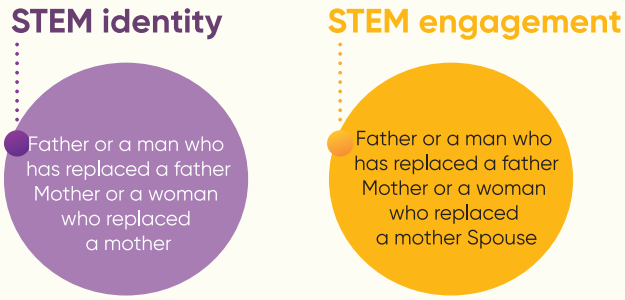


Figure 3.2.4. Assessment of the degree of people's influence on female respondents' choice of profession and specialization depending on STEM identity and STEM engagement, %

The in-depth interview analysis confirms the identified peculiarity that the influence of parents, relatives, and close friends is the dominant factor in choosing a profession. Thus, one of the female interview participants cites the study results as a factor that made her think about her profession.

Information from the IDI

Programmer, 21 years old

Scientists of Yale University conducted such research... 80% of people live without any plans and ideas, only 14% don't know what they really want «something or this or that» and only 2% of people have their goal and achieve something in their life. And they found out that there are 4 factors that influence goal-setting. The first is parents. The second is when a person does what he/she loves to do, etc. I would like to say that everything I've achieved is because of my family.

Besides, the female respondents' answers show a connection between the choice of profession and random people in the Internet space, who share their experience in blogs and inspire to engage in this activity.

Thus, the choice of profession and specialization can be determined equally by parents (father and/or mother), siblings, grandmothers, and teachers. Parents can be said to influence the choice of profession through their professional example and by identifying the child's interests and supporting him/her in this hobby.

Factors of STEM choice. Among the factors that had a greater influence on the choice of profession, the female study participants pointed first of all to competitions or Olympiads in subjects related to specialization (64.3%), reading popular science books and magazines (57.3%), availability of information about the profession in newspapers, magazines, and on television (50.8%) *(Table 3.2.3).*

Table 3.2.3.

Assessment of the degree of influence of various factors on the female respondents' choice of profession, %*

№	Factors	Very important	Important	Neutral	Unimportant	Completely unimportant
1	Competitions or Olympiads in subjects related to the specialization (e.g., math, biology, physics)	29,0	35,3	14,0	9,5	12,3
2	Popular science books and magazines	18,3	39,0	14,5	11,3	17,0
3	Information about the profession in newspapers, magazines, and on television	16,5	34,3	21,5	13,0	14,8
4	Popular science TV shows, channels, programs (e.g., Discovery, TedTalk)	9,8	26,0	24,3	15,0	25,0
5	Science fiction books and movies	9,3	25,8	24,3	17,5	23,3
6	Museums/research centers	5,8	26,3	20,3	18,5	29,3
7	Feature movies or TV series	6,5	20,8	22,8	20,0	30,0
8	Computer games	4,0	16,8	15,8	19,8	43,8

*- results are ranked based on the sum of "very important" and "important" responses

The analysis of factors influencing the profession choice depending on STEM identity shows that the female study participants with a high level of STEM identity consider such factors as popular science books and magazines, science

fiction books and movies, competitions or Olympiads in subjects related to their specialization (e.g., math, biology, physics), information about the profession in newspapers, magazines, and on television to be more important for them.

Information from the IDI

Working female student, 22 years old, majoring in computer science and engineering

The pursuit of knowledge is important. For example, there's a math book that I can't read. But I know I will. Fiction books allow me to reeducate myself - I like Theodore Dreiser... The book «There are no miracles» by the President of South Korea had a huge impact on me at the lyceum. The author wrote that he had hepatitis and worked at the time in a construction company and ... he went to work anyway ....

Female participants with a high level of STEM engagement consider reading popular science books and magazines, participating in competitions or olympiads on the subjects, and getting acquainted with information about the profession in the mass media as more important factors.

Female participants of the FGDs noted that while searching for an educational institution, they searched for information about the profession not only on the websites of these universities. They tried to find popular science and feature films about women in science. However, they did not find any Uzbek feature films.

Information from the FGD

Female FGD participants, 18-22 years old, technical HEIs

Since our childhood, we liked to look for movies. We watched popular science programs on National Geografic, shows on TedTalks... We wanted to find Uzbek movies, but there are none. Women are always belittled in them.

The factors that influenced the choice of profession include STEM-related activities shown in children's cartoons.

Information from the IDI

Female student, 22 years old, majoring in computer science and engineering

At one time, I was influenced by one cartoon...I can't remember the name...it was about robots...it was also about bots, about inventions of useful robots. I was about 13-14 years old...I recalled. It was «City of Heroes».

The analysis of the IDIs shows that the choice of specialty is based on the previous knowledge of girls, knowledge of the exact sciences, as well as previous training in special subjects (math, chemistry, graphic design, drawing).

Information from the IDI

Female student, 23 years old, majoring in information technology and automation

What led me to my choice? I went to college for accounting and auditing. My dad wanted me to major in it. He's an economist. And my grandfather is an economist, they wanted me to be the next... But I decided that there are a lot of economists... and college knowledge is enough if you want to work as an accountant. I had the choice of marriage or study. And I wanted to study, to develop, but not in economics.

A more detailed IDI analysis on the previous pre-university education or post-HEI education shows that it is not always a determining factor in the choice of STEM education or employment. The choice of education and employment in this sphere is more influenced by interests and hobbies of female respondents. Thus, having an obvious choice of educational direction, female respondents could change this direction to close specialties, wishing to study them more

deeply. Besides, the social and intellectual activity of female respondents, their participation in hackathons, projects, and competitions is also important All of these activities reflect the inherent "competitive spirit" of these girls.

Thus, STEM engagement is indirectly related to the factors that involved specific acts of professional choice by the female study participants.

Motives for choosing a profession. Several groups were identified as motives for choosing a profession:

1. motives of interest in the profession and self-realization;
2. motives of profession prestige and labor remuneration;
3. influence of relatives and friends;
4. situational motives, random choice.

The motives of interest in profession and self-realization are dominant for the female study participants. The motives of interest in profession and self-realization are dominant for the female study participants. The choice was very strongly and significantly influenced by the opportunity to do what is interesting (80.8%), abilities (76.1%) and the need for constant self-development in the chosen sphere (75.8%) *(Table 3.2.4).*

Information from the FGD

Female student, 19 years old

The choice of this sphere is related to me, as I studied my environment, imagined myself working in this sphere, imagined who I would be in the future, so I set a goal to enter this sphere. I have entered and I am studying.

The second most important group of motives for girls and women engaged in STEM *(Table 3.2.4)* are the motives of profession prestige and remuneration, including the opportunity for career growth (72.3%) and receiving a high income (71.1%), the prestige of the profession and its status in society (69.6%), the demand for the profession on the labor market (65.8%), and the opportunity to do what is important for people, society, and environmental protection (60.3%).

Table 3.2.4.

Motives for choosing a profession, %*

№	Motives	Very strong influence	Significant influence	Neutral	Minor influence	No influence
1	Being able to do what I am interested in	44,3	36,5	11,5	2,8	5,0
2	My abilities	34,8	41,3	14,0	3,5	6,5
3	Profession requires constant self-development	41,8	34,0	15,0	3,8	5,5
4	Opportunity for career growth	33,3	39,0	15,0	5,3	7,5
5	Possibility of getting a high income	31,8	39,3	14,3	5,8	9,0
6	Prestige of a profession and its status in society	26,8	42,8	16,0	5,3	9,3
7	Demand for the profession on the labor market	31,5	34,3	18,5	8,0	7,8
8	Opportunity to do what is important for people and society and for environmental protection	25,0	35,3	22,0	6,8	11,0
9	This specialty was easier for me to enroll in	23,8	29,0	18,0	10,8	18,5
10	Coincidence	19,5	28,0	22,5	15,0	15,0
11	Opinion of relatives, teachers, friends, their advice	16,3	28,0	21,0	13,3	21,5
12	Following a family tradition	12,0	21,8	21,3	11,8	33,3
13	I enrolled with some friends	12,5	20,0	20,0	14,5	33,0
14	Education in the specialty was cheaper	9,0	16,0	16,8	17,0	41,3

*- results are ranked based on the sum of "very strong influence" and "significant influence" responses.

More than half of the female respondents indicated that the profession was chosen because it was easier to enter the relevant educational institution (52.8%). To some extent, this opinion is also confirmed by the information obtained during focus group discussions with female students of technical specialties.

Information from the FGD

Female student, 19 years old, technical HEI

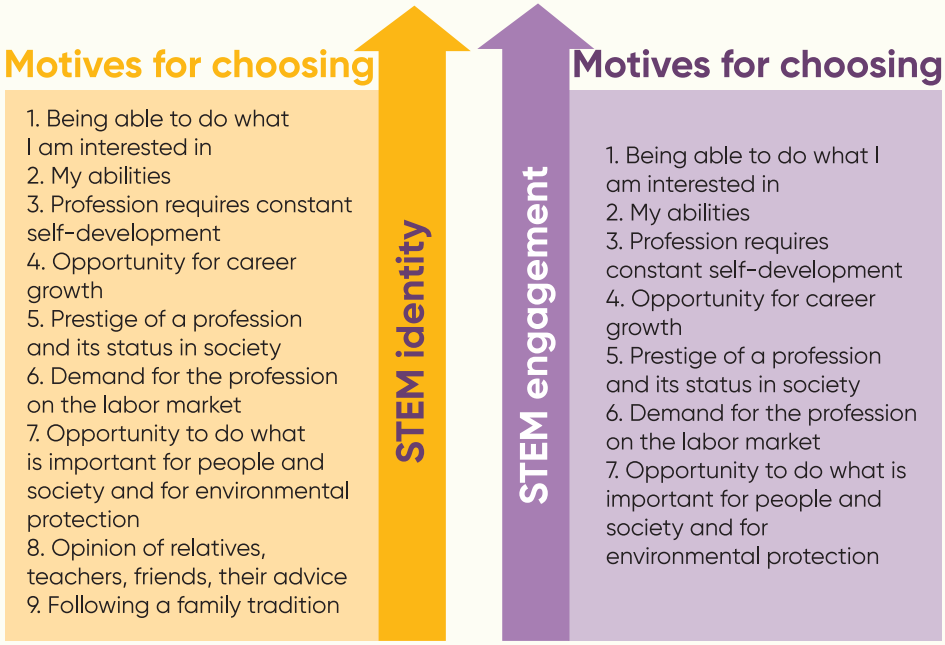
A relative recommended STEM, claiming that the entrance scores were low. And it turned out to be. And the most important thing influencing my choice was the desire to get away from rural life. I had not studied math and physics so intensively before. My choice was also influenced by the ease of entry... low entrance scores.

The degree of influence of motive on the choice of profession varies depending on the expression of STEM identity and STEM engagement among the female study participants *(Table 3.2.5)*.

Female respondents with high levels of STEM identity and STEM engagement have a higher assessment of the degree of influence of such motives as motives of interest in the profession and self-realization ("the opportunity to do what I am interested in", "my abilities", "the profession requires constant self-development", "the opportunity to do what is important for people and society, for environmental protection") and motives of prestige of the profession ("the prestige of the profession and its status in society", "the demand for the profession in the labor market"). Female study participants with high level of STEM¬ identity demonstrate also motives related to the opinion of relatives, teachers, friends, and following the family tradition.

Table 3.2.5.

Motives for choosing a profession depending on the level of STEM identity and STEM involvement expression



Qualitative data (IDI, FGD) indicate that the choice of educational specialization is primarily based on the range of interests of the female respondents, including childhood hobbies, the ability to constantly learn new information, and the desire to acquire new knowledge. At the same time, engagement in study is also related to a firm intention to acquire knowledge rather than an educational diploma. Some female respondents mentioned that they chose to study in order to avoid early marriage.

Thus, the dominant motives for choosing STEM professions are the motives of interest in the profession and self-realization.

3.3. Psychosocial factors of STEM identity and STEM engagement

The psychological resources of STEM identity and STEM engagement in this study were indicators of perseverance (including indicators of persistence of interest and persistent efforts), self-control and self-efficacy in educational/professional activities, reflection, and social support. The use of statistical data processing methods gives grounds to say that there is a relationship between the STEM identity and STEM engagement indicators and the indicators of psychosocial determinants of behavioural change *(see Annex 7).*

3.3.1. Psychological determinants of STEM identity and STEM engagement

AThe analysis of the IDI and FGD with female students and women working in STEM, their parents and spouses showed that their personality traits play an important role in their choice of profession, identity formation and inclusion. For example, their parents noted that, with sufficient parental support, girls themselves displayed qualities such as assiduity, pedantry, purposefulness, tidiness, and diligence.

Personality grit This personality trait is a characteristic that enables a person to overcome difficulties on the way to a goal. It includes 2 components such as ***perseverance of effort and passion for long-term goals***[80]. Psychological studies show that perseverance predicts success in a wide variety of productive activities.

The analysis of the IDI and FGD revealed that almost all female respondents noted that they achieve their learning objectives with high self-organisation and a clearly defined learning goal. The working female participants of the IDI and FGD, who are very positive about their successes, believe that their assiduity, purposefulness, desire to achieve goals, responsibility, desire to create, curiosity and activity help them to achieve their goals. They also emphasised that these traits, inherent in them since childhood, help them in their professional activities.

80 Duckworth A.L., Peterson C., Matthews M.D., Kelly D.R. Grit: perseverance and passion for long-term goals//J Pers Soc Psychol. 2007 Jun. 92(6): 1087-101. doi: 10.1037/0022-3514.92.6.1087. PMID: 17547490; Gordeeva T. O. Motivation of educational activity of schoolchildren and students: structure, mechanisms, development conditions: dissertation ... of doctor of psychological sciences: 19.00.07. [Place of defense: Lomonosov Moscow State University. Faculty of Psychology]. M., 2013. p. 444. Yerofeyeva V.G., Nartova-Bochaver S.K. What is «grit» and why it can be a personal resource? [Electronic resource] // Modern foreign psychology. 2020. Vol. 9. No. 4. P. 22–31.

Information from the IDI

Manager of the logistics department, 25 years old

In general, I am very easy-going and patient by nature, sometimes I think that my patience allows me to sit at the computer and create for hours. You know, websites are not created in half an hour. Even a seemingly simple interface takes hours and days to create. And then there are a lot of bugs, then the site can crash, and you have to fix the bugs. Impatient people have no place in this field.

