

Research Report

**Studies of Labor Demand, Barriers to
Participation in STEM Education
Programs and Occupations in Georgia**

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Foreword

The Government of Georgia (*GOG*) has identified low quality of human capital in general and specifically a shortage of skilled technicians and professionals in the areas of science, technology, engineering and mathematics (***STEM***) as binding constraints to Georgia's long-term economic growth and development. In addition, it was determined that despite of their superior performance in school mathematics and science – a smaller share of young women than young men are applying to and graduating from post-secondary STEM programs, which deprives Georgia of the benefits of these highly performing students.

The Government of Georgia has noted that students from socially disadvantaged groups (ethnic minorities, rural students, students from poor families) underperform in STEM areas, which suggest that quality of secondary STEM programs may be lower in schools serving these groups.

A group of *IPM researchers* traced the journey through school to further education and then onto employment to see why are so few women and marginalized aspire for a career in hard sciences.

This report focuses on practical ways that families, schools and communities can create an environment of encouragement that can disrupt negative stereotypes about women's capacity in these demanding fields. By supporting the development of girl's confidence in their ability to learn math and science, we may help motivate interest in these fields. Yet more work is needed to ensure that women and socially disadvantaged have full access to educational and employment opportunities in science, technology, engineering and mathematics.

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Studies of STEM Education and Occupations in Georgia: Barriers and Opportunities

EXECUTIVE SUMMARY

This report is the outcome of a major research project carried out by IPM Research over a period of 5 months starting in July 2013.

Overview of the findings

Study 1: Female participation in post-secondary STEM programmes

If we trace the journey through school to further education and then onto employment we can see that:

Georgia participated in the PISA 2009 international benchmarking exercise. These results show a clear picture: Georgia's overall performance in STEM subjects is below the OECD average.

Georgia also participated in the 2011 TIMSS benchmarking and this showed that Georgian eighth grade students' performance in mathematics and science is lower than the centre point of the TIMSS scale. The centre point is 500 and Georgian students are averaging at around 420 with chemistry lower and biology higher. Girls outperform boys by a margin of a few points except in Physics where boys do better by a margin of 2 points.

The pattern of girls outperforming boys is seen in the Computer Adaptive Test (CAT); in 2011 and 2012 girls outperformed boys in all STEM subjects both in the average scores and in the percentage gaining the highest pass grades.

The Unified Entry Examinations (UEE) showed girls marginally doing better except in math, where girls do significantly better than boys. However, more boys took the UEE in STEM subjects

Given that girls do at least as well if not better than boys in STEM subjects, the question arises as to why fewer girls than boys enter STEM careers.

The examination of admissions to TVET and Higher Education Institutes (HEI) shows that boys' admissions exceed those of girls. Girls had 24% of admissions to TVET in 2012 which was an improvement on previous years. Girls' share of bachelor STEM admissions in 2012 was 31%. Girls' admission to masters degrees in STEM subjects in 2012 was 25% and to doctoral degrees was 42%. However, doctorates gained by females in 2012 were 47% of the total.

Something is clearly happening between school and admission to TVET and HEI.

The quantitative and qualitative research shows that girls consistently undervalue their performance in STEM subjects compared to boys.

The qualitative evidence showed that there were a number of factors at work. These included parental and wider societal influences, attitudes of teachers and the relative willingness of parents to invest for girls as opposed to for boys in enrichment teaching for girls or in the costs attached to study in post-secondary education away from home.

The evidence from the 2009 PISA showed that enrichment classes were taken by 43.6% of boys and 38.3% of girls; the figures for science were 24.4% and 21%: more boys get enrichment classes than girls.

TVET and HEI faculty members were asked if they thought schools were encouraging girls as much as boys to aim for STEM careers. Only 12% of TVET faculty thought so but 62% of HEI faculty did. **This shows a clear difference between HEI and TVET; girls are not encouraged so much to pursue vocational training for STEM careers.**

A Georgian nationwide study in 2013 showed that 20% of the population still regards school education as more important for boys than girls, and 26% say the same about University education.

Students at TVET and HEI indicated that family influences still play a role in influencing students' choices of careers.

The qualitative focus groups showed that there are ingrained gender based stereotypes.

There was no evidence that teachers themselves have conscious gender bias but there was evidence to suggest that teachers gave more encouragement and positive feedback to boys. In the qualitative research girls repeatedly said that the attitude as well as the skill of the teacher towards them as girls was an important factor in their academic success.

This unconscious bias is shown in the nature of textbooks that show mainly male images and in the information and career guidance that girls receive at school: they perceive it to be lower than boys do.

The research showed no evidence that achievement of scholarships is a gender issue for University admissions. However, boys are almost twice more likely to receive a TVET scholarship than girls. The opposite situation arises for University study, where girls and members of socially disadvantaged groups have the higher share.

There was clear evidence of labour market barriers coming from the IPM Research survey of 150 employers.

The survey showed that employers believe that their working conditions for females are either excellent or good (75.3%), yet 74.7% of them have no special benefits for pregnant women, no maternity benefits (80%) and according to the absolute majority they have no child day facilities.

Also 92% saw no benefit in increasing their female representation in their work forces.

26.7% of employers recognized that there is gender inequality towards women but 91% assume that there are no barriers for women joining their workforce.

It is clear that there are barriers for female engagement but employers do not seem to be aware of it or aware of what could be done.

The key recommendations are

- A school programme to eliminate gender stereotyping, directed at parents, schools and school students
- An awareness raising programme in schools to show that STEM jobs are for women as well as men.
- Gender awareness to be a part of ongoing teacher continuing professional development

- Universities & TVETS to be encouraged to set up Gender Officer positions to facilitate gender equality in all aspects of the institutions' lives
- Career guidance in schools is a clear need. It needs to be incorporated into the work of each school and should involve local employers and the Employment Service who would provide realistic and up to date information
- An information campaign for employers about:
 - The benefits of increased female participation in their work force.
 - Clear information about what is needed to make firms friendly places for female workers (as it's clear most do not know)
 - Demonstration of what are the barriers and how they can be overcome
- Better information about scholarships to be available in all areas, particularly for girls and socially disadvantaged groups
- Target scholarships at under-represented groups (already being done for the specific socially disadvantaged scholarship)

Study 2: Barriers to the Participation of Socially Disadvantaged Students in STEM Programs

Social disadvantage in Georgia is classified in four main categories: ethnic minorities, low income families under the poverty threshold, families from remote high mountain areas and others, including those displaced as a result of conflict.

In the IPM Research survey, 45% of school teachers had experience of teaching socially disadvantaged students. Most of these teachers do not think that socially disadvantaged students study STEM subjects better than other students, 58% think that there is no difference in teaching socially disadvantaged students as opposed to the others. Most teachers do not think that socially disadvantaged students have any barriers in studying STEM subjects. However, **76% perceive an issue with parents not permitting their children to continue to study and for 8% there is an issue with affordability of books.**

Teachers reported, 53% that they thought that parents of socially disadvantaged students could be more involved in their children's education but has few ideas on how to achieve this.

The main barrier that teachers identified is to do with parental support both for children at school and in supporting continuation of studies. The focus groups did show that low family income and affordability of continuing study is an important factor.

It appears that teachers lack awareness about the special challenges that socially disadvantaged students have such as language, poverty, inability to purchase enrichment teaching which is common amongst school students, low parental engagement in their education and high parental influence into student choices.

Socially disadvantaged students at University, looking back at their schools, evaluated the quality of teaching in STEM subjects primarily as: math, excellent or very good, physics, average, chemistry, biology and geography as excellent or very good. The equivalent group at TVET rated all subjects primarily as average. This pattern is in agreement with the whole survey: students who go to University tend to rate their school STEM teaching quite highly whereas TVET students tend to rate it as average. This may indicate that teachers are not reaching the less able students as well as those of higher ability.

Socially disadvantaged students when asked at HEI and TVET themselves evaluated the school teaching of STEM subjects as satisfactory, which is significantly lower than the evaluation of HEI by non-disadvantaged students but not lower than the evaluation of TVET by non-disadvantaged students. Physics and chemistry were the lowest rated subjects, but this agrees with the reports from all students, not just the socially disadvantaged ones, however socially disadvantaged students find these harder.. This finding is also supported by the focus groups, so we can conclude that socially disadvantaged students, in the main, find STEM subjects, particularly physics and chemistry, hard and they receive less support at home. These points to the need to invest in improving the learning experience for socially disadvantaged students at school.

Neither TVET or HEI faculty believe that schools are doing a good job of teaching STEM subjects for preparation for post-secondary education or for employment in the sector.

Socially disadvantaged school students received similar information about universities as the population in general; the difference was with TVET, where only 26.2% got information compared with 73% in general.

Career guidance is another area where socially disadvantaged students received less advice than the population but only in relation to careers where the pathway was TVET. When the pathway was University, there was no difference.

The survey only addresses what students say they heard, it cannot address what might have been communicated but not heard. These results show that there may be a need for schools to take extra care in communicating information and guidance to socially disadvantaged students.

59.5% of socially deprived undergraduates stated that they did not receive information about government scholarships for studying in higher educational institutions at school. Only 14.3% of TVET students reported hearing about relevant scholarships. **The main source of scholarship information about TVET was the TVETs themselves, not the school.** The scholarship is quite important for TVET students as well, considering that 66.7% of them stated that they would not have been able to continue studies unless they had financial support.

The scholarships that the socially disadvantaged undergraduates had heard about include scholarships for: socially unprotected people, for large families and for students from the high mountain regions.

However, 90.5% of socially disadvantaged undergraduate students have had scholarships while studying at higher educational institutions. In most cases it was provided by the state/government. It should be noted that **more than half of the socially disadvantaged undergraduates (55.2%) stated that they would not have been able to continue their studies if they had not had that financial support.**

This points to the need for schools to have a clear approach to informing socially disadvantaged students about **all** of the scholarship opportunities open to them as the scholarship is so important for these students as confirmed in the focus groups as well.

Once at university or TVET, socially disadvantaged students rate the work of their faculties highly; 59% say it is good. This compares to the following for the

population as a whole: 80% of university students interviewed think their teachers know their subjects well; for TVET respondents the figure is 94%. The ability of teachers to explain subjects to students is rated at 72.7%, with university respondents and 91% with TVET students interviewed.

Teachers' ability to develop the skills of the student is rated as good by 68% of university respondents while 91% of TVET students interviewed rate their teachers' ability to develop the skills of the student as good. Although the socially disadvantaged ratings are lower than the population as a whole they are still high, which indicates that most of them are able to respond well to the teaching although not as many as the general population. This may reflect socially disadvantaged students finding their studies somewhat harder than their non disadvantaged peers.

Nonetheless, socially disadvantaged students do not perceive their circumstances as being a barrier to a successful STEM career. 66.7% of the University students in the sample see no barriers, and the figure for TVET is 81%.

Socially disadvantaged students' evaluation of their University or TVET is highly positive. This indicates that when socially disadvantaged students arrive in University or TVET, they might find the subjects hard but they do have belief in their ability to win through to a career and they do appreciate the support they receive.

Once these students find their way to employment they find that employers do not create any special support for them, they have to make their own way without any consideration of their particular needs

The FGD conducted with ethnic minorities indicates that the knowledge of Georgian language is one of the main obstacles for equal accessibility for education.

The presented statistics show that a high percentage of students (64%) applied for the preparation courses in the Georgian language in 2011; rising to 69% in 2012. Special program presented for ethnic minorities. On one hand that means that the language program works well; on the other hand, it shows that there is still a challenge for ethnic minorities to get a satisfactory education in the Georgian language in secondary schools.

The key recommendations are:

- An organized plan to enable socially disadvantaged students to study on an equal basis with all other students. The plan would address the specific difficulties that socially disadvantaged students face.
- Better information (informational meetings organized by HEI_TVET, Teachers guidance to present resources and information about recourses and specialisation at HEI_TVET, involvement of regional recourses centres of MoES) about scholarships to be available in all areas in a planned and organized way particularly targeting girls and socially disadvantaged groups.
- Socially disadvantaged ethnic minority students need strong language support in school and this needs to be organized possibly using special language 'enrichment' teachers.
- The one year program for ethnic minorities to improve their Georgian language skills to the point that they can enter post-secondary education needs to be evaluated for outcomes in terms of pathways into education and employment so that it can be continuously improved.