Information from the IDI

Female student, 19 years old, technical specialty

My brother, my little brother and I have never been afraid of work. We don't live in the city. Besides studying at school, we have a lot of chores around the house, for example, my brother used to get up at 4:30 in the morning to clean the cowshed and go to fetch water. Our mother worked and sent us to all the hobby groups, she told us that we should always think about studying first. We always had time to study even when we were busy.

Parents of female students and working women in STEM believe that one of the most important qualities inherent in their children is grit. Grit is reflected in such characteristics as achieving success by constantly seeking information and being interested in one's speciality. Spouses of female STEM students and employees also agree with this view.

The study found differences in grit between female study participants with low and high levels of STEM identity (Figure 3.3.1) and STEM engagement *(Figure 3.3.2).*

Information from the IDI

Mother of a programming specialist, 40 years old, secondary education

She is very diligent, she is a girl who will fight for her place that she holds on to, she has a very combative nature, she has always made her position clear since childhood.

Information from the IDI

Mother of a specialist in higher mathematics and programming, 50 years old, higher education

What characteristics of the daughter influenced her choice? I think it was her perseverance and her desire to be different from other girls. She graduated in higher mathematics, although I was against this sphere, I told her, «Study medicine or humanities»...After master's degree she wanted to study programming. I just know my daughter, if she decides to do something, she will do it by any means. As they say, she is a rebellious daughter who always says, «hop, mummy' and studies something new». She strived for a new education, worked, saved money. But what to do afterwards? Of course, after so much effort of my child, I am not going to stop her from getting a new education. My husband and I helped her with the rest of the money.

Female respondents with high levels of STEM identity and STEM engagement are more likely to have high levels of persistent effort and perseverance. These female study participants believe that they have achieved a goal that has taken several years of work, and that they are able to overcome failure and cope with serious difficulties. Their self-esteem is characterized by such characteristics as "I finish everything I start", "I am a hard worker", "Failure does not discourage me", "I am a persevering and persistent person".

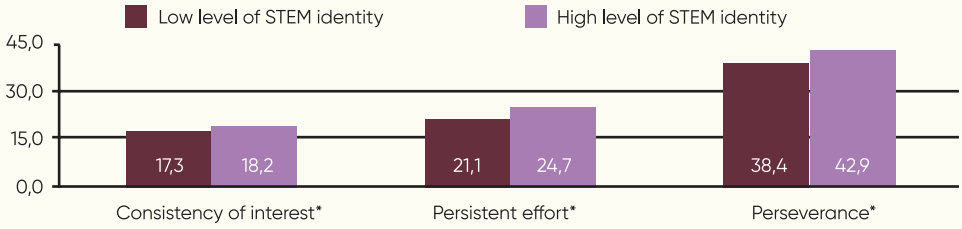


Figure 3.3.1. Grit indicators depending on STEM identity (based on average scores)

* reliable statistical differences are marked

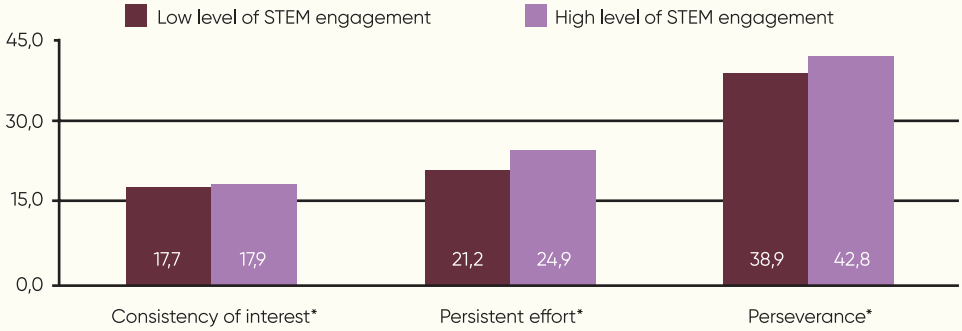


Figure 3.3.2. Grit indicators depending on STEM engagement (based on average scores) * reliable statistical differences are marked

Thus, persistent effort and persistence are expressed personality traits of the female study participants with high levels of STEM identity and STEM engagement.

Self-efficacy, self-control, and reflection. Psychological studies show that self-efficacy, self-control, and reflection are the factors of success in academic and professional spheres.

Self-efficacy, as one of the central explanatory mechanisms in Bandura's social cognitive theory, is defined as a conviction of an individual to organise and implement his or her actions to achieve his or her goals[81]. In this study, self-efficacy can be defined as a belief in one's academic and professional potential that contributes to maintaining interest in learning, professional activity, and success[82]

81 Bandura A. Social Cognitive Theory: An Agentic Perspective//Annual Review of Psychology. 2001. Vol.52. Pp.1-26.

82 For example: Gordeeva T. O. Motivation of educational activity of schoolchildren and students: structure, mechanisms, development conditions: dissertation ... of doctor of psychological sciences: 19.00.07. [Place of defense: Lomonosov Moscow State University. Faculty of Psychology]. M., 2013. P. 444.

Such quality of personality as self-control is associated with planning and regulation of activity. It contributes to success in various activities and is a predictor of academic performance. Self-control is considered as a person's ability to control himself, his behaviour and states, adjust his emotions and actions to establish an optimal correspondence between the world and himself[83]. In this study, self-control is defined as a person's ability to manage his or her behaviour and emotions to achieve goals in studies or professional activities[84].

In this study, reflection is considered as a personality trait manifested in reflecting on one's strengths and weaknesses during education and in professional activities. This quality is revealed in seeking help, support, and encouragement, in monitoring efforts and achievements, and in managing rewards and punishments[85] Reflection is an important criterion of academic resilience of an individual.

The analysis of the IDI and FGD shows that the female respondents pointed to self-control, self-efficacy and the need to work on themselves to achieve goals. They believe that these qualities were formed gradually, based on childhood behavioural patterns. Female IDI participants reflected that the difficulties of professional activity are more related to self-discipline and the need to make efforts to implement the set tasks during the work activity.

Information from the IDI

Programmer, 30 years old

I had difficulties at the beginning, social pressure, stereotypes, because the IT field was not so developed at that time and there were few women in it. It took me six months to get myself together. The difficulties are that you have to devote much time and keep learning, you have to be able to control yourself and realise that things don't always work out.

83 For example: Rothbaum F., Weisz J.R., Snyder S.S. Changing the world and changing the self: A two-process model of perceived control//Journal of Personality and Social Psychology. 1982. Vol. 42(1). Pp. 5-37. doi: 10.1037/0022-3514.42.1.5; Gordeeva T.O., Osin E.N., Suchkov D.D., Ivanova T.Yu., Sychev O.A., Bobrov V.V. Self-control as a personality resource:¬ assessment and associations with performance, persistence and well-being // Cultural-Historical Psychology. 2016. Vol. 12. No 2. P. 46-58. doi:10.17759/chp.2016120205.

84 Gordeeva T. O. Motivation of educational activity of schoolchildren and students: structure, mechanisms, development conditions: dissertation ... of doctor of psychological sciences: 19.00.07. [Place of defense: Lomonosov Moscow State University. Faculty of Psychology]. M., 2013. P. 444.

85 Cassidy S. The Academic Resilience Scale (ARS-30): A New Multidimensional Construct Measure// Front. Psychol. 2016. 7: 1787. doi: 10.3389/fpsyg.2016.01787; Postylyakova Yu.V. Adaptation of the Academic Resilience Scale (ARS-30) developed by S. Cassidy on a Russian-language sample. Work and Organizational Psychology. 2021. Vol. 6. No. 2. DOI: 10.38098/ipran.opwp_2021_19_2_00.

Female study participants with high levels of STEM identity and STEM engagement differ from those with low levels on indicators of self-control and self-efficacy related to academic or professional activities and on reflection *(Figures 3.3.3.3-3.3.4).* This is manifested in a sense of control over one's achievements, responsibility for one's success in the chosen profession, in studies or at work.

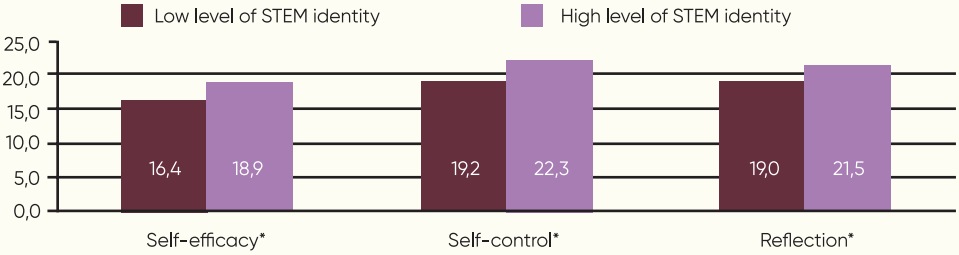


Figure 3.3.3. Self-efficacy, self-control, and reflection indicators depending on STEM identity (based on average scores) * reliable statistical differences are marked

Female study participants with strong STEM identity and STEM engagement believe more in their success in their profession. They believe that with enough effort, they will be able to overcome most problems and challenges in their profession, studies or work.

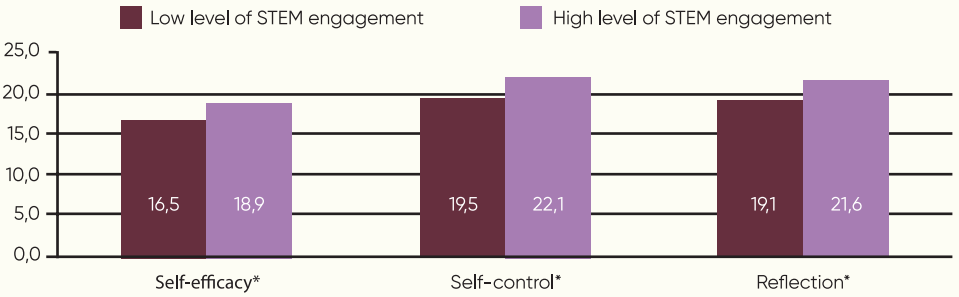


Figure 3.3.4. Self-efficacy, self-control, and reflection indicators depending on STEM engagement (based on average scores)

* reliable statistical differences are marked

Self-efficacy also extends into the future, as they express confidence that they will be able to improve their academic or work performance in the coming year. Unlike female respondents with low levels of STEM identity and STEM engagement, they believe that they are prepared for and can cope with any profession-related difficulties because they rely on their own abilities.

When analysing such an important component of academic or professional vitality as reflection, the female study participants with high levels of STEM identity and STEM engagement are characterised by high levels of reflection. In other words, the orientation of the female study participants to different ways of solving complex problems and their assessment of their strengths and weaknesses act as a peculiar psychological resource for ensuring identity and engagement in the profession in the situation of solving such tasks. In fact, the female study participants are characterised by a high degree of learnability, as they turned to colleagues, teachers, or classmates for help in a difficult problem-solving situation. At the same time, they are aware of the need to support themselves and focus on solving the problem instead of panicking.

It is of interest to find an answer to the question: "Does the employment of the female study participants with low and high levels of professional identity and engagement affect the expression of psychological resources?" *(Figure 3.3.5).*

The search for an answer to this question showed that, in general, the differences in the indicators of grit and perseverance, self-efficacy and self-control, and reflection remain the same at low and high STEM identity and STEM engagement levels regardless of the female respondents' employment. Although, the differences in the indicators of persistent effort and reflection between the female study participants with low and high levels of engagement from the working and studying group are manifested at the trend level, they remain expressed.

The differences between female study participants from different regions in STEM identity and STEM engagement need to be discussed in more detail. Female study participants from Andijan and Fergana provinces differ from those living in Tashkent city and Surkhandarya province in their higher indicators of consistency of interests, persistent efforts, perseverance, self-efficacy, self-control, and reflection.

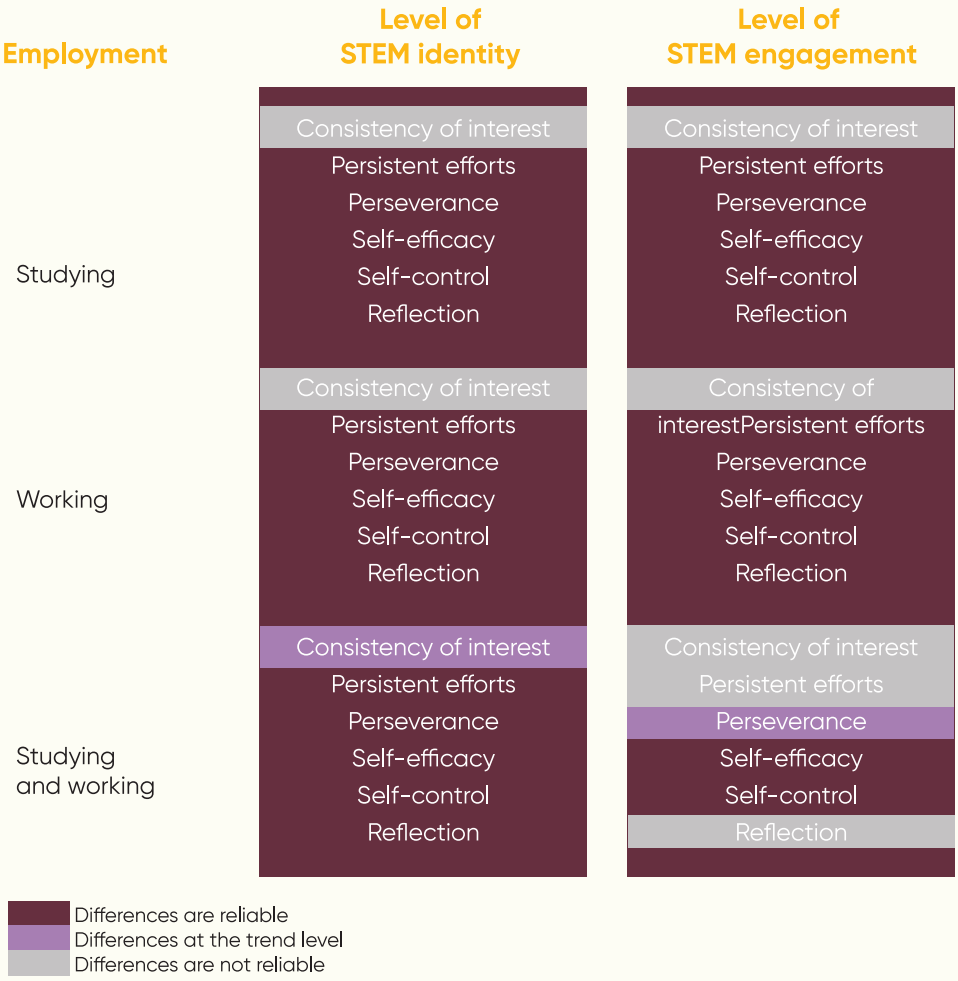


Figure 3.3.5. Expression of psychological indicators on STEM identity and employment

Thus, the psychological resources of the female study participants that determine their STEM identity and STEM engagement are their traits such as perseverance, self-efficacy, self-control, and personality reflection.

3.3.2. Social support as a factor of STEM identity and STEM engagement

Social support. In this study, the indicators of social support were the indicators of the social support scale (from family, friends, significant others), the attitude of parents, spouses and parents of spouses to the choice of profession by the female study participants, as well as the assessment of the opportunities for the professional motives implementation both in higher educational institutions and in organisations at the workplace.

Social support is expressed by providing a person or group of people with psychological or material resources to help them cope with possible life stresses. Social support is reflected in assistance with daily activities, receiving information, sometimes in the form of advice or assistance, expressing emotional support, including expressions of empathy, care, trust[86]. In general, social support gives a person a sense of inclusion in social networks, an understanding of the sources of help, and is built on relationships between people[87].

Reliable correlations were found between all indicators of social support, STEM identity and STEM engagement *(Figures 3.3.3.6-3.3.8).* These were confirmed by reliable differences in social support indicators between female study participants with low and high levels of STEM identity and STEM engagement *(Figures 3.3.3.7-3.3.9).*

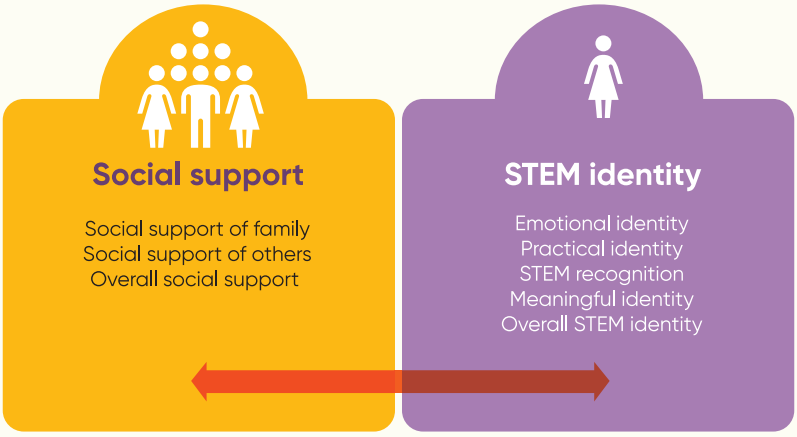


Figure 3.3.6. Relationship between STEM identity and social support indicators

86 Cohen S. Social Relationships and Health//American Psychologist, 2004. November. P.676-684.
87 Bright J., Jones F. Stress: Myth, theory, and research. - St. Petersburg: PRIME-EUROZNAK, 2003. P. 352; Silantieva T.A. Operationalizing the Construct «Social Support» [Electronic resource] // Modern Foreign Psychology. 2014. Vol. 3. No. 4. P. 57–70. URL: http://psyjournals.ru/jmfp/2014/n4/75375.shtml (accessed: 02.10.2022).

It is important to note that social support indicators are positively correlated with the indicators of emotional, practical, and meaningful STEM identity and STEM calling. Social support can be assumed to act as a resource for positive professional self-determination.

Female study participants with high levels of STEM identity differ from those with low levels of STEM identity in their high rates of perceived social support from family, significant others, and social support in general. They are more confident that their family really wants to help them, and that they can rely on someone close to them in a difficult situation *(Figure 3.3.7).*

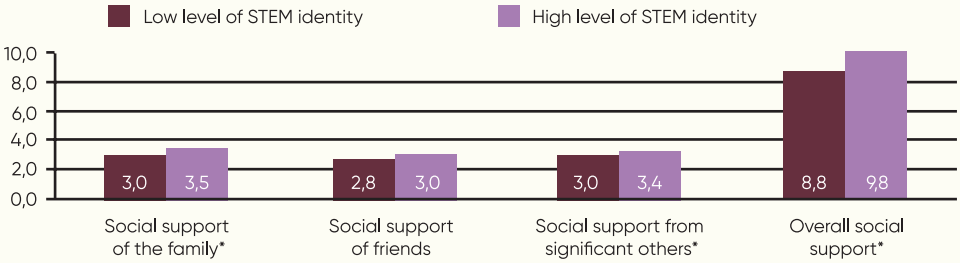


Figure 3.3.7. Social support indicators depending on STEM identity based on average scores * reliable statistical differences are marked

The cognitive, emotional, and behavioral components of STEM engagement are more expressed when there is social support from family, friends, and significant others *(Figures 3.3.8-3.3.9)*. It can be hypothesized that social support is a resource for the engagement of the female study participants at the cognitive level. This is expressed in an understanding of the need for additional knowledge and skills, key issues and topics of interest to the professional community.

Social support for emotional engagement is of great importance. It probably contributes to experiencing positive emotions when communicating informally with colleagues and friends about professional issues, and when organizing and carrying out events related to the profession *(Figure 3.3.8).*

Social support contributes to the behavioural manifestations of seeking additional information about the profession, receiving additional education in the specialty, organizing and carrying out professional events.

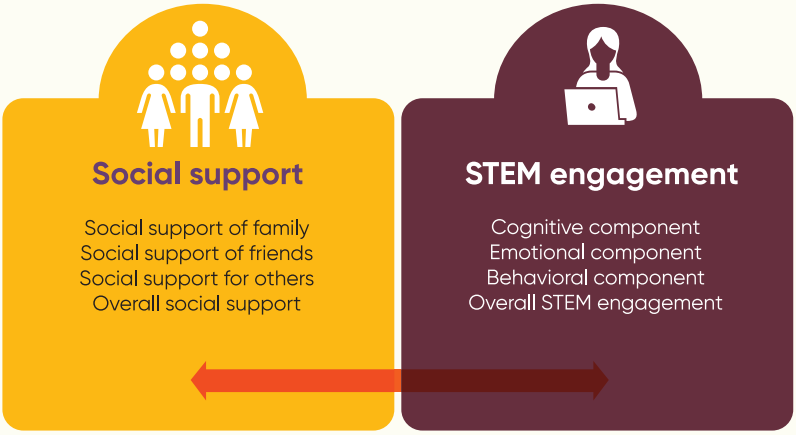


Figure 3.3.8. Relationship between STEM identity and social support indicators

High indicators of social support are characteristic of female respondents with a high level of STEM engagement *(Figure 3.3.9).*

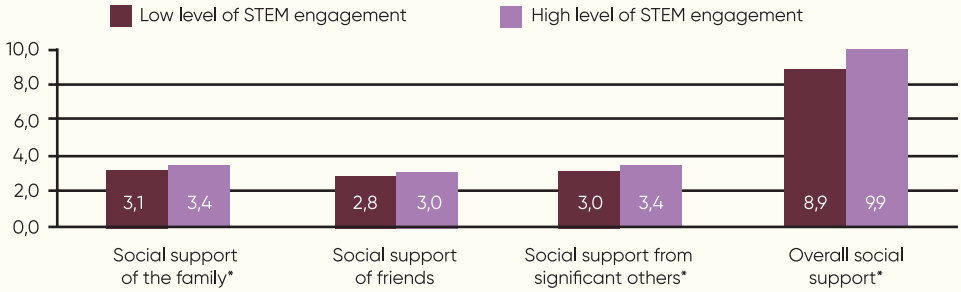


Figure 3.3.9. Social support indicators depending on STEM engagement based on average scores *reliable statistical differences are marked

It is hypothesized that high engagement in STEM professions among the female study participants is possible when there is emotional support from family, friends, and significant others. They feel the family's desire to help them make decisions *(Figure 3.3.9).*

The analysis of the expression of perceived social support depending on employment did not reveal any differences *(Figure 3.3.10).* In other words, more than half of the female study participants, regardless of their inclusion in education, work or both education and work (58.6%, 58.3%, and 57.8% respectively), are characterized by high levels of perceived social support.

Information from the IDI

Female student, 19 years old, majoring in information technology

The reason why I am here now (note: at the university) is my mother; you know, from childhood, she told us, «You should study», and she didn't just say it... She used to go to the field, pick vegetables, sell them and pay for our tutors. In our village, girls don't spend much on their studies, but my mother took us all to tutors. Math, physics, English, even chess, I was the only girl in the chess club. My mother was told that I would be spoiled and a bad bride, that she was teaching me the wrong things, but my mother said that I would keep studying.

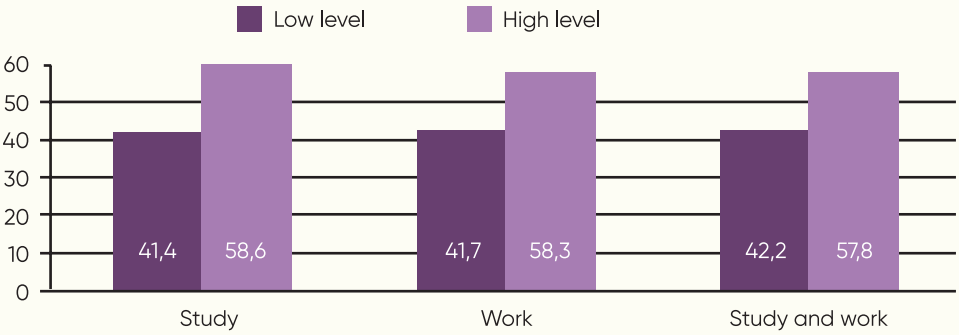


Figure 3.3.10. Levels of social support depending on employment,%

In general, the qualitative data (IDI, FGD) show the importance of social support, which is provided to a greater extent to the interviewed female students and working women by their parents and close environment.

Information from the IDI

Female student, 22 years old, master's degree in mathematics

The answer to the question about specific support situations: «Specifically, I can say that my parents gave me the opportunity to learn to work in Autocad, which, you know, is not cheap.»

Information from the IDI

Female student, 19 years old, majoring in information technology

When my mom couldn't pay for our tutors, she sold her rings to pay. She never told us that there was no money and we wouldn't go to tutors. My uncle bought me a laptop on credit. My uncle's wife never says bad things to me, they all say that I did well and now I have to prove to everyone that mom did not fight for our education in vain.

Social support role was noted not only by girls and women from STEM education and STEM professions, but also by their parents and spouses. For example, spouses of girls and women engaged in STEM professions believe that there is no need to share household chores in the family. They noted that they are always willing to do chores to help their spouse when needed.

Information from the IDI

Spouse, 27 years old, secondary education

I don't know what my qualities help, I am sympathetic to any situation, it is impossible to do everything perfectly, well, I don't bully her for that reason.

According to the IDI and FGD analysis, support from family and close environment can be informational, emotional, and instrumental.

The results of the survey confirm the information obtained using IDI and FGD. Parental support mainly consists in supporting the choices of the female study participants *(Table 3.3.1)*.

Information from the IDI

Spouse, 35 years old, higher education

My wife is helped first and foremost by her parents, who have always guided and supported her. For example, her father paid for her studies. We often consult each other when we have difficulties. She also has deadlines. I have to help her with the housework and look after the baby. If I can't help her with the baby, her mother helps us.

Table 3.3.1

Assessment by the female study participants of their parents' attitude to the choice of profession,%

Answers	%
My parents fully supported my choice, as I always persevered in achieving my goals	44,0
My parents guided me to choose this particular specialty	27,8
My parents fully supported me, as they always saw my abilities in the chosen specialty	14,0
My parents doubted my choice of profession, but over time, they began to support me	11,3
My parents reacted negatively to my choice of profession, as they believe that the main purpose of a girl is family	3,0

They either rely on their children's interests or guide their interests. 44% of the female survey participants indicated that their parents fully supported their choices as the female respondents were always persevering in achieving their goals. 27.8% noted that their parents guided them to choose this particular specialty. 14.0% of the female survey participants chose a profession based on their hobbies, and their parents fully supported them, as they noticed their abilities. 11.3% of female respondents noted that their parents became supportive over time despite their doubts.

Spousal support is an important factor that allows to stay in the profession *(Table.3.3.2).* According to the survey, 54.5% of female respondents noted that their spouses fully supports their choice, as they have always been persevering in

achieving their goals. 25.6% of female respondents indicated that their spouses' attitude to the activity depends on its importance for the female respondents. 14.2% of female respondents noted that they feel neutral attitude of their spouses to their activity. At the same time, 4.7% believe that their spouses do not support their choice, as they believe that this activity has a negative impact on their family relations.

Table 3.3.2

Assessment by the female study participants of their spouses' attitude to the choice of profession,%

Answers	%
My spouse fully supported my choice, as I always persevered in achieving my goals	54,5
My spouse fully supports me, as he knows that this is important to me	25,6
My spouse is neutral about my choice of profession	14,2
My spouse does not support my choice of profession, as he believes that it negatively affects our family	4,7

The study question was to investigate the extent to which married female respondents' choice of profession is supported by their spouses' parents *(Table 3.3.3)*.

Thus, 60.7% of the female respondents note that their spouse's parents fully support them in their choice of profession. Meanwhile, 25.6% of female respondents emphasize that their spouse's parents show a neutral attitude towards this activity and do not interfere in their family. 10.9% of the spouse's parents categorically reject respondents' choice, arguing that a woman should be primarily engaged in family, housekeeping and upbringing of children.

Table 3.3.3

Assessment by the female study participants of spouse parents' attitude to the choice of profession,%

Answers	%
My spouse's parents fully support my choice of profession	60,7
My spouse's parents believe that this is a family matter and do not interfere.	26,5
My spouse's parents do not support my choice of profession, as they believe that a woman should pay all attention to her family	10,9

When it comes to support from people other than family and friends, the picture is not clear. In this case, support can be characterized as largely

situational. For example, support in private tuition (courses) is more likely to be provided by teachers, but in higher education female respondents did not feel supported by teachers. In universities, support comes mostly from fellow students. Schooling was also not accompanied by strong support from teachers.

Information from the IDI

Female cybersecurity specialist, 24 years old

School teachers, especially maths teachers, were very toxic, saying things like «you can't do it», «it's hard for you», «prove on the blackboard that you've solved it yourself». At university I was lucky that my teachers were supportive.