- A program to counter cultural attitudes in socially disadvantaged communities about education and careers for girls as well as boys
- Improved career guidance
- TVET programs to support socially disadvantaged students in the following dimensions: increasing financial support through scholarship, implementing internship for socially disadvantaged students.
- A Corporate Social Responsibility program to encourage employers to recruit and retain socially disadvantaged workers (links to recommendation about increasing female engagement in the work force in Study 1). Namely, the teachers and other target groups (faculty members, companies) should be aware about the specific problems of socially disadvantaged students and elaborate the ways how they can support this group to overcome these obstacles.
- Databases for socially disadvantaged students need further development – It would be useful to know number of socially disadvantaged students by years in different sections and by HEI/TVET to make appropriate conclusions and implement different activities based on these statistics to improve involvement of such students in HEI or TVET.

Study 3: Labour Market Demand for STEM Occupations

STEM employers maintain that they have difficulty recruiting skilled STEM workers when needed. This holds true for operators, technicians and technical managers. 44% of employers say that they can recruit STEM operators, 38.7% say that they can recruit STEM technicians and 38% say that they can recruit technical managers. When asked about the reasons for this, the main answer was that there is a shortage in the country and that the skills are not being developed.

Many skills in short supply, but the main STEM positions reported as hard to fill are: software engineer, engineers, technicians, electricians and fitters. The typical action taken to overcome the skill shortage was to conduct internal training and sometimes to contract external training.

There is evidence of graduate unemployment and underemployment. This is linked in part to the alignment of educational institutions' outcomes with employer expectations but it is also linked to employer uncertainty about what skills will be needed in the future.

When asked what actions employers take to find recruits the overwhelmingly most frequent response was to ask a colleague to recruit staff, followed by announcing a vacancy. **This means that employers are using their own networks to find recruits rather than getting in touch with HEIs or TVETs.**

HEI students rate their school teaching in Math as excellent or very good but TVET students rate it much lower.

In Physics HEI less than a third of students rate their teaching as excellent or very good but there is a gender difference: only a fifth of female HEI students rate it as excellent or very good. A third of TVET and a fifth of HEI students rate their Physics teaching at school as poor or very poor, showing that there is an issue with Physics teaching. The lack of laboratories, practical teaching and high quality textbooks are quoted as issues.

The student ratings for teaching of Chemistry at school are marginally better than for Physics.

Students were quite positive about school teaching helping them to pass their examinations yet we know from PISA 2009 that 43.6% of boys and 38.3% of girls at Grade 9 had enrichment lessons in Math and 24.4% of boys and 21% of girls had enrichment lessons in Science.

Employers were quite critical of STEM teaching in schools with only 22.6% thinking schools were doing a good job in this. Employers were even more critical of schools' awareness of the realities of the labour market with only 7.3% taking a positive view.

It is clear that secondary school students are much less aware of what STEM jobs than post-secondary school students. About a half of HEI students were aware of STEM jobs at school, except for science where awareness was lower at about a third. The awareness for TVET students was lower at around a third of respondents again except for science where it was about a fifth. There was a gender bias with girls being much less aware except for Math jobs where there was no difference.

This relates to career guidance: 35.3% of University students received career guidance at school; the figure for TVET was 31.0%.

STEM jobs are perceived to be attractive according to the survey of students already doing STEM related post-secondary education but more so by those that go on to HEI than to TVET and there is evidence of some gender bias amongst students and teachers both at the level of 16-18%

Information about the post-secondary institutes is also not getting through to the schools as much as it could. About a third of students got information about specific HEIs at school but the figure for TVET was much lower at 17%.

Awareness about pay rates for STEM jobs while at school is about 25% with Universities higher than TVET students.

Employers were asked about the linkage between school and TVET. Most were unaware of any links but 28% thought the linkage was satisfactory.

Knowledge of scholarships is patchy, with about equal numbers receiving information at school and not receiving it.

Students at HEI and TVET rate their faculty highly in terms of knowing their subjects and developing the skills. **The students also think their faculty is well connected to the labor market. However employers do not agree.** Less than a third think that the HEIs are doing a good job of developing the skills needed in their firms and this drops to less than a fifth thinking that the HEIs are focused on the real job opportunities in the region. **About a quarter of employers think that TVETs are doing a good job of developing the skills needed in their firms and also in the region as a whole.**

The overwhelming majority of firms in the survey had no relationship with either HEIs or TVETs and this is a major area where improvement is needed.

Students think that their institutes are doing a good job of helping them to find employment but employers do not agree. Only a third of employers think that HEIs do a good job in this and for TVET only a quarter.

Students generally are very confident that their post-secondary education will enable them to get employment but desk research suggests that there is an oversupply of qualified young people and that many face unemployment or under employment.

There are definite gender issues in the workplace. It appears that there is an unconscious gender bias that creates an unwelcoming working environment for women.

69% had no mechanisms, procedures or actions in place to create an appropriately balanced gender workforce and 85% had no thoughts on how such mechanisms could be put in place. 92% of firms said that the organization would NOT benefit from employing more women.

Most employers do not see any gender imbalance yet over a third said that women of child-bearing age were NOT suitable for senior management. Three-quarters (75%) of firms overall did NOT have special benefits for pregnant women and NO firm reported having childcare available. 38% of firms had no senior female employees.

46.7% of employers think that they will need new skills in the future but find it difficult to be specific about what they are. They speak about combining existing skills or combining existing with new skills. 59% were unable to specify any new skills.

Technologists, Engineers and Electricians are the main skills sets that they foresee as being needed.

The report sets out the main areas for the development of qualified staff at operator, technician and technical manager levels. **Employers currently seem sceptical about HEI and TVET ability to deliver the skills they need and this is reflected in the paucity of the relationships they have with them.** There is a need for a sector based approach that engages employers with educators and government in developing the qualification standards on an industry by industry basis and this is already happening through the government's TVET strategy.

The key recommendations are:

- Improve the quality of STEM teaching in schools to at least the average OED level
- An organized and strategic plan to address gender balance in firms
- A strategic development of TVET and University vocational education and training is needed in order to address these endemic issues in partnership with government and employers
- Sectoral partnerships that bring employers, educational institutes and government together are needed to identify real present and future needs and to incorporate these into curricula.
- Upgrading of STEM teaching at HEI and TVET including the teaching technologies
- A plan to address specific skill shortages identified in the research
- Improved career guidance in schools involving up to date data on the labor market trends
- Upgrade the relationship between schools and HEI and TVET

The World Bank in its 2013 report on Skills Mismatch and Unemployment: Labor Market Challenges in Georgia said:

Georgia faces three main labor market issues: (a) underutilization of labor resources, (b) earnings inequality, and (c) skills mismatch. All three have a negative impact on poverty. Improving labor market outcomes is thus key to poverty reduction. This first

of all requires supporting the creation of more and better jobs in order to absorb the surplus labor and increase earnings. It also requires improving the quality of education to reduce the skills mismatch and support modernization of the Georgian economy. Finally, improving labor market outcomes requires developing institutions that improve access to jobs, reduce income inequality, and effectively protect core worker rights.

This statement encapsulates the need and proposed action.

BARRIERS TO FEMALE PARTICIPATION IN STEM POST-SECONDARY PROGRAMS

Study 1 has five main questions that will inform recommendations to the GoG and MCC, regarding:

- (i) the current situation of women in STEM fields and occupations in Georgia;
- (ii) social-psychological barriers that limit women's participation in secondary and post-secondary STEM education;
- (iii) institutional barriers that limit women's participation;
- (iv) labour market barriers to women in STEM fields; and
- (v) the characteristics of effective programs to boost women's participation in STEM fields and occupations.

On the basis of answers to these questions interventions for Compact II will be suggested.

1.1 Introduction to Study 1

This study has been commissioned to answer key questions about the issue of the take up of STEM careers at all levels, operator, technician and technical manager and involving both genders and those from socially disadvantaged groups. Much has been published about the skills mismatch between what skills employers say they need and what skills the providers of education and training develop in their graduates. There is a general agreement that there is a mismatch and also those women and those from socially-disadvantaged groups are under-represented in the STEM work force.

The reasons for this are many and complex. This study aims to identify all of the issues related to school, society, family, school – TVET / University interface and TVET / University – Employer interface. No single solution can fix what a complex issue is. There will need to be a number of actions drawn together into a comprehensive strategy that will involve a number of government actors, the education system and employers.

The work of the study involved desk research to identify the current state in the country and also to examine good practice from other countries including EU Member States. This was followed by a series of focus group discussions that were carried out with students, specifically but not only involving girls and socially-disadvantaged groups. Finally, structured questionnaires were designed and implemented with employers, TVET and Higher Education Institutes and secondary school..

The aim is to create a clear understanding of all of the causes of the current situation, what are the barriers and influencers, key roles played or not played, information availability or otherwise. Drawing on this understanding the report makes a number of recommendations for the Government of Georgia. In doing this the team is aware that the government is already progressing on a comprehensive TVET strategy and many of the recommendations fit with this.

Inevitably there are gaps in the information available and, where this is the case, it is pointed out. In a fluid and fast developing economy not all of the

answers are available to key questions and, where this is the case, the team have not entered into speculation but have stuck with the findings; pointing out gaps that currently exist.

To paraphrase a comment from the World Bank 2013 report, 'Georgia needs employers to develop high skill jobs, educators need to prepare students with the skills that the highly skilled jobs require and to do so in a way that engages the whole of the country's young people. And it needs to do both at the same time.'

As important as developing specific skills (that are identified in this report) is, the development of generic STEM skills, the learning to learn STEM skills and the ability to translate the generic STEM skills to new situations; these are all equally important.

This study has been conducted to identify the reasons of underrepresentation of women in science, technology, engineering and mathematics (STEM). The Government of Georgia foresees the lack of qualified female professionals in STEM as a serious loss to the country's economic development and long-term goals.

Currently, many European countries celebrate increasing opportunities for women in science, technology, engineering and mathematics but, unfortunately, Georgia still has a long way to go.

According to the literature obtained about other countries, mainly from the United States, underrepresentation of women in STEM fields has been proven by different research data. The number of women in science and engineering is growing, yet men continue to outnumber women, especially at the upper levels of STEM professions. Women hold a disproportionately low share of STEM undergraduate degrees, particularly in engineering. Women with a STEM degree are less likely than their male counterparts to work in a STEM occupation; they are more likely to work in education or healthcare.

Although women fill close to half of all jobs in the U.S. economy, they hold less than 25 percent of STEM jobs. This is also reflected in earnings: while a pay gap exists in nearly every occupational field, jobs traditionally associated with men tend to pay better than traditionally female jobs for the same level of skill required. Even in 2013 women and men still tend to work in different kinds of jobs. This segregation of occupations is a major factor behind the pay gap.

It is also proved that underrepresentation of women in STEM fields at all levels is not caused by their mental abilities and skills - over the years gender differences in cognitive skills and abilities decreased dramatically; the most recent studies show that girls' math test scores are even higher than those for boys. Girls outperform boys in STEM subjects however less young women take STEM careers. The horizontal gender segregation is also there at universities, with more women in humanities and more men in hard sciences. The leaking pipeline metaphor is used to describe the situation when equal number of boys and girls enter education institutions at early stage of development and much fewer women end up at the position of full professor at universities.

Academics from different countries found a number of reasons that prevent young women from entering STEM careers¹. There can be gender differences in STEM perceptions: women tend to perceive math as more difficult and less valuable than men. Also according to the model of achievement-related choices: for both males and females, occupational aspirations are mediated primarily by expectations and subjective task values. The young women, on average, are more likely to aspire to the health-related careers. There are gender differences in perceiving one's own abilities: women tend to have lower confidence in their ability than men do. Girls assess their mathematical abilities lower than do boys with similar mathematical achievements. Female students also tend to believe in the **long-standing stereotype**² that men are good in math and women are stronger in humanities. Also men attribute failure to their ability less frequently and success to their ability more frequently than do women; women attribute success more frequently to consistent effort than do men. Gender difference in willingness and ability to negotiate salary also explains the pay gap. Negotiating a salary can make a difference in earnings and men are more likely than women to negotiate their salaries. Research³ shows that bargaining behaviour is done mainly by men.