Information from the IDI

**Master's female student,
22 years old, majoring in mathematics**

My fellow students helped me the most, because if something was not clear, we would stay in the library after classes and they would explain everything to me. But there was no help from the teachers.

Thus, the study found that perceived social support from the environment in general and from the family in particular is an important factor in STEM identity and STEM engagement formation.

Assessment of the conditions of the educational or work organisation. Organizational conditions in educational or work organizations may have a number of characteristics that organizationally create conditions or barriers to educational or professional motivation.

In the study, female respondents were offered sets of organizational design characteristics to be identified as systemic factors affecting motivation *(Table 3.3.4)*.

Table 3.3.4

Assessment of the extent to which the organization contributes to the realization of each motive (sample as a whole, %)

Motives	Does not contribute at all	2	3	4	Contributes fully
Good conditions for studying or working (technical support, Internet, library, etc.)	4,8	3,3	15,5	27,0	**49,5**
Feeling of success	2,0	3,8	13,8	31,5	**49,0**
High-quality organization of the learning or work process	2,5	3,3	12,8	33,8	**47,8**
Opportunity for growth and improvement of professional competence	3,8	5,8	14,3	31,5	**44,8**
Opportunity for the most complete self-realization in professional activity now or in the future	4,3	3,8	13,0	34,8	**44,3**
Feeling of freedom, decision-making independence	1,8	5,0	14,5	35,8	**43,0**
Satisfaction with the process of activity and achievement of the goal	3,3	5,5	17,0	33,5	40,8
Current or future material wealth	4,5	6,8	21,3	31,0	36,5
Respect from others, social prestige	**9,5**	7,3	21,3	30,8	31,3
Communication with colleagues or classmates	**6,5**	7,3	19,8	37,3	29,8

In organizations where the female study participants study or work, the conditions for study or work (technical support, Internet, library, etc.) fully contribute to the realization of motives (49.5%). The condition of forming a feeling of success in the organization contributes to the realization of motives in 49% of the female respondents. Almost the same effect is possible through qualitative organization of the study or work process (47.8%).

According to the female study participants' assessments, their educational or work organizations contribute to the growth opportunities and improvement of professional competence (44.8%). This indicator is closely related to the pos-

sibility of future self-realization as a professional (44.3%). Being satisfied with the educational or work process and achieving a goal in the organization also contributes to the realization of motives (40.8%).

Attention should be paid to diametrically opposite assessments of such factors as respect from others and social prestige (9.5%). This is the highest indicator demonstrating that educational or work institutions where female study participants study or work do not contribute to the development and realization of motives. Communication with colleagues is also not assessed highly (6.5%). This indicator is indirectly confirmed by gender stereotypes that accompany the education or labor activity of the female study participants.

The comparative analysis by employment groups *(Table 3.3.5)* allows to conclude that such a motive as current or future material wealth is more significant within the framework of organizational conditions for the group of students than for those who work. Meanwhile, this motive is more significant for those who both study and work.

The motive of communication with colleagues or fellow students is more significant for working girls, as the opportunity to share experiences, opinions, and achievements significantly increases the chances of professional growth. However, this factor is less significant for female students, as it is associated with gender stereotypes, the first experience of facing of which is in an educational institution *(Table 3.3.5).*

Table 3.3.5

Assessment of the extent to which the organization contributes to the realization of each motive (by employment groups, %)

Employment groups	Motives	Does not contribute at all	2	3	4	Contributes fully
Study	Good conditions for studying or working (technical support, Internet, library, etc.)	7,6	3,5	12,1	24,7	**52,0**
Working		2,6	3,8	22,4	32,1	39,1
Studying and working		-	-	6,7	20,0	**73,3**
Study	Feeling of success	4,0	3,5	13,1	28,8	50,5
Working		-	4,5	17,9	36,5	41,0
Studying and working		-	2,2	2,2	26,7	**68,9**
Study	Feeling of success	4,0	3,5	13,1	28,8	50,5
Working		-	4,5	17,9	36,5	41,0
Studying and working		-	2,2	2,2	26,7	**68,9**
Study	Satisfaction with the process of activity and achievement of the goal	5,1	6,1	14,6	34,3	39,9
Working		1,9	5,8	23,1	34,0	35,3
Studying and working		-	2,2	6,7	28,9	**62,2**
Study	Opportunity for growth and improvement of professional competence	6,1	7,6	10,1	32,8	43,4
Working		1,3	5,1	20,.5	31,4	41,7
Studying and working		2,2	-	11,1	26,7	**60,0**

Employment groups	Motives	Does not contribute at all	2	3	4	Contributes fully
Study	Opportunity for the most complete self-realization in professional activity now or in the future	6,6	3,5	15,2	30,3	44,4
Working		1,9	4,5	11,5	41,7	40,4
Studying and working		2,2	2,2	8,9	31,1	**55,6**
Study	Feeling of freedom, decision-making independence	3,0	5,1	15,2	30,3	**46,5**
Working		0,6	5,1	16.0	42.3	35.9
Studying and working		-	4,4	6,7	37,8	**51,1**
Study	Respect from others, social prestige	12,1	9,1	22,2	24,7	31,8
Working		7,1	7,1	23,1	36,5	26,3
Studying and working		4,4	-	11,1	37,8	**46,7**
Study	High-quality organization of the learning or work process	4,5	3,5	12,1	33,3	**46,5**
Working		0,6	3,8	17,3	37,2	41,0
Studying and working		-	-	-	0,6	3,8
Study	Communication with colleagues or classmates	6,6	8,6	20,2	32,3	32,3
Working		5,8	7,1	21,2	43,6	22,4
Studying and working		4,4	2,2	13,3	37,8	**42,2**
Study	Current or future material wealth	6,1	6,1	16,7	31,3	**39,9**
Working		3,8	8,3	27,6	28,8	31,4
Studying and working		-	4,4	20,0	37,8	**37,8**

The motive of respect from others and social prestige are more significant for those who both study and work, as in the process of labor activity, the motivation is supported by the social effect of engaging in this professional activity *(Table 3.3.5)*.

The chance to grow and improve professional competence for female respondents who both work and study is more significant compared to other groups of respondents. A similar situation is observed regarding the assessment of creation of organizational conditions for full self-realization in professional activities, which is highly assessed by working and studying female respondents to a greater extent.

It is expected that respondents who both work and study assessed more highly the conditions that are created in the educational and work organization promoting the realization of the motive of satisfaction from the process of activity, achievement of the goal, as they can implement the theoretical knowledge obtained directly in practice.

Working and studying female survey participants assess the organizational conditions that promote a sense of freedom and independence in decision-making more highly. This condition is assessed lower by the female students. The reason for this difference may be the opportunities created in the organization where female students work to have a freer work schedule, as well as the conditions currently created by educational institutions to organize student employment and promote it *(Table 3.3.5)*.

The feeling of success as a result of the conditions in the organization or educational institution is assessed highly by simultaneously working and studying female study participants.

Quality organization of educational or work process contributes more to the realization of female students' motives. Such motive as good conditions for study or work (technical support, Internet, library, etc.) is valued more by those female study participants who both study and work. The reason for this assessment is the value of their time and the need to combine work and study activities, which make it inconvenient to prepare for classes by themselves. In this regard, a good material and technical base both in the educational institution and in the work organization is extremely important in these conditions.

No significant differences in the assessment of the conditions of organizations or educational institutions were found by statistical analysis between female students and employed respondents.

STEM identity (Table 3.3.6) and STEM engagement *(Table 3.3.7)* are the factors that positively influence a more positive assessment of the motives facilitated by the work organization or educational institution.

When comparing female study participants with different levels of STEM identity depending on their employment, a higher expression of STEM identity in the group of employed women influences a more positive assessment of motives.

Table 3.3.6

Average assessment of motives, the realization of which is promoted by an organization or educational institution, depending on the STEM identity level

№	Motives	Average score	
		Low level	High level
1.	Current or future material wealth	3,7	4,1
2.	Communication with colleagues or classmates	3,5	4,0
3.	Respect from others, social prestige	3,5	3,9
4.	Opportunity for growth and improvement of professional competence	3,9	4,3
5.	Opportunity for the most complete self-realization in professional activity now or in the future	3,9	4,3
6.	Satisfaction with the process of activity and achievement of the goal	3,8	4,3
7.	Feeling of freedom, decision-making independence	3,9	4,3
8.	Feeling of success	4,0	4,5
9.	High-quality organization of the learning or work process	4,0	4,5
10.	Good conditions for studying or working (technical support, Internet, library, etc.)	3,9	4,3

Female students with a high level of STEM identity assess more positively the conditions for the realisation of such motives as communication with fellow students, growth opportunities and improvement of professional competence, satisfaction with the activity process, achievement of the goal, feeling of freedom and independence in decision-making, feeling of success, and quality organisation of the learning process.

It is noteworthy that both female students and employed female respondents with high levels of STEM engagement are more positive about the motives facilitated by the work organisation or educational institution.

Table 3.3.7

Average assessment of motives, the realization of which is promoted by an organization or educational institution, depending on the STEM engagement level

№	Motives	Average score	
		Low level	High level
1.	Current or future material wealth	3,6	4,2
2.	Communication with colleagues or classmates	3,5	4,1
3.	Respect from others, social prestige	3,5	3,9
4.	Opportunity for growth and improvement of professional competence	3,9	4,3
5.	Opportunity for the most complete self-realization in professional activity now or in the future	3,9	4,4
6.	Satisfaction with the process of activity and achievement of the goal	3,8	4,3
7.	Feeling of freedom, decision-making independence	3,9	4,4
8.	Feeling of success	4,0	4,5
9.	High-quality organization of the learning or work process	4,0	4,5
10.	Good conditions for studying or working (technical support, Internet, library, etc.)	3,9	4,4

Thus, organisational characteristics of educational or work organisations are assessed more positively in terms of motive realisation at high levels of STEM identity and STEM engagement.

4. Stereotypes and professional identity and engagement

The possible influence of stereotypes on the professional identity and engagement of girls and women was studied through analysing the question about the influence of gender on the choice of profession and stereotypes related to STEM.

The content analysis of the IDI and FGDs with female students shows that gender stereotypes towards girls studying STEM are manifested in study activities. In particular, such stereotypes can be inherent in the closest environment as well as in teachers and students. Meanwhile, it should be noted that gender stereotypes in this case act as driving factors in overcoming difficulties in studies and later in professional activity. At the same time, some female respondents were openly judged during their studies because they were in a homogeneous gender group (male).

Information from the IDI

Female student, 22 years old, majoring in computer science and engineering

When I did homework with the boys, being the only girl among the boys, it was awkward at first. But I stopped paying attention to the whispers, the judgement, I learnt to assert my boundaries...Having changed my attitude towards myself, I changed their attitude towards me. The main pressure was inside the university ... My family, both my mother and father, supported me.

Female students who participated in the IDI noted that stereotypes are manifested when trying to get a job, i.e. when wanting to combine study and work. It is rarely possible to do so, as it is common for employers to refuse when interviewing due to gender and young age. A common explanation from employers is not so much the gender itself, but the likelihood of starting a family and having children in the future. According to employers, this circumstance will not allow one to fully perform functional duties, especially in STEM fields.

Information from the IDI

Female student, 23 years old, technical speciality

Being a girl didn't interfere with my studies... but it was very difficult to get a job. I've been looking for a good job, I want a good salary, I want to recoup my parents' contract costs. Since last year, I've been interviewing at banks, logistics companies... When they find out that I'm not married and will be on maternity leave, they say, «We need a permanent employee. We can hire you as an assistant, since you're a girl... that is a man's job.» It makes it very hard to find a job... Our mentality makes itself felt.

The analysis of the IDI and FGD with girls and women working in STEM allows to say that gender stereotype-related factors negatively affecting personal growth are noted in a number of interviews. These include verbal and social barriers which may include explicit expressions of "sometimes it happens, a broad in robotics". Meanwhile, the result of confronting social stereotypes is the development of the motivation to achieve things and to move on.

Information from the IDI

Manager of the logistics department, 25 years old

Yes, there were times when social stereotypes tried to stop me and at one point, I was even torn in two thinking of quitting everything, but it didn't stop me, I made a very important decision for me and it was for the good of my career, but whether it was for the good of other things, I don't know....

Some working female FGD participants noted that stereotypes manifestation depends on the organisation where professional activity is carried out. When an organisation has clear policies and procedures to counter stereotypes and treat all employees respectfully, regardless of gender, female IDI and FGD participants reported feeling comfortable working in such an organisation.

Information from the FGD

Master of production, 28 years old, secondary specialized education

I was so happy to be here. All the conditions are good, the work is safe. The management always asks us what we need, the foreman adjusts the schedule for us. I used to work at another factory, it was very tough, I was harassed both in terms of salary and working conditions. And here... here it is all about how you carry out your duties and treating everyone with respect. I'm still in shock at how someone can do such a good job.

In general, stereotypes per se had little impact on the education and employment of female IDI and FGD participants. Rather negative impact of age stereotyping is noted by parents. The analysis of the IDI with parents of female students and women working in STEM supports this idea.

Information from the IDI

Mother of a female student, 44 years old, higher education

Not in a bad way, there was no such influence. There was a time when my daughter worked for a construction company in Tashkent. At first, she said, she was underestimated, not because of her gender, but because of her age, because she was still «green». The company had a good attitude towards girls. For example, they didn't stay at work late, those who needed it were allowed to leave if a child got sick or if they needed to go away for family matters.

Parents note that stereotypes do not affect them or their children, as upbringing in the family was based on the values of orientation to one's own life, possibility of choice and support for choice. This is why gender stereotypes had no impact on girls' well-being and self-efficacy, even when there were situations where girls or their parents faced rejection of their educational or professional engagement.

Information from the IDI

Mother of a programming student, 40 years old, secondary education

In our area, I have not seen at all that they spent money on a girl's education and gave her the opportunity to make choices, our girls are taught to bake bread, milk cows. But I say it's never too late to learn housekeeping; when I got married, I had never seen a cow in my life, but I learnt to milk it, but I wish I'd had an education.

Spouses of female students and women working in STEM who participated in the IDI note that the boundaries regarding male and female employment are blurring in modern times, there are many leaders in management among women. They emphasized that there are also a lot of girls and women in the IT at the moment. The interviewees indicated that it is not common for their spouses to be negatively treated because of their gender identity.