Stereotypes in turn create threats for vulnerable groups, in this case, for women, to perform well. Stereotype threat is described as a social psychological predicament⁴ rooted in the prevailing images for women as intellectually inferior in STEM. This appeared to be related to **parents' beliefs** in the difficulty of math for their child. Parents had sex-differentiated perceptions of their children's math abilities despite the similarity of actual performances of their sons and daughters. They also thought advanced math was most important for their sons than for their daughters.

Stereotypes also appeared to be related to **teachers' beliefs** in the difficulty of math for their students⁵. Teachers then act according to these beliefs:

¹ American Association of University Women (AAUW). (2010). *Why So Few? Women in Science, Technology, Engineering and Mathematics*. Washington DC. AAUW

² Starobin, S. S., & Laanan, F. S. (2008). Broadening female participation in science, technology, engineering and mathematics: Experiences at community colleges. *New Directions for Community Colleges*, 142, 37–46

³ Babcock, Linda C., Bowles Hannah Riley and McGinn Kathleen "Constraints and Triggers: Situational Mechanics of Gender in Negotiation" with, *Journal of Personality and Social Psychology*, 89(6), 2005, pp. 951-965.

⁴ Aronson, J., Fried, C.B., Good, C.(2002). Reducing the Effects of Stereotype Threat on African American College Students by Shaping Theories of Intelligence. *Journal of Experimental Social Psychology* 38, 113–125.

⁵ Eccles (Parsons), J. S., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J. L., & Midgley, C. (1983). Expectancies, values and academic behaviors. In J. T. Spence (Ed.), *Perspective on achievement and achievement motivation* (pp. 75–146). San Francisco: W. H. Freeman.

encourage boys more than girls, expect more from boys than girls and help boys more than girls. Many school teachers would believe and state that math and hard sciences ability is a gift which makes women vulnerable from lower teacher expectations and attention, as well as to stereotypes. This is also reflected in the finding related to college education that a higher percentage of recommendation letters for women were very short, whereas a higher percentage of letters for men – very long; letters for female applicants were lacking in basic features and included greater rate of doubt raisers⁶.

University teachers appear to hold the same bias as school teachers: both male and female faculty judged a female student to be less competent and less worthy of being hired than an identical male student and also offered her a smaller starting salary and less career mentoring⁷. Mediation findings shed light on the processes responsible for this bias, suggesting that the female student was less likely to be hired than the male student because she was perceived as less competent. Additionally, moderation results indicated that faculty participants' pre-existing subtle bias against women undermined their perceptions and treatment of the female (but not the male) student, further suggesting that chronic subtle biases may harm women within academic science.

Female faculty members were just as likely as their male colleagues to favor the male student. The fact that faculty members' bias was independent of their gender, scientific discipline, age and tenure status suggests that it is likely unintentional, generated from widespread cultural stereotypes rather than a conscious intention to harm women.

Parents' and teachers' attitudes provided above show that **implicit bias** is common, even among individuals who actively reject these stereotypes.

Overall, the students' expectations and plans are related most directly to their self-concepts of math abilities and to their perceptions of their parents' and teachers' beliefs about their math aptitudes and potentials. Negative stereotypes about girls' abilities in math can indeed measurably lower girls' test performance. Experimental evidence confirms that many people continue to hold biases against women in the workplace, especially those who work in traditionally male fields. A lack of social and academic support for female students, a lack of female role models, gender stereotyping and less family-friendly flexibility in the STEM fields can impede their academic and career aspirations to pursue STEM fields.

There are societal attitudes to women and men in STEM careers, meaning that there are widespread implicit beliefs that woman are not fit for such a career, while a man is, this also contributes to women's underrepresentation in STEM careers. Although, a woman's success frees her from being perceived as

⁶Trix, F., & Psenka, C. (2003). Exploring the color of glass: Letters of recommendation for female and male medical faculty. *Discourse & Society, 14*(2), 191–220

⁷ Moss-Racusin, C., Dovidio, J., Brescoll, V., Graham, M., & Handelsman, J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences of the USA, 109*. 10.1073/pnas.1211286109.

incompetent, it can create new problems by activating **social rejection**⁸. When success was made explicit, women were viewed far less likable and more interpersonally hostile than man. Those who were reported to be likable were evaluated more favourably than those who were reported to be not likable. This, in turn, affected pay: not only were competent employees recommended for a higher salary than less competent employees but likable employees, whether competent or not, were recommended for a higher salary than less likable employees.

Based on USAID Georgia Sector Assessment Report, the Government of Georgia, in cooperation with Millennium Challenge Corporation (MCC) decided to address the gender gap in STEM fields and identify those barriers that impede women break through the sectors, which are vital for country's economic growth.

The current report is based on all available findings and recent research data about women and girls' achievements in education in Georgia and addresses the questions listed above one by one.

Study 1: question 1. Women and girls performance in STEM subjects

The current situation in Georgia is similar to of the international one and is described here in regard to girls' performance and representation in STEM fields. The analysis is based on the data of eighth grade students' achievement in math and science from TIMSS 2011, PISA 2009 data on secondary school students' achievement in mathematics and science, 2011 and 2012 CAT results and university students' achievement scores in STEM subjects for Unified Entry Examination. Also, it provides information of girls representation in academic and professional programs based on the National Statistics Office of Georgia data from the school years of 2009-2010, 2011-2012 and 2012-2013. Data from IPM Research survey of school female students, TVET and university STEM faculty students and professors, STEM teachers as well as parents and employers is discussed.

The table below summarizes numbers and corresponding percentages of men and women's STEM enrolment starting from school years followed by different levels of post-secondary education and employment at the post-secondary education institutions. The data shows that there is an almost equal number of men and women at school level but that the percentage of women dramatically decreases for post-secondary education. This trend is stable even for university professors, with the exception of PhD education and TVT faculty.

⁸ Heilman, M. E., Wallen, A. S., Fuchs, D., & Tamkins, M. M. (2004). Penalties for success: Reaction to women who succeed in male gender-typed tasks. *Journal of Applied Psychology*, 89(3), 416–27

Table 1.1. Various educational levels' enrolment data by gender

	Year	% Male	% Female	Male	Female
Grade 12 student enrolment	2011	49.7%	50.3%	22493	22778
Grade 12 student enrolment	2012	49.7%	50.3%	20140	20405
STEM I-IV TVET level students	2009-10	86.6%	13.4%	531	82
STEM I-IV TVET level students	2011-12	79.4%	20.6%	660	171
STEM I-IV TVET level students	2012-13	76.2%	23.8%	445	139
STEM undergraduate students enrolment	2009-10	65.3%	34.7%	3631	1930
STEM undergraduate students enrolment	2011-12	64.9%	35.1%	2885	1561
STEM undergraduate students enrolment	2012-13	68.9%	31.1%	3471	1567
STEM Master's students enrolment	2009-10	61.6%	38.4%	508	316
STEM Master's students enrolment	2011-12	59.9%	40.1%	494	330
STEM Master's students enrolment	2012-13	75.1%	24.9%	508	168
STEM Doctorate Students enrolment	2007	41.1%	58.2%	23	32
STEM Doctorate Students enrolment	2008	51.6%	48.4%	146	137
STEM Doctorate Students enrolment	2009	52.4%	47.6%	335	304
STEM Doctorate Students enrolment	2011	52.8%	47.2%	151	135
STEM Doctorate Students enrolment	2012	58.2%	41.8%	177	127
STEM TVET faculty	2013	51.2%	48.8%	127	121
STEM University faculty	2013	71%	29%	796	325

Below we will discuss this trend in more detail providing data according to the educational levels starting from school years.

School years - Average scores on TIMSS, PISA and CAT math and science tests by gender

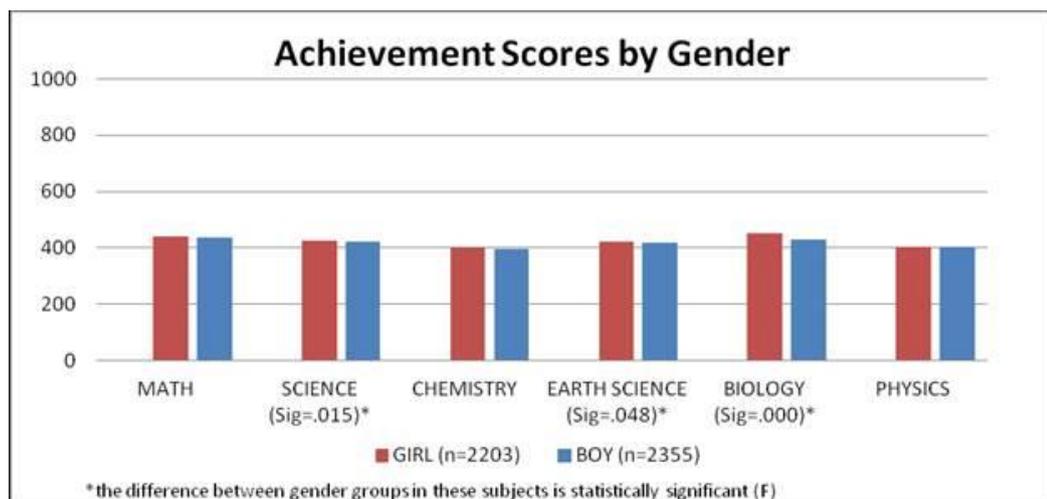
Below we will present data according to the ages of boys and girls starting from the earliest age we were able to obtain data on their STEM performance. Namely, TIMSS provides data on school children of 8th grade, PISA – on schoolchildren of 10th grade, CAT on schoolchildren of 12th grade.

TIMSS 2011 comparing girls' performance with boys'

This is the international assessments of student achievement dedicated to improving teaching and learning in mathematics and science - TIMSS 2011⁹ gives the opportunity to identify the social-psychological barriers that may cause women's underrepresentation in STEM. TIMSS reports on the achievement of fourth and eighth grade students every four years. The following analysis is based on eighth grade students' data. 5000 eighth grade students of 172 schools participated in TIMSS 2011 from all regions of Georgia.

The overview of achievement results shows that generally, Georgian eighth grade students' performance in mathematics and science is lower, than the centre point of the TIMSS scale (500). **Graph 1.1** provides Georgian eighth grade students' average achievement scores¹⁰ by gender in math, science, chemistry, earth science, biology and physics. As shown from the graph, in all the cases girls outperform boys by a few points: math – 439 (girls) and 438 (boys); science – 427(girls) and 420 (boys); chemistry – 398 (girls) and 396 (boys); earth science – 422 (girls) and 417 (boys); biology – 451 (girls) and 430 (boys); only in physics, boys have a 2-point higher score (404), than girls (402). However, differences in only three subjects are significant – science, earth sciences and biology.

Graph 1.1 Eighth grade students' achievement scores in STEM subjects by gender, 2011



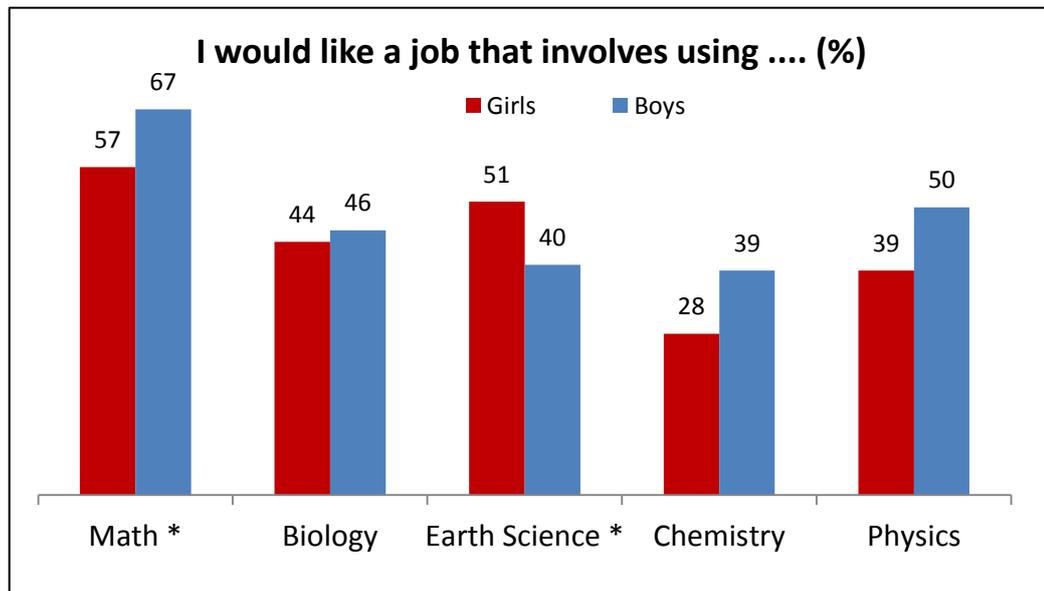
Although girls outperform boys in all STEM subjects except for physics. The TIMSS shows that girls' higher performance in STEM does not lead to higher preferences for STEM careers. --Despite their higher achievement scores, fewer girls than boys choose STEM fields. TIMSS 2011 results revealed that Georgian eighth grade girls, compared with the boys, are less likely to prefer a job that involves using STEM

⁹ TIMSS 2011 Assessment. Copyright © 2013 International Association for the Evaluation of Educational Achievement (IEA). Publisher: TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College, Chestnut Hill, MA and International Association for the Evaluation of Educational Achievement (IEA), IEA Secretariat, Amsterdam, the Netherlands.

¹⁰ to compute the mean score 1st plausible value was used

subjects. **Graph 1.2** shows that almost in all cases, the boys' preference for STEM is at least 10% higher than girls'.

Graph 1.2 Eighth grade students' job preference by gender



*the difference is statistically significant (Sig=.000)

The IPM Research survey confirms girls' preferences for STEM careers through TVET are lower than boys'. The IPM Research survey data shows that while there are no differences between preferences of University students, there are clear differences in the preferences of TVET students.

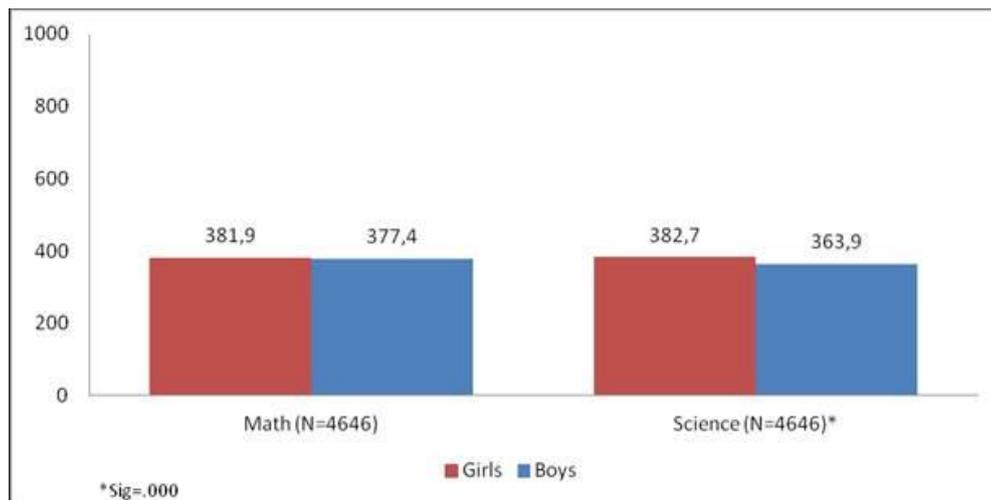
50% of university STEM students agree that science jobs are attractive, 73.1% of students agree that technical jobs are attractive; 63.9 % of students agree that engineering jobs are attractive; 50.9% of students agree that mathematical jobs are attractive. There were no statistically significant differences between boys and girls, unlike TVET STEM students, where percentages of boys and girls providing these answers differed: 58.3% of male students and 35.7% of female students agree that science jobs are attractive (Sig=.046); 72.2% of male students and 46.4% of female students agree that technical jobs are attractive; 69.4% of male students and 21.4% of female students agree that engineering jobs are attractive (Sig=.000); 59.7% of male students and 25% of female students agree that math jobs are attractive (Sig=.000).

PISA 2009-Programme for International Student Assessment demonstrates girls outperform boys in science and math. The Program for International Student Assessment (PISA) is an international study which aims to evaluate education systems worldwide by testing the skills and knowledge of 15-year-old students. Since the year 2000, every three years, a randomly selected group of fifteen-year-olds take tests in the key subjects: reading, mathematics and science, with focus given to one subject in each year of assessment. The students and their school principals also fill in background questionnaires to provide information on the students' family background and the way their schools are run.

Due to the fact that in 2009 the focus of the assessment was reading the test included limited number of items related to mathematics and science. Accordingly, the data gives the possibility to conduct only general analysis of 15-year old students' achievement in math and science.

Approximately 5000 fifteen-year old students of 226 schools participated in PISA 2009 from all over Georgia. The average score of Georgian students' in mathematics is 379 and 373 in science. Graph 1.3 provides average scores in mathematics and science¹¹ by gender. As it is shown from the graph, girls outperform boys in both cases.

Graph 1.3: Achievement average score by gender



CAT – COMPUTER ADAPTIVE TEST

CAT - Computer Adaptive Testing system was launched in Georgia in 2011 within the educational reform for passing-out examinations for twelfth-grade students. CAT is conducted simultaneously all over Georgia. The main priority of CAT test is that it reduces time for test administration two-fold because students only answer the questions within their knowledge capacities. This method enables the school to identify the knowledge level and skills of the students and get the results immediately¹². CAT system covers eight subjects:

- Georgian language and literature
- Foreign language (Russian, English, German, French)
- Mathematics
- History
- Geography
- Physics
- Chemistry
- Biology

The following report is focused on students' results in mathematics, geography, physics, chemistry and biology. The table overleaf provides general

¹¹to compute the mean score 1st plausible value was used

¹²Source: NAEC CAT Results 2011-2012

information on male and female performance and improvements through 2011-2012 in STEM subjects within CAT. As it is shown from the table 1.1, in 2011, as well as in 2012, girls outperform boys in all STEM subjects. The scores range from 5 (the lowest passing grade) to 10. Information about scores below 5 are not publicly available.

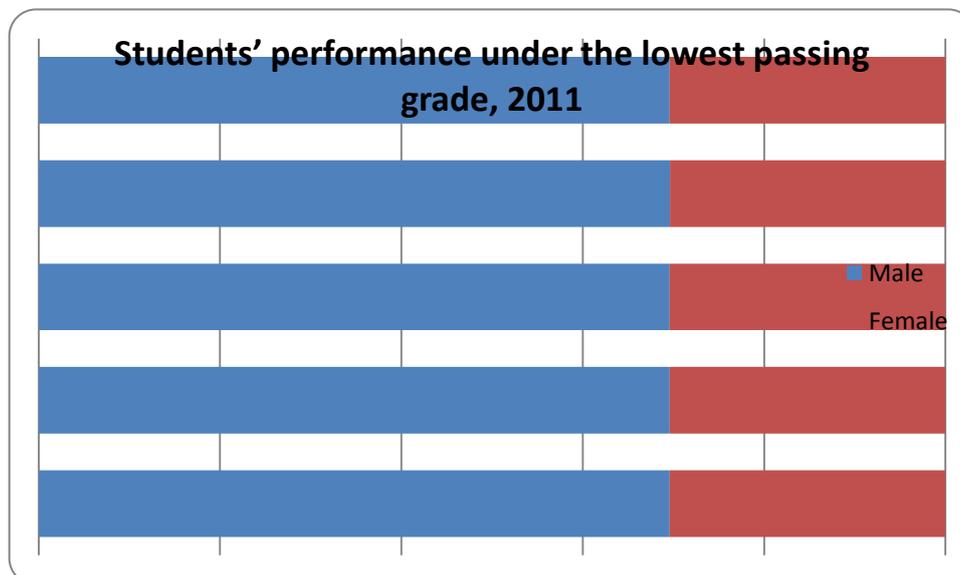
Table 1.1. Average CAT results for boys and girls in 2011-2012 *

Subjects	2011/F	2011/M	2012/F	2012/M
Mathematics	6.9	6.75	7.22	7.11
Biology	7.54	7.09	7.51	7.12
Chemistry	7.46	6.92	7.6	7.16
Physics	7.21	7.1	7.28	7.18
Geography	7.58	7.45	7.52	7.47
N	22778	22493	20405	20140

* each case is statistically significant (Sig= .000)

Graphs 1.3.1 and 1.3.2 below provide the information about students, who performed under the passing grade (5.5) in STEM subjects, by gender. It is clear from the figures, that higher share of boys did not succeed in CAT STEM subjects, than girls.¹³

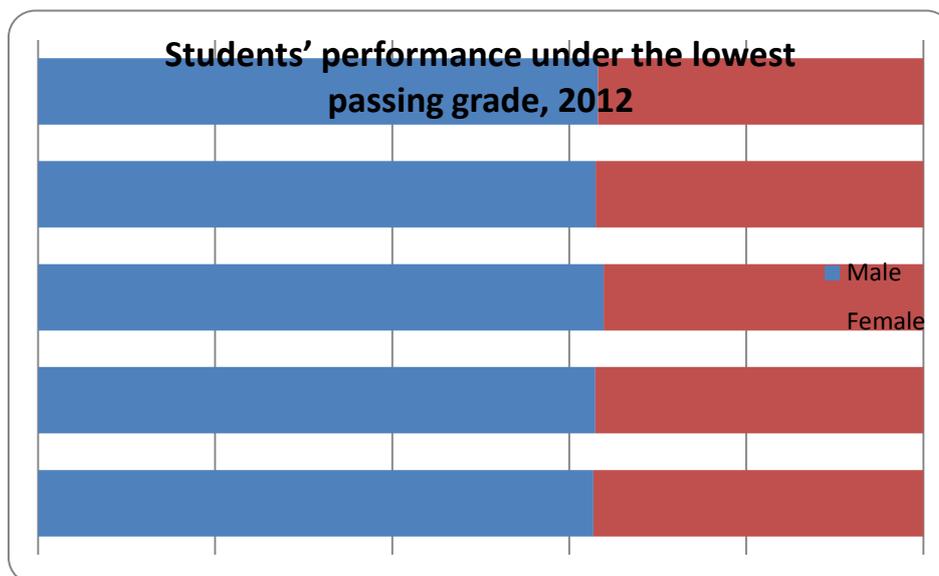
Graph 1.3.1 Students' performance under the lowest passing grade in STEM subjects, by gender, 2011



*Sig=.000; **Sig=.004

¹³ A student failed the CAT exam when performing under the lowest passing grade (5.5) in at least three subjects in 2011 and in 2012 student failed CAT exams when performing under 5.5 in at least one subject.