Thus, in general, the content analysis of the qualitative data did not reveal clear examples of the gender stereotypes' influence on girls' and women's engagement in STEM professions.

The criteria of expression of stereotypes related to professional choice and professional activity in the questionnaire were:

1. female participants' general assessment of the situation in relation to stereotypes (e.g., "There are few women among students or working in my professional field", "Women do not choose my profession because it is a male-dominated field");
2. assessment of limitations due to traditions (e.g. "Women's participation in my profession is restricted by their parents", "Our mentality and traditions prevent women from working and building a career in my speciality");

3. assessment of personal choice (e.g., "I am constantly proving to myself and others that I am as capable as men as men");
4. susceptibility to stereotypes (e.g., "Male fellow students or male colleagues treat me according to the principle 'Women don't belong in this profession'", "My being a woman does not affect the way fellow students, teachers, colleagues or supervisors communicate with me").

The analysis shows that, in the sample as a whole, female study participants were most likely to agree to varying degrees with statements that

1. fellow students or colleagues treat them as a knowledgeable person and professional rather than as a woman (44.8%);
2. being a woman does not affect the way fellow students, teachers, colleagues or supervisors communicate with them (41.1%) *(Table 4.1).*

However, female respondents noted that there are few women in their professional sphere among students (39.6%) and working people (39.6%). But despite this, female study participants feel comfortable studying or working with men (fellow students or colleagues) (38.3%).

The study showed that the statements "Our mentality and traditions prevent women from working and building a career in my profession" (30.1%) and "Male fellow students or male colleagues treat me according to the principle 'Women don't belong in this profession'" (28.8%) are the ones that female participants agree with the least. However, almost one in three female respondents agreed with these statements.

The question is: "How are the perceptions of the female study participants, conditioned by gender stereotypes about STEM engagement and their personal experiences, manifested depending on social (age, region of residence, employment), educational and professional (year of study, specialty) and psychological (STEM identity, STEM engagement, social support) factors.

Younger female study participants are more likely than those aged 22-55 to hold opinions about the low number of women in the profession, the insufficient number of jobs for them, and the dominance of men in STEM. They are more characterized by perceptions about the negative influence of parents, mentality, and traditions on women's participation in these spheres *(Figure 4.1).*

Table 4.1

Assessment of stereotypes in connection with the STEM choice, %*

№	Motives	Totally agree	More likely to agree	Neither yes nor no	More likely to disagree	Strongly disagree
1	I feel that fellow students or colleagues treat me as a knowledgeable person and professional rather than as a woman	23,8	21,0	20,8	21,5	13,0
2	My being a woman does not affect the way fellow students, teachers, colleagues or supervisors communicate with me	28,3	12,8	21,5	18,8	18,8
3	There are few women among the students studying my profession	19,3	20,3	21,5	22,5	16,5
4	There are few women working in my professional field	18,8	20,8	17,0	28,3	15,3
5	I feel comfortable studying or working with men (fellow students or colleagues)	20,3	18,0	24,8	23,5	13,5
6	Women do not choose my profession because it is a male-dominated field	17,3	19,8	23,5	18,0	21,5
7	Stereotypes about women in my profession did not affect my choice	19,0	16,0	24,5	20,5	20,0
8	I am constantly proving to myself and others that I am as capable as men as men	19,0	15,3	26,0	22,0	17,8
9	Women's participation in my profession is restricted by their parents	16,3	16,8	30,0	16,5	20,5
10	I feel that teachers or colleagues favor my male fellow students or colleagues	16,5	16,5	30,3	20,0	16,8
11	Our mentality and traditions are barriers for women to get an education in my specialty	14,3	16,3	25,5	20.0	24,0
12	The number of jobs for women in my profession is not enough	16,5	13,8	23,3	23,3	23,3

№	Motives	Totally agree	More likely to agree	Neither yes nor no	More likely to disagree	Strongly disagree
13	Our mentality and traditions prevent women from working and building a career in my speciality	16,8	13,3	26,5	18,8	24,8
14	Male fellow students or male colleagues treat me according to the principle "Women don't belong in this profession"	16,8	12,0	21,5	17,5	32,3

*- results are ranked based on the sum of "totally agree" and "more likely to agree" responses

Female study participants aged 22-35 are more likely to prove to themselves and others that they are as capable as men. Younger respondents probably assess the situation based on general ideas about the stereotypes in this sphere. Female study participants aged 22-35 are already guided by their own experience of job search and career building in the professional field *(Figure 4.1).*

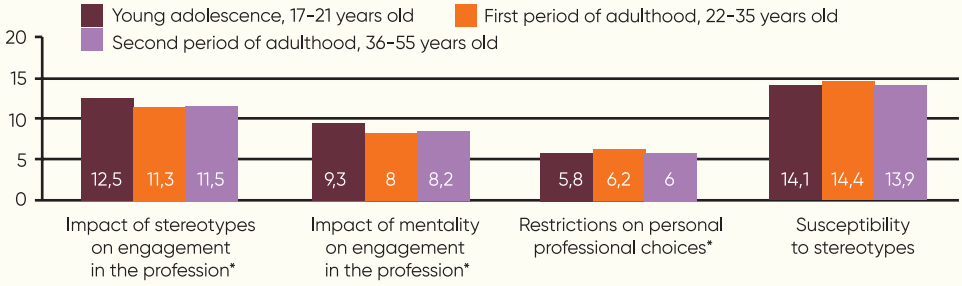


Figure 4.1. Assessment of the representation of women in the profession and personal experience by age (based on average values)

*significant differences are marked

In the regional context, female study participants from Surkhandarya province have more negative assessment of the influence of mentality and traditions on women's participation in STEM, while those from Andijan province have more positive assessment *(Figure 4.2).*

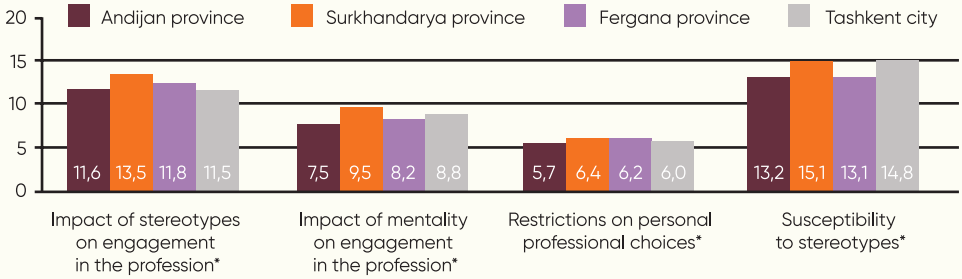


Figure 4.2. Assessment of the representation of women in the profession and personal experience by region (based on average values)

*significant differences are marked

In other words, female respondents living in Andijan province are less likely to hold the opinion that parents' opinions and traditional ideas about women's education and professional activities act as barriers to engagement in STEM professions.

It is noteworthy that female residents of Surkhandarya province and Tashkent city are more susceptible to stereotypes than those of Andijan and Fergana provinces *(Figure 4.2).* For example, they are more likely to feel that men at school or work treat them according to the principle "Women don't belong in this profession". If we compare the expression of stereotypical perception assessment indicators in residents of Tashkent city and other regions, female respondents living in Tashkent are more susceptible to stereotypes, i.e. they feel uncomfortable in a collective because of men's attitude towards them.

Employment of female study participants also acts as a factor influencing their assessment of stereotypical perceptions of women in their professions *(Figure 4.3).* Female students are more likely than working female respondents and those who both study and work to note the influence of stereotypes on women's engagement in the profession. They believe that there are few women both among students and among those working in their professional fields. They believe that women's participation in the profession is restricted by their parents and that mentality and traditions are barriers to education and professional activities in STEM.

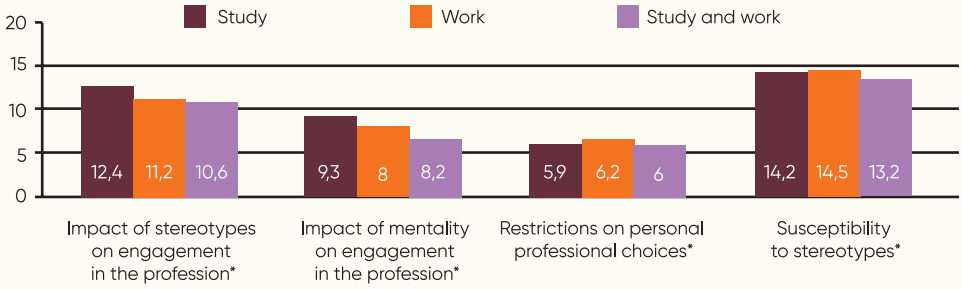


Figure 4.3. Assessment of the representation of women in the profession and personal experience by employement (based on average values)

*significant differences are marked

The stereotype susceptibility is influenced by such educational and professional factor as the year of study in a HEI *(Figure 4.4).*

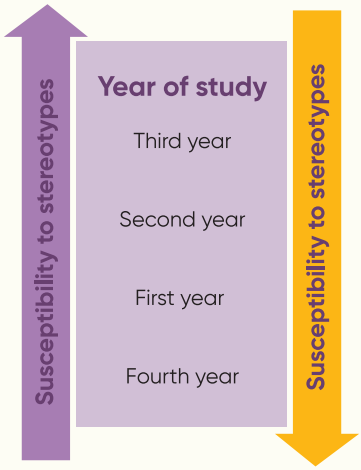


Figure 4.4. Susceptibility to stereotypes by year of bachelor's degree

Studying in the third year, female students may begin to become more engaged in professional activities due to an increase in the number of specialization subjects and internships. It can be assumed that they develop a personal negative experience of being treated as a woman rather than as a knowledgeable person and future professional. The susceptibility to stereotypes decreases as experience is gained in the fourth year of university. This is supported to some extent by the fact that female respondents who both study and work show less susceptibility to stereotyping, although this is not at a statistically reliable level.

The educational specialization and the professional sphere are not factors influencing the manifestation of perceptions related to stereotypes.

STEM identity, STEM engagement and social support perceived by the female study participants act as factors of stereotype susceptibility *(Figure 4.5).*

The lower the emotional, practical, and meaningful STEM identity, STEM recognition, and general STEM identity indicators, the higher the stereotype susceptibility indicators[88]. In other words, the female study participants who perceive their choice as a true calling, are willing to study more in their specialty, are seen by others as specialists in their profession, and see value in their studies and/or work were less likely to note that men treat them according to the principle "Women don't belong in this profession". They were less likely to indicate that they felt that teachers or colleagues favored their male fellow students or colleagues.

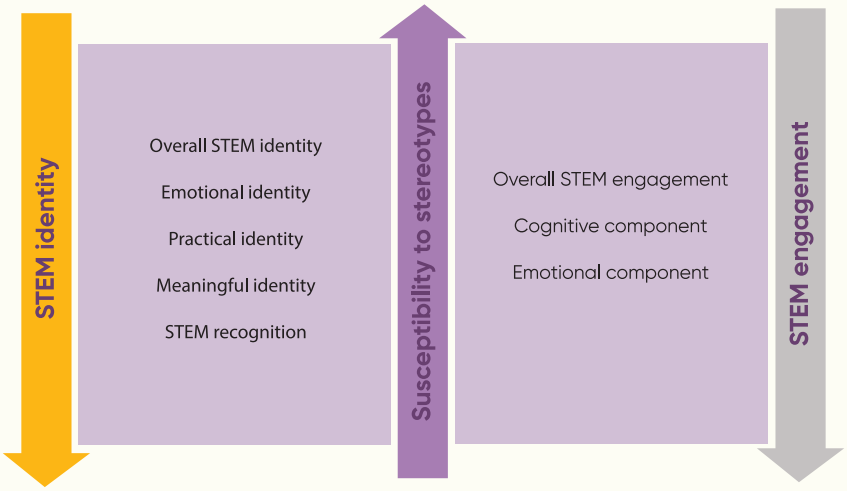


Figure 4.5. Relationship between indicators of STEM identity, STEM engagement, and susceptibility to stereotypes

Moreover, it is important to note that ***emotional identity*** acts as a kind of resource to confront mentality and traditions as barriers to women's education, work and careers in specialty. The same resource is the recognition by others ***(family, teachers, friends, colleagues) of the female study participants as professionals in their field.***

Those female respondents who show their ***engagement at the cognitive and emotional levels are less susceptible to stereotypes.*** They are aware of innovations in their specialty and the need for additional knowledge and skills

88 Based on the correlation analysis between STEM identity, STEM engagement, and stereotype susceptibility indicators, and on the analysis of differences in stereotype susceptibility indicators between female study participants with low and high STEM identity and STEM engagement levels

in the profession. They are happy and satisfied with the opportunity to receive new information, participate in professional community events, and communicate informally with colleagues and friends on professional issues.

The factor of perceived social support contributes to decreased susceptibility to stereotypes *(Figure 4.6).* Female study participants who feel the emotional support of family and friends and have the opportunity to discuss their feelings, problems and decision-making with them more often indicated that they feel comfortable interacting with men in the professional environment. They are less likely to feel the attitude of male fellow students or male colleagues towards them according to the principle "Women don't belong in this profession". The group of female study participants with high levels of social support is more likely to believe that being female does not affect the way they are treated by fellow students, teachers, colleagues, or supervisors.