Graph 1.3.2. Students' performance under the lowest passing grade in STEM subjects, by gender, 2012



*Sig=.000; **Sig=.048

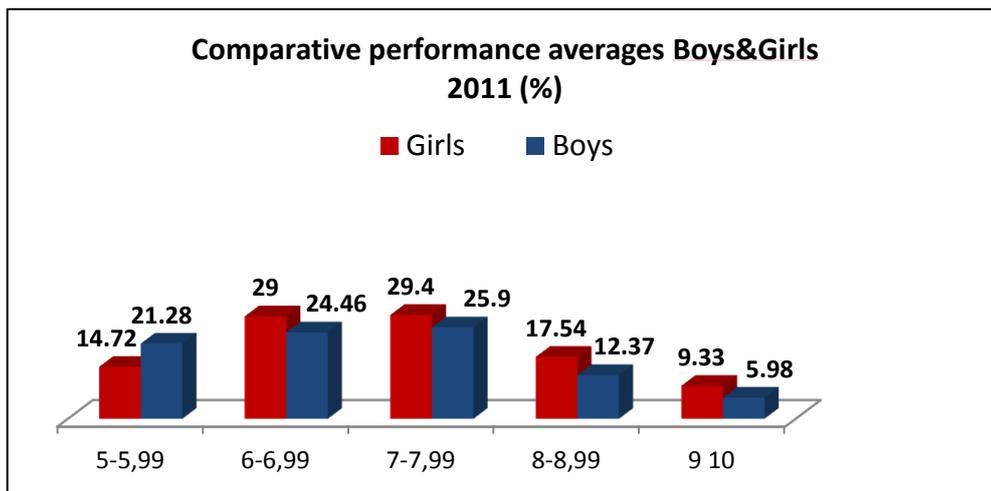
In order to have a clear picture about performance level between boys and girls, for our research the CAT grading system conditionally has been grouped into five categories:

- 5-5.99 lowest grade
- 6-6.99 below average
- 7-7.99 average
- 8-8.99 above average
- 9-10 very good

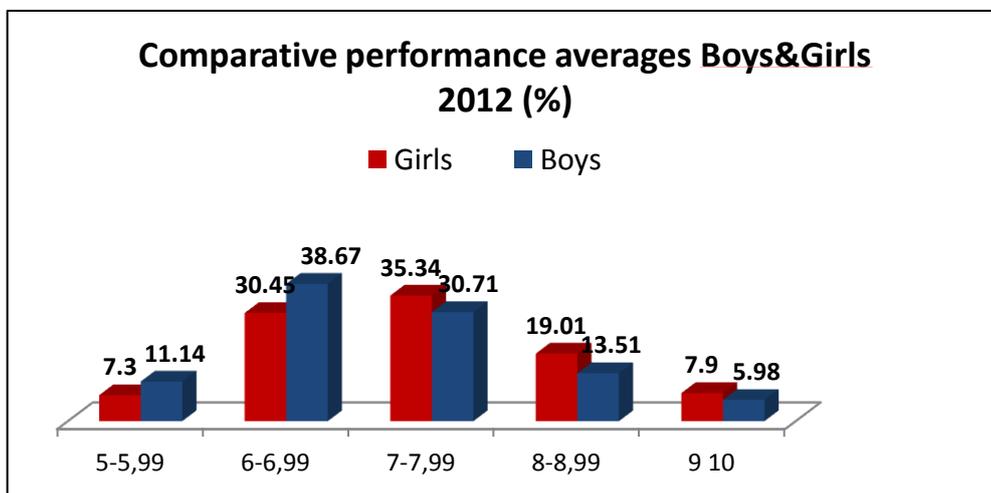
Tables below provide information about girls' and boys' performance per CAT grading scale and subjects in 2011 and 2012; graphs 1 and 2 present comparative performance average of boys and girls in 2011 and 2012. As is clear from the graphs below a much higher share of girls is outperforming boys in the top range (9-10) in two areas: chemistry and biology (**ANNEX 1, Tables 1 - 5**).

According to the graphs the level of proficiency is low among boys and girls in all subjects. In general, the main performance level for both boys and girls is **average** and **below average** within the 6-6.99 & 7-7.99 grading scale. It should also be emphasized that the mean percentage of female (by 7.42%) and male (by 10.14%) students under 5-5.99, the **lowest passing grade**, decreased in 2012 in all subjects. This shows an improvement in the test results. At the same time, the **above average** level performance is higher with girls (26.87%), than with boys (18.35%) in 2011, as well as in 2012: girls-26.91%; boys-19.48%. Overall proficiency is low in all subjects but the pattern of girls outperforming boys is clear.

Graph 1.6 Comparative performance averages by gender, 2011



Graph 1.7 Comparative performance averages by gender, 2012

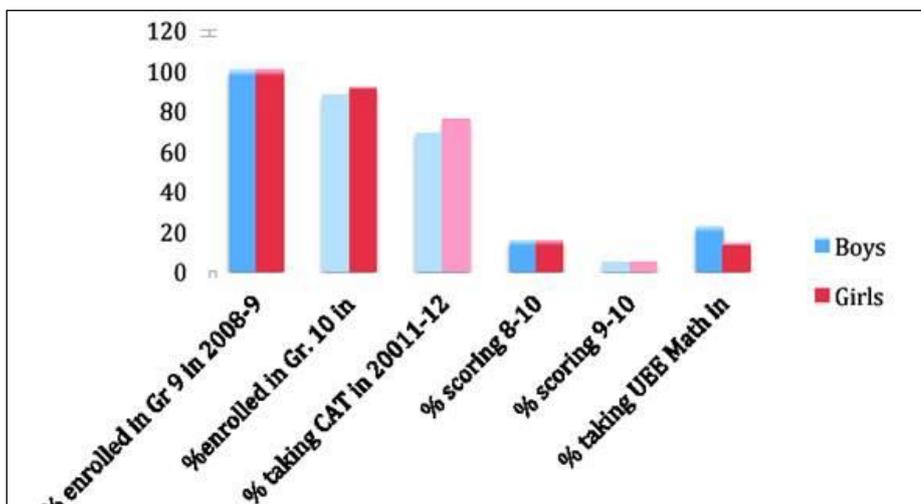


The data provided above tells us that, starting from grade 8; schoolgirls outperform schoolboys in STEM subjects. At the same time girls do not plan to choose STEM jobs or to follow STEM career.

Post-secondary education: Part 1:

The data set gathered in these studies allows us to track a single cohort of students as they attempt to enrol in post-secondary education. In the following graphs it is shown what happened to the boys and girls who were enrolled in Grade 9 in 2008 / 9 as they progressed through the next few years. The vertical axis indicates the percentage of Grade 9 students who participate in each of the subsequent activities.

Graph 1.8 the percentage of Grade 9 students who participate in each of the subsequent years' academic activities



Specifically, the Graph shows the percentage of those Grade 9 students who transitioned to Grade 10 in the following year, who took the CAT in 2011/12, who scored well on the CAT math test (8/10 points), who scored very well on the CAT math test (9/10 points) and who took the UEE math exam, by gender.

It shows that the percentage of Grade 9 girls who enrolled in Grade 10 exceeded the percentage of Grade 9 boys enrolled in Grade 10, that the percentages of those Grade 9 girls and boys who achieved high scores on the CAT math tests when they took them in Grade 12 were very similar but only about half as many of those Grade 9 girls took the UEE math test as compared with their Grade 9 male classmates.

This 'leak' of female students represents a substantial loss of potential STEM talent to Georgia.

In analyzing specific years of students two sets of data are provided:

- Average scores on UEE math and science tests, by gender
- Enrollments in university and TVET levels IV-V STEM fields, by gender;

Unified Entry Examinations 2011-2012. The tests for unified entry examinations are shaped in different ways in terms of scores. For example, the score range for mathematics is 0 to 59, while for physics, biology and chemistry is 0 to 75. These scores are then converted according to a UEE formula and final scaled scores are created. Students' achievement scaled scores in STEM subjects from Unified Entry Examinations 2011 and 2012 are provided below. As it is clear from the data science scores are quite similar for boys and girls, the difference is a maximum of 1 point in both 2011 and 2012 years; as for mathematics, the difference between students' scores is 4 points in 2011 and 3 points in 2012, in both cases girls outperform boys.

Analysis of variance showed statistically significant difference only in mathematics. In 2011 maximum and minimum scores were: math-123.5-188.7; biology-128.1-181.8; chemistry-127.3-184.3; physics-130.3-189.5; standard deviation – 15. In 2012 the maximum and minimum scores were: math-119.2-

187.5; biology-125.9-180.7; chemistry-128.7-185.2; physics-132.5-200; standard deviation – 15.

Table 1.2. Students' UEE scores in math and science by gender, 2011

	Math*	N	Biology	N	Chemistry	N	Physics	N
Boys	148.07	7441	149.4	1102	150.1	222	149.9	267
Girls	153.7	3991	150.3	2394	150.02	691	150.2	83

*Sig=.000

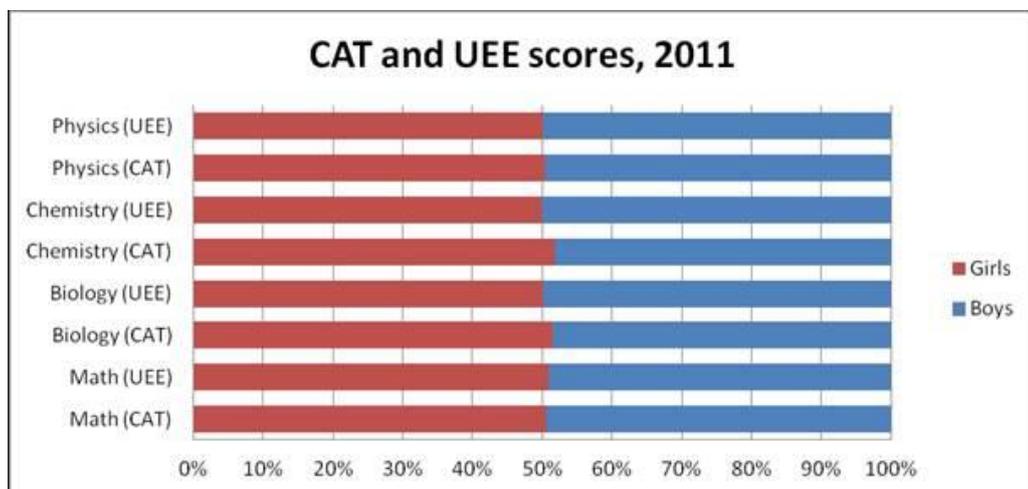
Table 1.3. Students' UEE scores in math and science by gender, 2012

	Math*	N	Biology	N	Chemistry	N	Physics	N
Boys	148.4	6515	149.8	1116	149.5	431	149.9	445
Girls	152.8	3673	150.1	2328	150.2	996	150.1	149

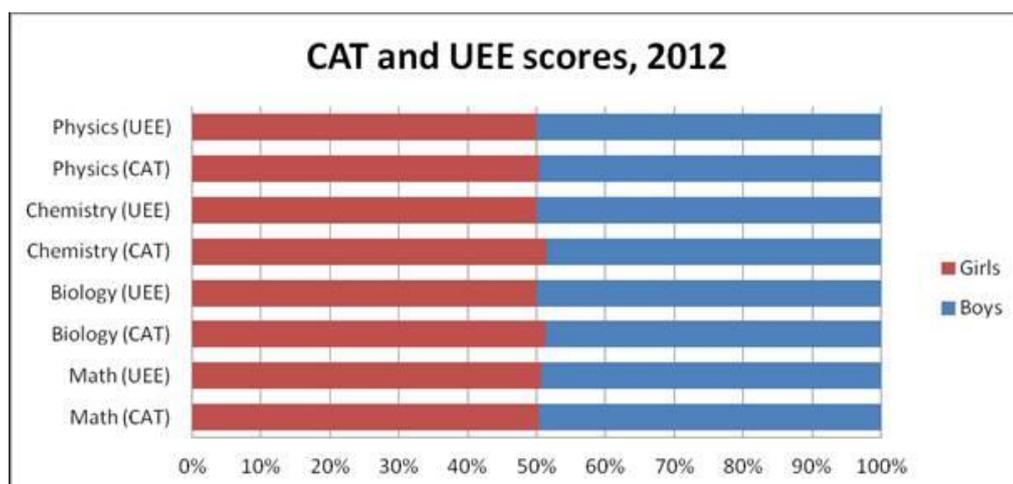
*Sig=.000

Unlike the results based on CAT and PISA, students' performance is more or less similar by gender; only in math girls outperform boys. The tables above also show that more boys than girls take the math and physics tests, whereas more girls than boys take the biology and chemistry tests. Correspondingly, more boys enrol for mathematics and physics and more girls enroll for biology and chemistry majors at universities (as shown in the graphs below). Also, more girls enter medical schools and, therefore, take biology and chemistry tests. However, these differences do not explain the lack of gender differences in performance. It is also possible that many girls, who have good knowledge of mathematics do not take mathematic tests as they do not plan to pursue STEM career. Overall we can conclude that girls, if they choose to follow STEM education, mainly opt for biology and chemistry subjects indicating the prevalence of medical education among girls. Schoolchildren of 12th, last grade, pass exams two times; first for the school completion – CAT and the second, for entering universities UEE. The graph below show how these scores compare in years 2011 and 2012:

Graph 1.9. Comparison of CAT and UEE scores by subjects, year 2011



Graph 1.10 Comparison of CAT and UEE scores by subjects, year 2012



These graphs show that the results of CAT and UEE are basically similar; also there is not much difference between boys' and girls' achievements. At school, including CAT, girls show better results/achievements than boys but the scores at UEE become even. It might be that boys improve their performance for UEE, however, this is less likely, as the time between these two events is quite short, around a month. It is more likely, that some girls who studied better than boys, did not take UEE in STEM. This is also shown by the TIMSS data above on fewer girls planning to take STEM career. The data below on TVET and university enrolments show the same trend.