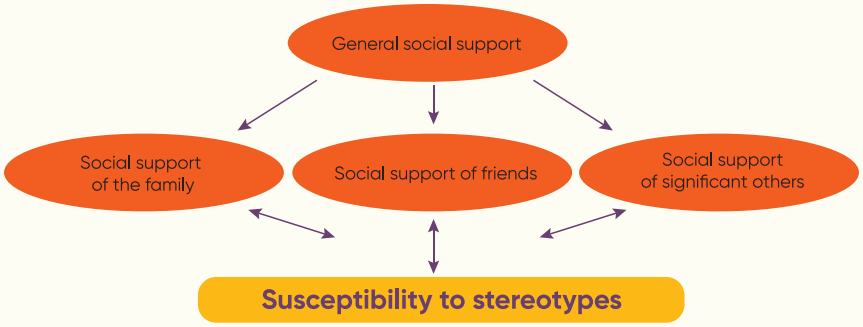
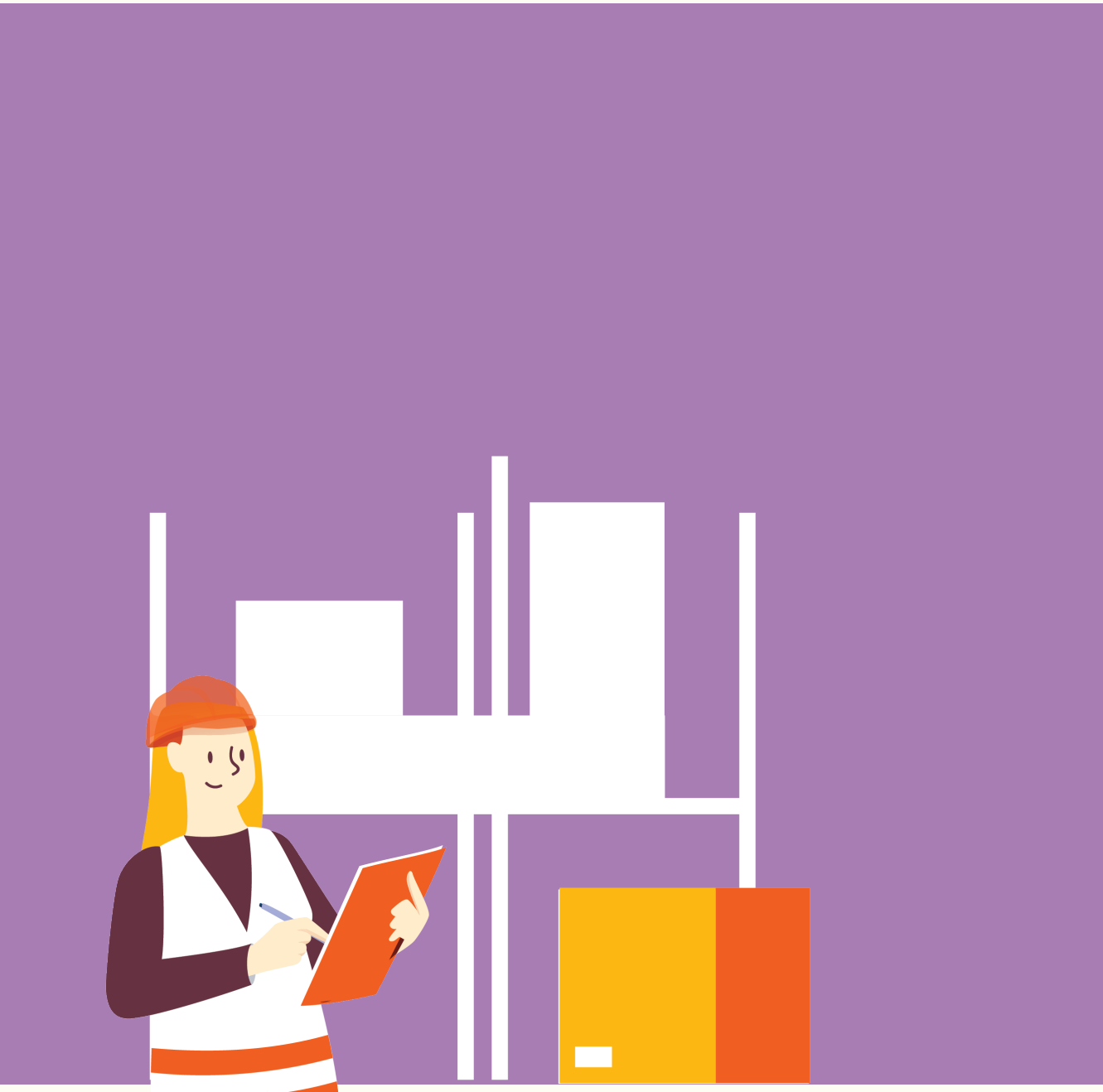


Figure 4.6. Relationship between indicators of social support and susceptibility to stereotypes

The survey also revealed that the fact of being female in general did not matter (57.3%) when choosing a specialization at university or career field. The average score of the gender factor assessment when choosing an educational specialization or career field is low, regardless of the employment factor, STEM identity and STEM engagement levels.

Thus, the resources to counteract stereotypes are work experience in the profession, the number of enterprises and organizations providing employment opportunities at the social level, as well as experience gained during education at the educational and professional level, and STEM identity, STEM engagement, and perceived social support at the personal level.

5. Assessment of future prospects



Future prospects were studied based on several criteria:

1. assessment of the need to implement actions to attract girls and women to STEM;
2. plans for the future after graduation or after 5 years;
3. assessment of the chances of finding a job after graduation;
4. retrospective assessment of the choice of specialty and professional field; and
5. assessment of factors for continuing a career in STEM.

According to the first criterion, the survey revealed that the majority of female study participants consider it important to take actions to increase engagement in the field of specialty and professional activity: 41.3% of them are more likely to agree, and 33.8% of them are totally agree *(Table 5.1).* Meanwhile, 23% of the female respondents express a medium agreement with this statement.

Table 5.1.

Assessment of the need to implement actions to attract girls and women to STEM in the whole sample, %

Answers	%
Totally agree	33,8
More likely to agree	41,3
Both agree and disagree	23,0
More likely to disagree	1,0
Strongly disagree	1,0

According to the second criterion, the absolute majority of interviewed female students plan to work in their specialty in the future (92.1%) *(Table 5.2).*

Table 5.2.

Assessment by female students of plans to work in their field of study after graduation, %

Answers	Sample as a whole	STEM identity		STEM engagement	
		Low	High	Low	High
Yes	92,1	87,7	97,8	90,1	95,2
No	7,9	12,3	2,2	9,9	4,8

Persistence in building a career in STEM is shown by 87.6% of working female study participants who plan to pursue a career in this field after five years *(Table 5.3).*

Table 5.3

Assessment by the working female study participants of the opportunity to work after 5 years in the professional field,%

Answers	Sample as a whole	STEM identity		STEM engagement	
		Low	High	Low	High
Yes	87,6	83,3	90,8	83,8	91,0
No	12,4	16,7	9,2	16,2	9,0

According to the third criterion, it was revealed that 48.6% of female respondents highly estimate their chances of employment in their specialty after graduation. One in five (19.6%) girls who are studying are already employed or have received a job offer.

Table 5.3

Assessment by female students of the chances of finding a job in the professional field after graduation, %

Answers	Sample as a whole	STEM identity		STEM engagement	
		Low	High	Low	High
I am already working or I have already received a job offer	19,6	8,3	34,4	11,5	32,1
I am sure that I will be able to get a job by profession without any problems	48,6	51,2	45,2	51,5	44,0
I think there will be some difficulties in finding a job, but I will find a job by profession	16,4	19,8	11,8	18,5	13,1
I doubt that I will be able to get a job by profession	5,1	5,8	4,3	6,9	2,4
I do not plan to work by profession	7,9	11,6	3,2	8,5	7,1
It is difficult to answer	2,3	3,3	1,1	3,1	1,2

16.4% of female respondents believe that they will still find a job in their specialty if they face certain difficulties in employment. It is necessary to pay attention to those female respondents who do not plan to work in their specialty at all as 7.9% of girls chose this answer.

According to the fourth criterion, a retrospective assessment of the likelihood of choosing a STEM profession, 60.3% of female respondents would choose this specialty, while 23.8% would choose another one. 12.0% of female respondents would adjust their specialty directions while remaining in the same profession they are studying for *(Figure 5.1).*

It is important to note that female students with high STEM identity and STEM engagement levels were more likely to select the option "I am already working or have already received a job offer" when assessing their chances of employment after graduation. The expressed professional identity and engagement in the professional sphere of the female study participants acted as a factor of the same specialty in the retrospective assessment.

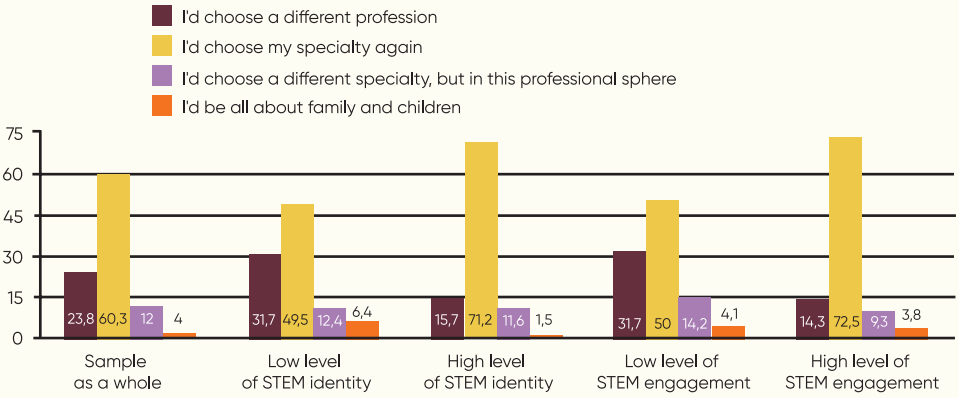


Figure 5.1. Retrospective assessment of the choice of specialty and professional sphere in the sample as a whole and depending on the STEM identity and STEM engagement levels,%

According to the fifth criterion, the factors that determine the continuation of professional activity after 5 years, the following results were obtained. Several groups were identified ***as factors of stability of professional choice:***

1. motives of interest in the profession and self-realization;
2. motives for developing a profession, including its prestige, salary, and working conditions;
3. support of significant others
4. situational motives.

The assessment of the factors of professional choice stability is in fact generally differentiated *(Table 5.4).*

Table 5.4

Factors of stability of professional choice in 5 years, %*

№	Motives	Very strong influence	Significant influence	Neutral	Minor influence	No influence
1	Opportunity for continuous self-development	45,0	37,3	12,5	3,3	2,0
2	Development of the profession in our country	49,0	32,8	12,3	3,0	3,0
3	My abilities	41,0	39,0	13,5	3,5	3,0
4	Being able to do what I am interested in	40,8	38,3	12,8	4,5	3,8
5	Opportunity for career growth	35,8	38,0	17,3	3,3	5,8
6	Demand for the profession on the labor market	38,0	35,8	15,8	3,5	7,0
7	Support from family (e.g., spouse, parents)	40,8	33	15,3	4,8	6,3
8	High competence of colleagues	32,3	40	18,3	4,5	5
9	Getting a high income	31,8	40,3	16,3	5,5	6,3
10	Opportunity to do what is important for people and society and for environmental protection	32,3	36,3	21,8	4,3	5,5
11	Prestige of a profession and its status in society	31,8	35,3	18,8	4,3	10,0
12	Convenient work schedule, possibility to work remotely	25,5	36,8	20,5	6,5	10,8
13	Coincidence	17,8	32,8	25,8	9,0	14,8
14	Following a family tradition	20,0	25,0	24,8	7,8	22,5

*- results are ranked based on the sum of "very strong influence" and "significant influence" responses.

Meanwhile, the female study participants believe that all factors have a significant influence except for coincidence (50.6%) and following a family tradition (45%).

The ranking (Table 5.4) shows that self-development (82.3%), abilities (81.8%), and interest (79.1%) are the dominant factors for the female study participants. The second group of factors is related to the profession development, including its prestige, salary, and working conditions: the factor of profession development in the country (81.8%) ranks second. It is noteworthy that support of relatives (73.8%) is considered by female respondents as a factor that has a significant impact, along with the factors of career growth opportunities (73.8%), demand for a profession on the labor market (73.8%), high competence of colleagues (72.3%), and getting a high income (72.1%).

Female study participants with high STEM identity and STEM engagement levels differ from those with low levels of these characteristics in their assessment of the significance of the stability factors' influence *(Figure 5.2).*

Figure 5.2. Factors of stability of professional choice in 5 years depending on the level of STEM identity and STEM engagement expression

Thus, when STEM identity and STEM engagement levels are high, all factors except those of coincidence and following a family tradition are statistically significantly more highly assessed.

Female study participants who both study and work consider the influence of such factors as the prestige of the profession and its status in society, the career growth opportunities, and high competence of colleagues to be more significant.

In the context of specialization, the factor of convenient work schedule and the possibility to work remotely are considered as significant by the female study participants with education in the field of information and communication technologies.

The analysis of the IDI and FGD data confirms that girls and women who are engaged in STEM professionally assess their professional future prospects highly. However, they are clearly aware of possible difficulties and obstacles related to social barriers and society's rejection of a girl's education in "male" specialties.

Information from the IDI

IT product specialist, 27 years old

IT product specialist, 27 years old Advice to girls considering STEM careers: «STEM tries to find solutions to real problems, to improve lives. It helps connect people to life. Break stereotypes, don't be afraid to try new things and, probably most important, don't be afraid to make mistakes. The more often you make mistakes, the better you understand how things work and the more creative and correct the final result will be.»

Thus, the study shows that factors of self-development, abilities, and interest are most likely to determine respondents' continuation of professional activities after 5 years. A high professional identity and engagement will promote inclusion in the professions.

6. Conclusions and recommendations

The conducted study of social and psychological determinants of behavioral change in girls and women in STEM professions allowed to draw the following conclusions:

1. Behavioral changes in this study were revealed through the extent to which the individual identified with the professional field (STEM identity) and through his or her inclusion in the professional field (STEM engagement). Behavioral changes of female students and women working in STEM are manifested in positive emotional experiences related to the profession, choice to study STEM professions at the bachelor's, master's, and doctoral degrees, regular additional education in the specialty, and professional communication.

2. The STEM identity and STEM engagement expression of the female study participants is independent of the education of their parents or siblings. However, the technical education of the siblings of the female study participants is a factor in developing a sense of recognition of their belonging to STEM, the truth of their calling, and the right choice of the profession.

3. Higher STEM identity and STEM engagement expression is characteristic of female study participants who both study and work. It is the active inclusion in the professional sphere and work experience that contribute to a more conscious attitude to the specialty and independent building of individual trajectories of professional development.

4. Higher STEM identity and STEM engagement expression is characteristic of the female study participants from Andijan and Fergana provinces. The positive experiences related to the profession and desire for additional education are particularly evident among the female study participants from Andijan province. The obtained data can be explained by the number of universities, operating enterprises and organizations in the industry sector in Andijan and Fergana provinces.

5. The specialisation of the professional sphere is a factor that influences the expression of identity and engagement. For example, higher STEM identity and STEM engagement levels were found among female study participants working in the "Natural Sciences, Maths, Statistics" and "Mechanical engineering, Process and Construction".

6. Success and abilities self-assessment by the female study participants is quite high. Higher assessment of their successes and abilities is characteristic of those female study participants who have high STEM identity and STEM engagement expressions and who both study and work.