In order to define gender differences in enrolment and graduation from STEM professions, National Statistics Office of Georgia data from the school years of 2009-2010, 2011-2012 and 2012-2013 was analyzed. The data provides information about students' enrolment and graduation from higher education institutions on bachelor, master and doctorate level academic programs, as well as TVET level IV-V programs. The data includes gender variable that gives an opportunity to analyze data of students' enrolment by gender. In addition, IPM Research survey data is considered.

According to the data for the bachelors' and masters' degree, as well as for high professional programs, boys are more likely to enrol in STEM programs; as for the doctoral degree, gender difference is only seen in the engineering, manufacturing and construction fields (**ANNEX 2, Tables 1 - 4**).

The admissions statistics show a clear picture: boys' admissions for STEM subjects at University and TVET are substantially higher than girls'. The theme continues into admissions for Masters Degrees. For doctorates the numbers are much lower and statistical significance is only found in the engineering, manufacturing and construction fields,

Post-secondary education. Part 2:

- Graduates of TVET STEM fields, by gender;
- Bachelor's degrees earned in selected STEM fields in 2010, by gender;
- Master's degrees earned in selected STEM fields in 2010, by gender;
- Doctorates earned in selected STEM fields in 2010, by gender;

The data below on degrees earned in post-secondary education show that men are more likely to earn bachelors' and masters' degree in STEM fields and graduate from TVET programs but as for earning doctorates, there are no tendencies regarding gender differences, because the numbers are too small to produce significant results (**ANNEX 3, Tables1 - 4**). Data from bachelor graduates of 2011-12 and 2012-13 in science differ from the general trend: more girls than boys earned the degree.

The data on enrolments and graduation presented above does not enable us to compare the number of those who enter and those who finish studies. Georgian higher education system is organized in the following way: bachelor education lasts for 4 years, masters for 2 years and PhD for 3 to 5 years.

To sum up more male students enrol and graduate from TVET, bachelor and master STEM programs. As for doctorate level, there is no gender difference in enrolment and graduation in STEM. According to the IPM Research survey, 51.2% of school STEM teachers say that very few of their students are going to major in STEM subjects. This coincides with the National Statistics Office data¹⁴ that show that STEM subjects are less popular than other subjects like law, humanities, or social sciences. In 2009 - 23% of all students enrolled in university STEM programs; in 2011 and 2012 – only 17% of all students did. On top of that, STEM subjects are even less popular among girls.

To summarize: At school girls outperform boys in STEM subjects, however, fewer girls pursue STEM career at post-secondary education level.

Study question 1.1.9: Female STEM faculty in post-secondary TVET STEM and four-year educational institutions, by discipline and tenure status.

The analysis is based on the data from 6 Georgian universities and 14 TVET institutions STEM faculty. Generally, in Georgia the gender distribution of teachers at schools as well as universities is uneven. According to a 2010 study, “Women are represented disproportionally in the teaching profession but due to vertical segregation there are greater numbers of women working at the public primary and secondary school levels and fewer professors at the university level”(Duban, 2010)¹⁵.

Data on faculty gender composition from 6 universities shows a higher share of male faculty members at STEM departments. The difference between the number of male and female faculty members is higher for full professor and associate professor level and is lower for assistant professor level. Moreover, in several departments of the Georgian Technical University, the number of female assistant professors exceeds the number of male assistant professors. It is noteworthy that in I. Gogebashvili Telavi State University, the number of female representatives exceeds the number of male representatives for all professor levels; however, the total number of professor is so small that does

¹⁴ National Statistics Office of Georgia-

http://geostat.ge/index.php?action=page&p_id=205&lang=geo

¹⁵ Duban, Elizabeth, DevTech Systems, Inc .Gender Assessment USAID/Georgia 2010

not provide enough grounds to consider the case as an exception. Overall, the leaking pipeline paradigm is clear: the higher the professor's position and all the corresponding material and psychological benefits, as salary, teaching load, prestige and power are, the more men are found.

Table 1.4 STEM faculty gender composition of the universities:

	Faculty member – Male	Faculty member – Female
Ilia State University	66	20
Tbilisi Ivane Javakishvili State University	106	50
Georgian Technical University	561	222
Telavi I.Gogebashvili State University	7	10
Batumi State Maritime Academy	21	7
Batumi Shota Rustaveli State University	35	16

Table 1.5 STEM faculty composition of the TVETs

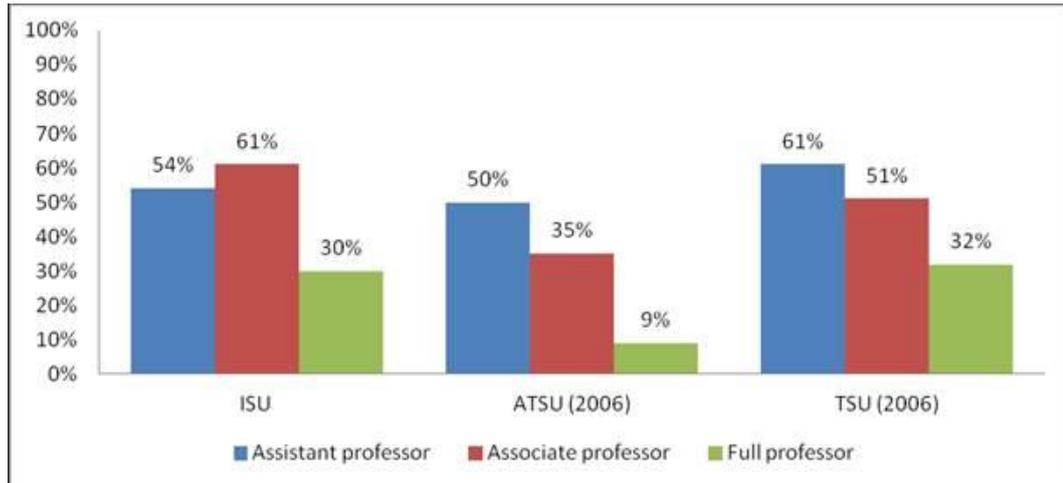
	Faculty member – Male	Faculty member – Female
Vocational College "Erkvani"	3	2
Vocational College "Fazisi"	6	2
Vocational College "Aisi"	15	12
Vocational College Profiunite	4	0
Vocational College "Panatsea"	2	5
Community College "Akhali Talgha"	34	11
Vocational College "Orientiri"	3	16
Vocational College "Horizonti"	8	12
Akhaltshikhe Community College	2	18
Vocational College "Gantiadi"	17	16
Community College "Spektri"	29	20
Community College "Modusi"	1	4
Community College "Iberia"	3	3

The above finding is supported by a master thesis research conducted in 2008, that considered the leaking pipeline paradigm and compared data on faculty gender composition from the three largest public universities in Georgia (see graph 18 below): Tbilisi State University (TSU), Tbilisi, Ilia State University (ISU), Tbilisi and Akaki Tsereteli State University (ATSU), Kutaisi¹⁶. Women are mostly

¹⁶ Kvernadze, S.2008. Gender difference in higher education system of Georgia. Master thesis. Tbilisi State University, gender studies program.

found in the humanities faculties, while men mainly in the hard science faculties where only 25% of women were found. This shows horizontal segregation in Georgian universities. In terms of vertical segregation, women constitute more than a half of assistant and associate professors, while they represent only about 25% of full professors across all three universities - around 30% in both Tbilisi universities and only 9% in ATSU, a regional university. No trend on gender differences according to specialty was found.

Graph 1.19. Female representation in all staff positions in three Georgian universities



Different from universities, TVET colleges are composed more or less equally by gender. In total, 127 male and 121 female members are represented in TVET colleges. In four colleges (“Phazisi”, “Profiunite”, “Akhali Talga” and “Spektri”) the number of male members exceeds the number of female members and in two colleges (“Orientiri, Akhaltsikhe Community College) the number of female members exceeds the number of male members. The data does not give us an opportunity to compare gender composition of faculty according to specialty.

In order to better understand the difference between universities and TVETs, one might look at gender distribution of school teachers. The majority of school teachers - 85% - in Georgia are women, this is because the income and prestige of this profession is lower than that of a university professor and because pedagogy is considered as a natural follow up of women’s nurturing nature (AST, 2013)¹⁷. The overall trend is as follows: more women than men at schools, equal number of women and men at TVETs and fewer women than men at universities, especially on the top professorship level. Together, all three levels of education prove the leaking pipeline paradigm.

Study question 1.1.8: Employment in selected STEM occupations, most recent year, by gender;

¹⁷ Javakhivili, N., Gachechiladze, N. ACT Georgia Gender Study, 2013 (UNDP)

No archival data could be obtained to address this question. The IPM Research survey is the only source for this answer. As it is revealed from the IPM Research survey of 150 employers, they have 2493 skilled STEM workers, from which, 25.8% are permanent female STEM workers. There are 2810 full-time seasonal or temporary workers employed during last year, from which about 13% are female workers. 38% of the STEM firms had no women in senior positions and 45% of the STEM firms had only 1 or 2 women in senior positions. According to the results, there are 201 women on senior positions, e.g. heads of department, managers or chief scientists/engineers in participated organizations. This number constitutes about 30% of all women employed in surveyed organizations. Unfortunately, there is no data on total number of senior position holders, so that we could judge about gender proportion of decision makers.

Overall, most of the STEM jobs are occupied by men. This might be caused by both attitudes of men and women to STEM jobs and attitudes of employers on gender link to STEM jobs. In other words, men like STEM jobs and want to pursue STEM careers, while women choose other careers in the main. Employers hire mostly men, because of the widespread stereotypes (see question 1.2) on STEM careers to be more appropriate for men than for women.

To summarize: all the answers to all sub-questions from this section we can state that:

- According to the data from TIMSS 2011, PISA and CAT, in all cases, girls outperform boys in all STEM disciplines. The only exception is physics in TIMSS 2011, where boys outperform girls with only 2 points.
- In Unified Entry Examinations girls and boys perform more or less similarly in STEM subjects; only in mathematics, girls outperform boys.
- Despite the fact that girls are equal, or even outperforming in STEM subjects, there is an obvious underrepresentation of girls in the first year enrollment and in degree earnings in STEM professions in academic programs.
- Female STEM talent and skills are being systematically lost as girls progress through the education system.
- The leaking pipeline paradigm can be used to describe the situation in STEM fields' faculty at schools, TVET centers and universities in Georgia: almost equal number of men and women at assistant professorship level and more men at associate and full professorship levels.
- More men are employed at STEM jobs than women.
- There is underrepresentation of women on decision making positions, which provides few female role models for newly hired women
- Overall, the data points to situation that is similar to that of the United States: girls are underrepresented in STEM fields at vocational and higher education levels, as well as at labor market, however, they outperform boys in almost all STEM subjects.

Study 1: Question 1.2. There are social-psychological barriers which limit women's representation in STEM programs

1. Beliefs about gender differences in intelligence;
2. Stereotypes about gender and STEM subjects;
3. Girls' and women's self-perceptions of their abilities in STEM subjects;

The following part attempts to identify the socio-psychological barriers that may cause girls' and women's underrepresentation in STEM fields. Below, we present data on family and society attitudes to gender roles and responsibilities and respectively, to gender differences in education. The analysis is based on the international findings and research data from Georgia: assessments of eighth grade students' achievement in mathematics and science – TIMSS 2011 and PISA 2009, as well as IPM Research focus group discussions conducted in Tbilisi, Kutaisi, Akhaltsikhe and Marneuli, among female ethnic Georgians, ethnic minorities and socially vulnerable minorities within 9, 10, 11 and 12 grades. The data provides the information about students' self-perception and beliefs on their performance in STEM subjects. IPM Research survey research data is also considered, as well as Grade 9 National Assessments in Mathematics.

Sub-question 1 beliefs about gender differences in intelligence;

Sub-question 2 stereotypes about gender and STEM subjects;

According to all the studies dedicated to the gender equality theme¹⁸, Georgia is a masculine country. In 2011, 58% of population stated that there is no gender equality in the country. This is widespread with different roles and obligations, requirements and expectations for men and women. Men are dominant and controlling of everyday life behaviors of their family women, especially wives, sisters and daughters and this is generally accepted by women who share the overall societal views

Attitudes to gender equality are quite traditional and are maintained over the generations. According to the 2013 study (Japaridze et. al.)¹⁹, "despite the political, social and economic changes in Georgia over the last twenty years, traditional views and stereotypes regarding gender preferences and roles are still prevalent in today's youth. Young people viewed and interpreted issues,

¹⁸ Chitashvili, M., Javakhishvili, N., Arutinov, L., Tsuladze, L. & Chachanidze, S. (2010). National Research on Domestic Violence against Women in Georgia. Tbilisi: UNFPA.

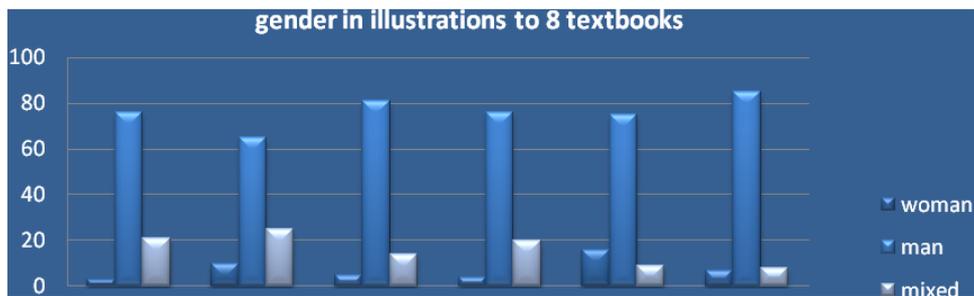
¹⁹ Japaridze, E., Zhghenti, N., Barkaia, M., Amashukeli, M. (2013). Gender Attitudes and Perceptions among Young People in Georgia. Center for Social Sciences. Gender Equality Program. Tbilisi
<http://www.google.ge/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCUQFjAA&url=http%3A%2F%2Fcss.ge%2Ffiles%2Fdocuments%2FPapers%2FGenderAttitudesandPerceptions%2CJul2013Eng.pdf&ei=aCJZUp6AC7TX4QTHy4CABQ&usq=AFQjCNEkjcmeEY9pXGVkJEZf4pRGGwBYSg&sig2=HxKR5QKhE2HY0zJk6AGBUg&bvm=bv.53899372,d.bGE>

such as the preference of having son or a daughter, gender distribution in education and employment, family gender roles and women’s private lives, including their sexual freedom, in strictly traditional frames”.

These attitudes are also reflected in the education sphere. Teachers at schools hold conservative notions of the “appropriate” roles of men and women; textbooks perpetuate stereotypes. The CEDAW Committee has recommended that the Government of Georgia eliminate gender stereotyping and mainstream gender perspectives in curricula and textbooks (CEDAW committee, 2006). A 2012 year study²⁰ of history and civic education textbooks for schoolchildren (10 textbooks were studied) revealed that men are represented better regarding quantity – more pictures, more characters and quality - more positive discussion, more praise of their activity. In addition, most textbooks contain stereotypical information on gender roles and responsibilities.²¹

In terms of quantity, 70% of pictures in textbooks depicted men only, 7% of pictures – women only and 16% of pictures depicted both men and women. In all textbooks, there were about 10 times more men pictures, than those of women. See graph below:

Graph 1.20: Pictures of women and men in 8 textbooks.



The authors also considered tests from students’ workbooks on civic education. One of the tests for the topic “I want to create a family” asked about “ideal wives” and “ideal husbands”. According to the test, the portraits of an ideal wife and an ideal husband are as follows:

“An ideal wife should be willing to create a family. Her first serious feelings should be crowned by marriage. She should be getting up earlier than other family members, should quickly prepare delicious meals, should be

²⁰ Khomeriki, I. Javakhishvili, M. Abramishvili, T. (2012). Gender Equality Issues in Studying Social Sciences. Gender Analysis of Textbooks. Center for Civil Integration and Inter-Ethnic Relations

²¹ Source: Khomeriki, I. Javakhishvili, M. Abramishvili, T. (2012). Gender Equality Issues in Studying Social Sciences. Gender Analysis of Textbooks. Center for Civil Integration and Inter-Ethnic Relations

knowledgeable in at least one direction of arts and should keep a healthy life style – no smoking and no drinking. Men might get interested in such women even if they are not good looking. An ideal husband should also want to create a family; however, not all of his love affairs should finish with marriage. He should be able to do some mending at home, serve as a handyman. He should be able to cook one special food (pages 25-26)”.

In the section above we presented data on university faculty gender composition that illustrated a leaking pipeline paradigm. One of the reasons for uneven gender distribution among faculties is the stereotypical views on the abilities of women as lower to men in hard sciences. In interviews conducted in the frames of a Masters’ thesis research a number of men faculty provided statements such as: *women’s brains are organized in a different way, or women’s brains do not fit well into hard sciences (Kvernadze, 2008)²²*.

However, the IPM Research survey results show that the respondents do not think that women have fewer opportunities than men: 61.9% of higher education STEM faculty and 48.8% of TVET STEM faculty disagree that women do not have opportunities to participate into all aspects of political, business and social life. Similarly, 63.1% of university faculty and 56% of TVET faculty disagree that women do not have opportunities to participate especially in STEM fields. Only a small section of the university STEM faculty (16.7%) and TVET STEM faculty (9.5%) says that it is difficult for women to combine their careers with family obligations in Georgia and agree that it is so because of social stereotypes (in Georgia a woman’s family duties are considered more important than career objectives). The numbers of faculty female and male respondents were relatively small; therefore, the gender differences in answers were not statistically significant.

The IPM Research survey results contradict literature findings. This might be explained by two reasons:

- Lack of gender equality understanding among respondents
- Social desirability effect

Lack of gender equality understanding in the whole society: These arguments are supported by the IPM Research survey data that only two female school students out of 49 agree that their gender has been an obstacle for them in some cases and they provided some kind of stereotypical explanations, such as *“I want to be a boy when I watch sports activities”* and *“being a teacher is for girls, while men should be lawyers and engineers”*.

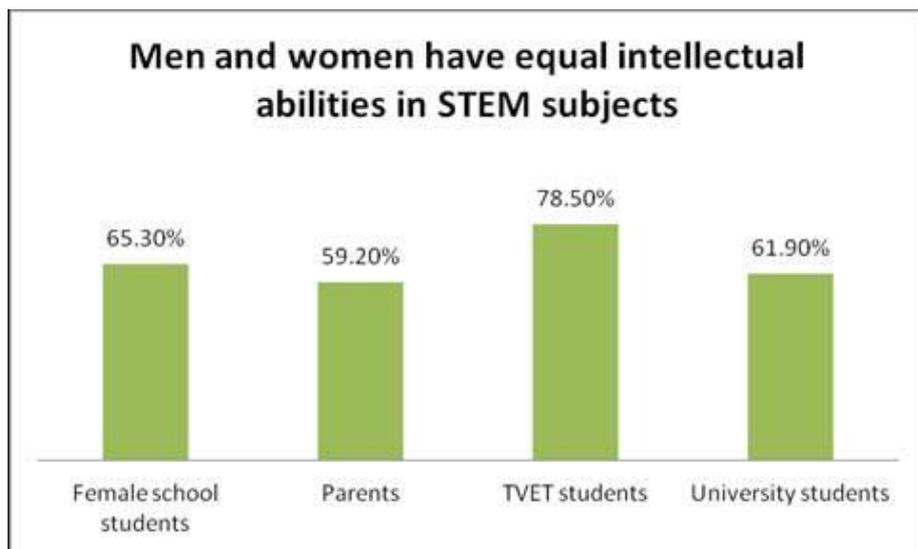
At the same time, opinions of the IPM Research survey respondents on performance of boys and girls in STEM subjects coincides with the findings from the desk study discussed in the first section for question 1 of this study that girls outperform boys in STEM subjects. Almost an equal number of TVET and university students - 53.7% of TVET students and 59.5% of higher

²² Kvernadze, S.2008. Gender difference in higher education system of Georgia. Master thesis. Tbilisi State University, gender Studies program.

education institution students agree that girls perform better than boys on most of subjects in their group. None of the respondents from university STEM faculty and only one respondent from TVET STEM faculty agree that boys outperform girls in their group.

Even more, most of the respondents think that men and women have equal intellectual abilities in STEM subjects - most of female school students (65.3%) and their parents (59.2%) agree that women have the same level of capabilities in technical subjects as men, similarly, 78.5% of respondents from TVET students and 61.9% of university students agree with this statement.

Graph 1.21. Percentages of respondents who feel men and women have equal intellectual abilities in STEM subjects.



It is clear that most informants in the IPM Research surveys believe that men and women have equal intellectual abilities in STEM subjects and that girls outperform boys in them. What is the reason then, of women under-representation in STEM subjects? The answer is provided by some respondents of the IPM Research survey:

- 27.4% of university STEM faculty and 22.6% of TVET STEM faculty agree that many girls, who were interested in HEI STEM fields, did not choose them but other careers, deemed more appropriate for women due to the social stereotypes.
- 14.3% of respondents from higher education STEM faculty and 21.5% of TVET STEM faculty agree that STEM fields are regarded as male. The numbers of female and male respondents were relatively small; therefore, the gender differences in answers were not statistically significant.

So, girls do not opt for STEM careers because of societal stereotypes that these careers are not considered as fit for women as others. These social stereotypes are pronounced by around **20%** of the respondents:

- 32.6% of female school students and 22.4% of their parents, as well as 26.2% of TVET students and 25% of university STEM faculty and 14.3% of TVET STEM faculty agree that women need to work harder than men to prove their competence and professionalism, because men have more

capabilities and possibilities, women are considered weak creatures and because employers prefer to get men in the working places.

- 16.7% of university students agree with this statement and provide various explanations, such as: “women need to prove their mental abilities”; “as women in Georgia are considered to have lower level of professionalism”; “they are more looked at as the weaker sex”; “Women are less relied on when it comes to their competence”; “These are technical subjects and expectations toward women are lower than toward men”. The numbers of female and male respondents were relatively small; therefore, the gender differences in answers were not statistically significant.
- 28.5% of STEM faculty and 28.6% of TVET STEM faculty, as well as 16.3% of female school students agree that there are social and cultural stereotypes regarding male and female professions in Georgia. 17.9% of school STEM teachers think that stereotypes about gender specific professions exist, the most widespread stereotypes among their students are: “STEM subjects are for men”; “a woman should be a teacher”; “humanitarian subjects are for girls”, etc. The numbers of female and male respondents were relatively small; therefore, the gender differences in answers were not statistically significant

Overall quite a large segment of population thinks that skills and knowledge of women in STEM fields are limited, or, in other words, men are fit to STEM professions better than women.