7. The analysis of the peculiarities of the choice of a profession shows that

- female participants became interested in their profession during adolescence and young adulthood, as well as in early adulthood.
- the choice of profession and specialization can be determined equally by parents (father and/or mother), siblings, grandmothers, and teachers.
- the choice of profession by the female study participants was influenced by competitions or Olympiads in subjects related to their specialisation, reading popular science books and magazines, availability of information about the profession in newspapers, magazines, and on television, watching scientific TV shows, channels, and programmes (e.g. Discovery, TedTalk);
- the dominant motives for choosing STEM professions are the motives of interest in the profession and self-realisation, i.e. the opportunity to do what is interesting, abilities and the need for constant self-development in the chosen sphere.

8. The psychological resources of the female study participants that determine their STEM identity and STEM engagement are their personality traits such as perseverance, self-efficacy, self-control, and reflection. Moreover, the female study participants living in Andijan and Fergana provinces are characterised by greater expression of these qualities.

9. Social support is a key factor of STEM identity and STEM engagement expression. It was revealed that

- perceived social support from the environment in general and from the family in particular is an important factor in STEM identity and STEM engagement formation and a resource for positive professional self-determination;
- parental support is about supporting female study participants' choice of profession, while spousal support contributes to staying in the profession;
- organisational characteristics of educational or work organisations are assessed more positively in terms of motive realisation at high levels of STEM identity and STEM engagement. Meanwhile, the female study participants indicated that the conditions for study or work (technical support, Internet,

library, etc.), formation of the feeling of success, quality organisation of the study or work process contribute to the realisation of their activity motives.

10. The analysis of the possible impact of stereotypes on STEM identity and engagement revealed the following:

- in general, no clear examples of the gender stereotypes' influence on girls' and women's engagement in STEM professions have been revealed. However, female study participants noted that gender stereotypes were more evident during the interview than during the study;
- female study participants most frequently indicated that fellow students or colleagues treat them as a knowledgeable person and a professional rather than as a woman and that being female does not affect the way they are treated by fellow students, teachers, colleagues, or supervisors;
- female study participants realise that there are few female students and employees in their professional sphere, but despite this they feel comfortable studying or working with men (fellow students or colleagues);
- the resources to counteract stereotypes are work experience in the profession, the number of enterprises and organizations providing employment opportunities at the social level, as well as experience gained during education at the educational and professional level, and STEM identity, STEM engagement, and perceived social support at the personal level.

11. When assessing their professional future prospects, the female study participants noted that they plan to stay in their chosen professional field. Almost half of the female students who participated in the study highly assess their chances of being employed in their speciality after graduation, and every fifth girl who studies is already employed or has received a job offer.

12. The factors that will determine the female participants' continuation of professional activities after 5 years are the factors of self-development, abilities, and interest. A high professional identity and engagement will promote their inclusion in the professions.

Recommendations for engaging girls and women in STEM were developed based on research data, as well as data from the literature review and analyses of legal and regulatory documents. The recommendations are based on a systemic approach and take into account micro-, meso- and macro-level factors, i.e. individual, environmental, and social factors.

At the micro level, it is recommended to

- Build interest and motivation for STEM professions and related identity among girls in younger school and teenage years by engaging them in various STEM-related programs (e.g., Technovation competitions, Olympiads, school-based competitions), organizing field classes aimed at introducing them to professions in demand on the labour market, informing them about STEM professions, character of work, and career prospects, taking them on excursions to various industrial enterprises, and meeting with young women and men working in STEM.
- develop interest in STEM professions through the presentation of role models (girls and women from Uzbekistan studying STEM, engaged in STEM professions) in social media, popular science TV channels, TED Talks programs and speeches;
- develop girls and young women's self-efficacy, perseverance in achieving goals, self-control, and reflection as personal qualities through their engagement in school-based personal growth training programs, as well as in computer skills training programs, programming skills programs, and competitions to create mobile applications for the population;
- train female students to prepare a portfolio to demonstrate their professional competences in order to find a job while studying at HEI.

At the meso-level, it is recommended to

- for schools to introduce parents to the prospect of engaging children in STEM professions through joint field classes, meetings with parents engaged in STEM professions;
- develop a gender-sensitive pedagogical culture among teachers, train them in methods of building children's interest in and motivation for STEM professions, and develop children's skills in self-assessment of their own achievements;
- improve professional orientation programs in general education institutions, which will contribute to the empowerment of girls in their choice of profession;
- develop practices at HEIs to promote the attraction of female applicants to STEM specialties and prevent female students from being expelled during their studies. In this context, it is necessary to develop a system of early intervention in girls' education, implying feedback aimed at studying the needs

of female students during the initial phase of education, understanding their expectations of the profession and academic problems;

- for HEI to hold information events for applicants and graduates of secondary schools to increase girls' access to STEM education programs;
- introduce mentoring programs into the education system to get effective feedback during STEM education, consolidate a stable connection between girls and mentors who can monitor academic success, initiate additional activity as participation in master classes, hackathons, research and applied projects, and conferences;
- study and share positive practices of INHA University in Tashkent and Turin Polytechnic University in Tashkent of engaging students in professional activities through the creation of conditions such as support groups for girls, special events that increase interest in the profession and increase engagement in the profession;
- create a system of cooperation between technical universities and industrial enterprises, aimed at further employment of female graduates and mentoring of female students by employees of professional organizations.

At the macro level, it is recommended to

- to implement further policies to support women's education in higher, secondary specialized and professional educational institutions in Uzbekistan at the legal and regulatory level;
- analyze foreign constructive practices to support women and girls in STEM and introduce them taking into account the socio-cultural specifics of Uzbekistan;
- allocate special grants and scholarships, internships on specialty in leading foreign HEIs and enterprises for female students and young women scientists;
- make feature and popular science films about famous women scientists of Uzbekistan and Central Asia;
- film and broadcast television shows about girls and women of today who are studying and working in STEM;
- film and broadcast on social media TED Talks presented by girls and women studying and working in STEM.

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Annex

Annex 1.

List of media interview links

№	Link name	Link
1	Startup Mix PR Corner discussion #6: Shakhlo Turdikulova & Elena Selezneva	https://www.youtube.com/watch?v=PWL-ymvqwt0
2	Saida Yusupova: We choose our own priorities	https://www.youtube.com/watch?v=iMsYkBjzpLI
3	This woman wants more female coders in Uzbekistan	https://edition.cnn.com/2021/12/20/world/female-coders-uzbekistan-spc-intl/index.html
4	Women in tech & science WEEK	https://womenintech.uz/
5	"I cried for nights": Dilbar Dalimova on the creation of the Uzbek vaccine	https://uz.sputniknews.ru/20220217/uchenyy-dilbar-dalimova-ya-plakala-nochami-a-utrom-vse-nachinala-snova-22760987.html?ysclid=l9n87it223420467514
6	Women In Technical Professions In Uzbekistan	https://videozerk.com/watch/5vPskN0A_KqgaCc4uvJh9g/?ysclid=l9s21frwn2345430681
7	More and more women with scientific degrees in Uzbekistan	https://www.youtube.com/watch?v=z_Ft2ObfnjA
8	Success story of a woman entrepreneur from Uzbekistan	https://www.youtube.com/watch?v=K_WmRacYIls
9	Strong women of Uzbekistan: from power to art	https://themag.uz/post/silnye-zhenshhiny-uzbekistana-ot-vlasti-do-iskusstva
10	Strong Gender: 25 Inspiring Stories of Women Entrepreneurs in Uzbekistan	https://www.spot.uz/ru/2019/03/07/women/
11	Nalegke No. 30 - ZAMIRA RAKHMANOVA (TESTO, Korzinka.uz) on difficulties, complexes and successful partnership.	https://www.youtube.com/watch?v=c5MysJEu2bs
12	Zamira Rakhmanova about Childhood	https://www.youtube.com/watch?v=AmeJoQHSErM

Annex 2

Guide for a focus group discussion with students

TOPIC 1. PERSONAL AND PROFESSIONAL PROFILE OF THE RESPONDENT

1. Please tell us a little about yourself. Place of birth. Education. Study experience.
2. Please tell me about your family. What is the social and economic status of the family? Who makes the important decisions in your family? How can you characterize the relationships in your family?

TOPIC 2. CHOICE OF STEM

1. When did you become interested in your chosen specialty? Can you recall any particular childhood experience that contributed to this interest? If so, can you give examples and explain?
2. What does your choice mean to you? Who or what influenced your choice of profession? What key factor influenced your choice of profession?
3. Are hobbies important in STEM? What about hobbies in general? Can you share some of your hobbies that may (or may not) have helped you get involved in STEM?

TOPIC 3. STUDY AND PROFESSIONAL ACTIVITIES

1. Please describe yourself as a student. What are your favorite subjects? What is your favorite thing to do during your studies? Please give us more details.
2. What additional classes do you take? Why? Who encourages you and keeps you interested?
3. What and who helped during your studies? What and who stopped you?
4. Have you noticed any special treatment because of your gender during your studies? Who treated you that way more (classmates, teachers, university administration)?
5. Was there a time when you (or someone close to you) wanted you to quit your STEM studies (job, hobby, both)? What made you stay?
6. Do you have a mentor or friend who inspires you? (someone you know personally)
7. Recall specific situations of support from the environment when you faced difficulties in your studies.
8. What is your daily routine (at school, university, work or home). How does this affect your participation in STEM?

TOPIC 4. FUTURE PLANS AND REFLECTION
1. What advice would you give to girls interested in pursuing a career in STEM?
2. What achievement do you look at and think, «I wish I could go back in time and tell myself that it was possible»?
3. If you could go back and change one thing about your STEM path, what would it be?
4. What advice would you give to women who are 1) interested in STEM, 2) questioning their intentions when choosing STEM-related studies
5. How do you see your future career in STEM? If not in STEM, where? Why?

Guide for a focus group discussion with people working in STEM

TOPIC 1. PERSONAL AND PROFESSIONAL PROFILE OF THE RESPONDENT
1. Please tell us a little about yourself. Place of birth. Education. Study and work experience.
2. Please tell me about your family. What is the social and economic status of the family? Who makes the important decisions in your family? How can you characterize the relationships in your family?

TOPIC 2. CHOICE OF STEM
1. When did you become interested in your chosen specialty? Can you recall any particular childhood experience that contributed to this interest? If so, can you give examples and explain?
2. What does your choice mean to you? Who or what influenced your choice of profession? What key factor influenced your choice of profession?
3. Are hobbies important in STEM? What about hobbies in general? Can you share some of your hobbies that may (or may not) have helped you get involved in STEM?

TOPIC 3. STUDY AND PROFESSIONAL ACTIVITIES

1. Please describe yourself as a student. What were your favorite subjects? What was your favorite thing to do during your studies? Please give us more details. What and who helped during your studies? What and who stopped you?
2. Please describe yourself as a specialist. What do you enjoy most about your job? Please give us more details.
3. Have you noticed any special treatment towards you because of your gender during your studies or at work? Who treated you that way more (classmates, teachers, university administration, management, male staff members)?
4. Was there a time when you (or someone close to you) wanted you to quit your STEM studies and work? What made you stay?
5. Do you have a mentor or friend who inspires you? (someone you know personally)
6. Recall specific situations of support from the environment when you faced difficulties in your studies and work life.
7. What is your daily routine (at school, university, work or home). How does this affect your participation in STEM?

TOPIC 4. FUTURE PLANS AND REFLECTION

1. What advice would you give to girls interested in pursuing a career in STEM?
2. What achievement do you look at and think, «I wish I could go back in time and tell myself that it was possible»?
3. If you could go back and change one thing about your STEM path, what would it be?
4. What advice would you give to women who are 1) interested in STEM, 2) questioning their intentions when choosing STEM-related studies
5. How do you see your future career in STEM? If not in STEM, where? Why?

Annex 3

Examples of FGD collages

Annex 4

Guide for in-depth interviews with female students

TOPIC 1. PERSONAL AND PROFESSIONAL PROFILE OF THE RESPONDENT

1. Please tell us a little about yourself: where you were born, your family, what your family members do, the occupations of your parents.
2. Education and specialization: what kind of education did you get before studying at the university? Have you had any work experience in your chosen specialty?
3. Choice

- What and where did you study that led you to your chosen specialty? How did you choose this university and specialty?
- What does your choice mean to you?
- How would you rate your achievements in your chosen profession?

TOPIC 2. STUDY AND PROFESSIONAL ACTIVITIES

1. What were the characteristics you had as a child that influenced your choice?
2. What did you know about your chosen specialty as a child, teenager and young adult?
3. What are your first positive memories in your life related to your studies?
4. Who or what influenced your choice of profession? Was there anyone who inspired you? What key factor influenced your choice of profession?
5. Have you ever been stopped by factors related to your social environment, to social stereotypes that interfere with technological progress or personal growth? If so, how did you realize this and at what point did you decide to move forward?
6. What and who helped/is helping you during your studies at school, college or lyceum, and now at university? What and who stopped/is stopping you?
7. Are there any difficulties in studying now? If any, which ones
8. How did/are your teachers treat/treating you? Did they support you?
9. What was your family and friends' attitude towards your choice? Did they support you?
10. Please recall specific situations of support from the environment when you faced difficulties in your studies at university.

TOPIC 3. RESPONDENT, STEM AND LIFE
1. What is your normal lifestyle in general and every day? How does this affect your inclusion in your studies and your chosen specialty?
2. First positive memories in life related to the chosen profession.
3. First disappointments in life related to the chosen profession. If there were difficulties, what were they?
4. Have you encountered girls/women being treated a certain way because of their choice of profession? If so, in what way? Can you recall instances where you questioned your participation in STEM because of your gender? Tell us about these instances.
5. If you are employed, who has treated you that way more in your working life?
6. How do you assess yourself? How do you assess your personal qualities that you think helped you in your choice of profession?

Conclusion
1. If you could go back and change one thing about your STEM path, what would it be?
2. What advice would you give to girls or young women who are interested in STEM?
3. If you meet a girl or young woman who wants to study in STEM (your chosen specialty),
• what message will you give her if she hesitates?
• what message will you give her if she wants to quit her studies/work one day?

Guide for in-depth interviews with working people

TOPIC 1. PERSONAL AND PROFESSIONAL PROFILE OF THE RESPONDENT
1. Please tell us a little about yourself: where you were born, your family, what your family members do, the occupations of your parents.

2. Education and specialization: what kind of education did you get before studying at the university? What higher educational institution did you graduate from and in what specialty? Did you have work experience in your chosen specialty during your university studies? If yes, what kind of experience?
3. Choice

- What and where did you study that led you to your chosen specialty? How did you choose this university and specialty?
- What do you do now? How did you choose your field of work to date?
- What does your choice, i.e. the choice of specialty and the activity you are doing now, mean to you?
- How would you rate your achievements in your chosen profession?

TOPIC 2. STUDY AND PROFESSIONAL ACTIVITIES

1. What were the characteristics you had as a child that influenced your choice?
2. What did you know about your chosen specialty as a child, teenager and young adult?
3. What are your first positive memories in your life related to your studies?
4. What are your first positive memories in your life related to your professional activities?
5. Who or what influenced your choice of profession? Was there anyone who inspired you? What key factor influenced your choice of profession?
6. Have you ever been stopped by factors related to your social environment, to social stereotypes that interfere with technological progress or personal growth? If so, how did you realize this and at what point did you decide to move forward?
7. What and who helped/is helping you when you were at school, college, university and now at work? What and who stopped/is stopping you?
8. Are there any difficulties in the work now? If any, which ones
9. How did/are your former teachers treat/treating you? Did they support you? What about your family and friends?
10. Please recall specific situations of support from the environment when you faced difficulties in your professional activities..

TOPIC 3. RESPONDENT, STEM AND LIFE
1. What is your normal lifestyle in general and every day? How does this affect your inclusion in the profession and your professional activities?
2. First achievements and disappointments in life due to the chosen profession. If there were difficulties, what were they?
3. Have you encountered girls/women being treated a certain way because of their choice of profession? If so, in what way? Can you recall instances where you questioned your participation in STEM because of your gender? Tell us about these instances.
4. If you have been treated in a special way in your working life because of your gender, by whom?
5. How do you assess yourself? How do you assess your personal qualities that you think helped you in your choice of profession and that help you now?

Conclusion
1. If you could go back and change one thing about your STEM path, what would it be?
2. What advice would you give to girls or young women who are interested in STEM?
3. If you meet a girl or young woman who wants to study in STEM (your chosen specialty),
• what message will you give her if she hesitates?
• what message will you give her if she wants to quit her studies/work one day?

Guide for in-depth interviews with parents

TOPIC 1. PERSONAL AND PROFESSIONAL PROFILE OF THE RESPONDENT
1. Please tell us a little about yourself: where you were born, your family, how many children you have, what your family members do, the occupations of your parents.
2. Education and specialization: what kind of education did you get? What is your occupation? Your attitude towards your choice

TOPIC 2. ABOUT THE CHOICE OF A DAUGHTER

1. When did you notice your daughter's interest in her chosen specialty, her abilities? Please recall specific situations.
2. What characteristics of your daughter influenced her choice of university, specialty, and profession?
3. Which members of your family influenced your daughter's choice? What do you think your daughter's choice means to her?
4. Was there anyone who inspired your daughter to make her choice? What key factor influenced her choice of profession?
5. What features of your family, your upbringing and communication with your daughter influenced her choice? And what features are helping her now?
6. How would you rate your daughter's achievements in her chosen specialty? What qualities of hers will help her to follow her chosen path?
7. Who (what) helps or will help your daughter to follow the chosen path?

TOPIC 3. CHOICE OF DAUGHTER AND POSSIBLE BARRIERS

1. Have you ever been stopped by factors related to your social environment, to social stereotypes, that made you think that your daughter's choice is not common for a girl? If so, what are the factors. Please give examples.
2. What was the attitude of relatives and friends towards your daughter's choice?
3. Has your daughter encountered girls/women being treated a certain way because of their choice of specialty? If so, in what way? Can you recall instances where she questioned her participation in STEM because of her gender? Tell us about these instances. What did you tell her?

Conclusion

1. If you could go back and change one thing about the way your daughter was raised, what would it be?
2. What advice would you give to parents whose daughters are interested in STEM?
3. What message would you give to a girl or young woman who wants to study STEM,

- what message will you give her if she hesitates?
- what message will you give her if she wants to quit her studies/work one day?

Guide for in-depth interviews with spouses

TOPIC 1. PERSONAL AND PROFESSIONAL PROFILE OF THE RESPONDENT

1. Please tell us a little about yourself: where you were born, your family, how many children you have, what your family members do, the occupations of your parents. When and how did you meet your spouse?
2. Education and specialization: what kind of education did you get? What is your occupation? Your attitude towards your choice

TOPIC 2. ABOUT THE CHOICE OF SPOUSE

1. What do you think your wife's choice of university and specialty (if she is studying) and/or professional activity means for her?
2. When and how do you think your wife's interest and abilities in her chosen specialty were formed? Who/what influenced her choice?
3. What characteristics of your wife influenced her choice of university, specialty, and profession?
4. How would you rate your wife's achievements in her chosen specialty? What qualities of hers will help her to follow her chosen path?
5. Who (what) helps or will help your wife to follow the chosen path?

TOPIC 3. CHOICE OF SPOUSE AND POSSIBLE BARRIERS

1. Each member of the family has his or her own responsibilities. What qualities of yours and characteristics of your family help your wife to fulfill her responsibilities and work (study)?
2. What was the attitude of relatives and friends towards your wife's choice?
3. Has your wife encountered girls/women being treated a certain way because of their choice of specialty? If so, in what way? Can you recall instances where she questioned her participation in STEM because of her gender? Tell us about these instances. What did you tell her? How did you support her?

Conclusion
1. What advice would you give to parents whose daughters are interested in STEM?
2. What message would you give to a girl or young woman who wants to study STEM,
• what message will you give her if she hesitates?
• what message will you give her if she wants to quit her studies/work one day?

Table 1. Associations with STEM (N=414)*

№	Groups of selected categories	N	%
1.	Equipment	39	9,4
2.	Opportunities	35	8,5
3.	Mathematics	34	8,2
4.	Programming	31	7,5
5.	Science	26	6,3
6.	It	22	5,3
7.	Development	18	4,3
8.	Future	17	4,1
9.	Complexity	17	4,1
10.	Engineering	16	3,9
11.	Innovations	13	3,1
12.	Study	13	3,1
13.	Business	11	2,7
14.	Creativity	10	2,4
15.	Labor	10	2,4
16.	Computers	9	2,2
17.	Competence	9	2,2
18.	Intelligence	9	2,2
19.	Skills	8	1,9
20.	Career	7	1,7
21.	Algorithm	7	1,7
22.	Modernity	6	1,4
23.	Production	6	1,4
24.	Results	6	1,4
25.	Logic	5	1,2
26.	Data	5	1,2
27.	Interest	5	1,2
28.	Cooperation	5	1,2
29.	Artificial intelligence	4	1,0
30.	Robots	4	1,0
31.	Discoveries	3	0,7
32.	Language	2	0,5
33.	Sexism	2	0,5

* N - number of associations obtained with the Associations technique

*Figure 1. Associations with STEM (N=414)**

Table 2. Associations with qualities that influence success in STEM (N=413)*

№	Groups of selected categories	N	%
1.	Interest, motivation	46	11,1
2.	Knowledge	42	10,2
3.	Creativity	38	9,2
4.	Analytical thinking, intellect, quickness	35	8,5
5.	Grit	33	8,0
6.	Communication skills	21	5,1
7.	Skills	20	4,8
8.	Responsibility	20	4,8
9.	Purposefulness	19	4,6
10.	Self-improvement	17	4,1
11.	Attentiveness	14	3,4
12.	Resilience	14	3,4
13.	Assiduity	12	2,9
14.	Hard work	10	2,4
15.	Activity	9	2,2
16.	Logic	9	2,2
17.	Learnability	8	1,9

№	Groups of selected categories	N	%
18.	Languages	7	1,7
19.	Self-efficacy	7	1,7
20.	Punctuality, accuracy	7	1,7
21.	Memory	6	1,5
22.	Experience	5	1,2
23.	Curiosity	5	1,2
24.	Teachers	3	0,7
25.	Multitasking	2	0,5
26.	Finance	2	0,5
27.	Heredity	1	0,2
28.	Maturity	1	0,2

* N - number of associations obtained with the Associations technique

Figure 2. Associations with qualities that influence success in STEM

Annex 6

Questionnaire sections and study methodology

№	Questionnaire section	Questions and psychological techniques	Description of psychological techniques	No. of questions/ statements
1	Social and demographic data about the respondent	Questions about age, education, marital status of female respondents, children, their employment, self-assessment of their financial situation, place of residence, etc.		14 questions
2	Choice and motivation for choosing a profession.	Interest in the profession, evaluation of time periods, evaluation of the role of people who influenced the choice, evaluation of different practices, motives for choosing the profession		5 difficult questions
3	Professional identity and engagement in the profession	Success and abilities assessment		2 questions
		Identity Scale	• Emotional identity • Identity related to practices • STEM recognition • Meaningful identity • Overall STEM identity indicator	20 statements
		Engagement scale	• Cognitive component • Emotional component • Behavioral component • Overall STEM engagement indicator	15 statements

№	Questionnaire section	Questions and psychological techniques	Description of psychological techniques	No. of questions/ statements
4	Assessment of significant qualities	A. Duckworth's Grit Scale, adapted by T.O. Gordeeva, E.N. Osin	• Consistency of interest • Persistent efforts	12 statements
		Both control and self-efficacy scale	• Control • Self-efficacy	10 statements
		Reflection in difficult study or work situations	• Reflection	5 statements
5	Social support	Social support scale	• Social support of the family • Social support of friends • Social support from significant others • Overall social support indicator	12 statements
		Questions about support from parents, spouse, spouse's family		3 questions
		Resource assessment of the organization		10 statements
6	Stereotypes	Scale of stereotypes and stigmatization		14 statements
		Question about career choice in relation to gender		1 question
7	Future prospects	Questions about plans		5 questions

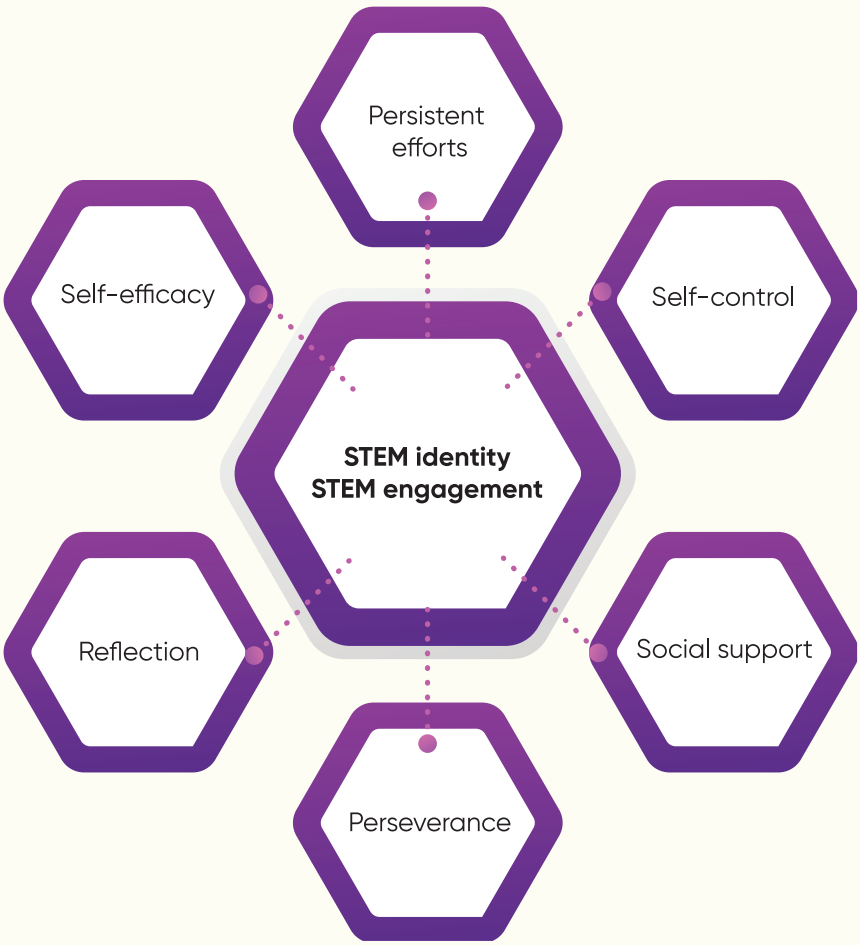

Figure 1. Relationship of STEM identity, STEM engagement, and psychosocial resources

Correlations of psychological indicators of STEM identity and STEM engagement, N=400

	Emotional identity	Practical identity	STEM recognition	Meaningful identity	STEM identity
Cognitive component of STEM engagement	,502**	,433**	,555**	,508**	,595**
Emotional component of STEM engagement	,484**	,425**	,492**	,532**	,569**
Behavioral component of STEM engagement	,434**	,401**	,513**	,428**	,533**
STEM engagement	,525**	,469**	,576**	,538**	,627**

Note:* - p < 0.05 **- p < 0.01

Correlations of psychological and STEM identity indicators, N=400

	Emotional identity	Practical identity	STEM recognition	Meaningful identity	STEM identity
Consistency of interest	,136**	-,064	,028	,127*	,074
Persistent efforts	,465**	,389**	,444**	,447**	,519**
General perseverance	,391**	,190**	,298**	,405**	,389**
Self-efficacy	,322**	,194**	,256**	,458**	,356**
Self-control	,441**	,388**	,370**	,546**	,506**
Reflection	,350**	,339**	,300**	,393**	,404**
Social support of the family	,236**	,171**	,241**	,316**	,284**

	Emotional identity	Practical identity	STEM recognition	Meaningful identity	STEM identity
Social support of friends	,058	,032	,098	,112*	,096
Social support from significant others	,205**	,213**	,205**	,282**	,266**
General social support	,191**	,163**	,213**	,275**	,251**

Note:* - p < 0.05 **- p < 0.01

Correlations of psychological and STEM engagement indicators, N=400

	Cognitive component of STEM engagement	Emotional component of STEM engagement	Behavioral component of STEM engagement	STEM engagement
Persistent efforts	,442**	,510**	,458**	,520**
General perseverance	,301**	,385**	,276**	,352**
Self-efficacy	,304**	,365**	,222**	,325**
Self-control	,442**	,489**	,411**	,485**
Reflection	,398**	,410**	,374**	,428**
Social support of the family	,202**	,221**	,165**	,225**
Social support of friends	,169**	,128*	,122*	,152**
Social support from significant others	,233**	,261**	,191**	,255**
General social support	,245**	,238**	,204**	,254**

Note:* - p < 0.05 **- p < 0.01