Sub-question 3 girls’ and women’s self-perceptions of their abilities in STEM subjects;

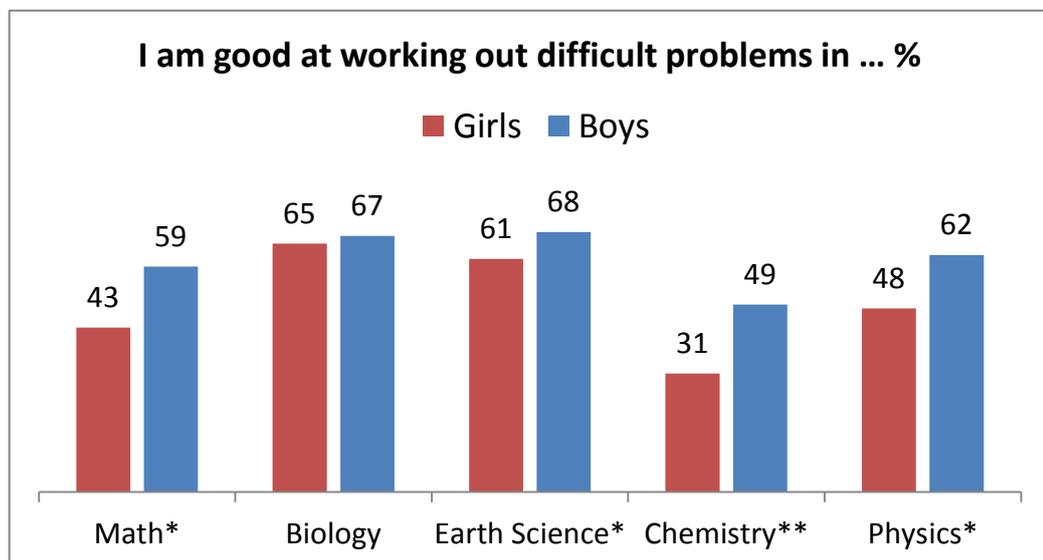
- As the IPM Research survey results revealed, STEM faculty students named various reasons why they chose STEM professions. Mostly they named that they have talent and interest in this field (boys-45.4%; girls-47.6%; desire to achieve success was another factor for choosing this profession (boys-44.4%; girls-47.6%). Similar factors were found with TVET STEM students: 52.8% of boys and 32.1% of girls say that they have talent and interest in this field. There is no statistically significant difference between boys and girls’ answers mainly because their numbers is too small - they have similar reasons for choosing STEM career. Specifically, those who have chosen a STEM career, consider their abilities good enough for this field. According to this data there is no difference between girls’ and boys’ self-perceptions of their abilities in STEM fields, however, there might be a difference expected among those, who did not choose STEM career.
- Indeed, the IPM Research survey data shows the reason for less representation of girls in STEM fields. 38.8% of female school students and 28.5% of their parents, as well as 44% of STEM school teachers, 16.7% of TVET students and 31% of university students agree that many girls don’t pursue STEM education because they think STEM professions are above their capabilities.
- However, only 12.9% of respondents from university STEM faculty and only 4.8% of TVET STEM faculty agree that girls have lower self-perceptions of their abilities in STEM subjects but it should be remembered that this

survey was carried out with students who had already selected STEM.

- The conclusion is that girl school students can be put off a STEM career because they think it might be too hard for them but once they have selected STEM and are studying at HEI or TVET, these negative perceptions are not found.
- According to Grade 9 National Assessments in Mathematics data, generally, equal number of ninth grade girls (38%) and boys (37%) assess their performance as good. However, boys are more likely to assess their math ability higher, then girls, 25,7% of girls and 32,8% of boys think that they are good in math (difference is statistically significant, sig=.000).

Various factors may define a student's willingness of enrollment in a particular profession. Beliefs and self-perception are one of the crucial factors that can influence students' preferences. In the section dealing with the question 1 of this study on the current gender situation in the STEM filed, we analyzed data on gender differences in achievements of schoolgirls and schoolboys. On the one hand, girls score the same and in some cases even more than boys and, on the other hand, girls have lower self-assessment than boys. Despite equal achievement scores of boys and girls, boys are assessing their achievements higher, than girls. The graph below provides the information about Georgian eighth grade students' self-perception on solving difficult problems in STEM subjects. As it stands from the graph, boys are more likely to think that they can work out difficult problems successfully, than girls. The difference is 7-18 percent in most of the cases.

Graph 1.22 Eighth grade students' self-perception in STEM subjects by gender, TIMSS 2011

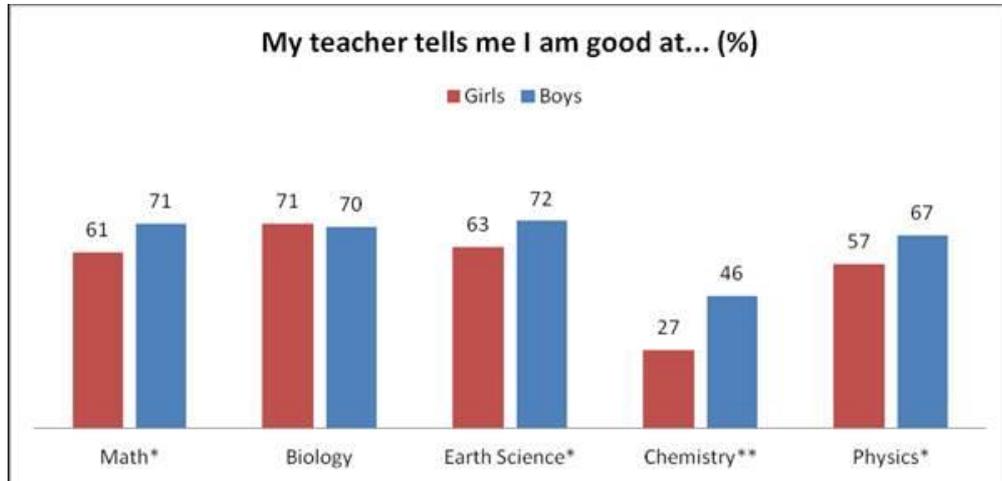


*the difference is statistically significant (Sig=.000); **Sig=.020

According to the IPM Research focus group results, encouragements from teachers, parents and other authoritative persons play a role in developing self-perception. As it is shown from the **graphs 1.21 and 1.22**, boys felt more encouraged by teachers, than girls did. Despite their almost equal achievements, boys are assessed more positively in STEM subjects by teachers,

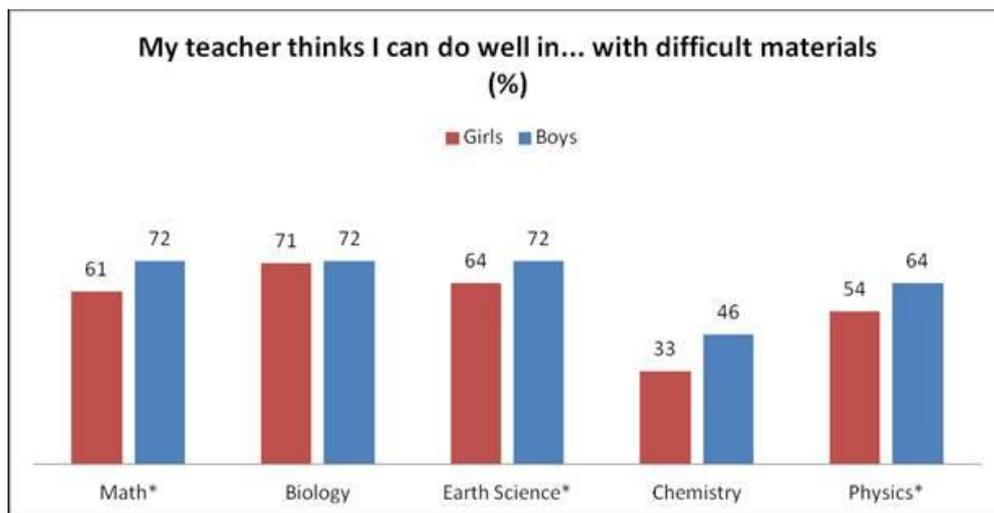
than girls are. Similarly, boys are more encouraged for their ability to deal with the difficult materials in these fields, than girls are. The differences in both cases are at least 10%.

Graph 1.23 Georgian children’s beliefs on how their teacher tells them they are good at STEM subjects



*the difference is statistically significant (Sig=.000); **Sig=.020

Graph 1.24 Georgian children’s beliefs on how their teacher thinks they can do well in difficult subjects



*the difference is statistically significant (Sig=.000)

According to TIMSS 2011, the correlation between encouragement and self-assessment is significant for all above mentioned cases (table 1.6):the higher the teacher’s assessment of student’s performances, the higher is the student’s assessment of his/her own ability working out difficult problems in STEM subjects.

Table 1.6 Correlations between self-perception and encouragement from teacher

My teacher tells me I am good at...	I am good at working out difficult problems in...				
	Math	Biology	Earth Science	Chemistry	Physics
	.478**	.562**	.592**	.794**	.623**

N	4233	4193	3726	177	4114
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** Correlation is significant at the 0.01 level

It is suggested that students prefer to work in the spheres, where they believe they are able to perform successfully. According to the above provided data, in spite of Georgian eighth-grade girls outperforming boys in STEM subjects, they assess their own abilities lower, than boys do. Consequently, we can assume that encouragement from teachers may be considered as one of the crucial factors for girls' underrepresentation in STEM professions.

However, the findings presented below are contradictory, most of them disagree that teachers treat boys and girls differently. As the IPM Research survey has shown, most of female school students, TVET students, university students, parents of school students and school STEM teachers think that teachers hold equal expectations from female and male students in STEM subjects. Only 11.9% of them agreed that teachers have lower expectations from female students and provided various explanations regarding boys' capabilities, such as: boys have better thinking skills, boys love technical subjects; girls are more interested in humanities and find STEM subjects difficult to study; girls get married in early age and do not continue studies; etc.

According to Grade 9 National Assessments in Mathematics data, girls - 69.7% - are more likely to think that their math teacher is sure that they will become successful if they study well, than boys - 63.3%. Similarly, more girls - 65.7% think that their math teacher makes them feel that they can solve all problems they start doing, than boys - 60.8% (the difference is statistically significant, sig=.000). Also, more girls (75.0%), than boys (67.0%) think that their math teacher is fair. More girls (80.5%), than boys (68.2%) disagree that their teacher does not like them and this attitude prevents them to study math well.

As the IPM Research survey has shown, most of female school students - 67.3%, their parents - 69.4%, 70.2% of school STEM teachers, 61.9% of TVET students and 64.3% of university students disagree with the statement that girls are rarely encouraged to pursue math and science at school. However, only 30.6% of female school students agree that their mathematics (physics) teacher encouraged them to pursue the STEM career.

Most of the female school students do not agree with the statement that they like, or dislike STEM subjects because of the teacher. However, those, who agree with this statement, say that the reason is the teachers' explanatory skills; also, 93.9% of students say that teacher's role is important in the study process. 97.9% of the parents also agree with the importance of the teachers' role in study process.

In most of the school STEM teachers' opinion, girls do not think that STEM subjects are beyond their capabilities. Those who think so, provide reasons, such as: "girls are more humanitarians"; "it is perceived as difficult subject for girls"; "it needs fast thinking"; "based on the specifics of the subject"; "poorly written textbooks", etc. Somewhat contrary to the above, 41.7% of teachers agree that boys find STEM subjects easier, than girls and provide explanations

with regard to boys' capabilities, such as: "boys are more able to think fast"; "boys are more practical"; "boys are more technical"; "boys are more skilful and open-minded"; etc. Overall, teachers think that boys have more abilities to pursue STEM subjects.

Despite the fact that girls are outperforming in STEM subjects, boys are more likely to feel encouraged by teachers, than girls. Teachers may also be biased which also affects students' self-perception and beliefs. This finding is supported by the data from IPM Research focus group discussions conducted in Tbilisi, Kutaisi, Akhaltsikhe, Akhalkalaki and Marneuli, among female ethnic Georgians, ethnic minorities and socially vulnerable minorities within 9, 10, 11 and 12 grades. According to the participants, teachers' personality and behaviour might become reason for liking or disliking subjects at school:

- 'Teachers make a great influence on students. They can force them to love the subject.'
- 'I love Geography and mathematics because of my teachers; I can understand [the] subjects very well'.
- "I don't like mathematics but I like our teacher of mathematics and he made me love the subject itself'.

According to the respondents, they cannot learn the subject well if they don't like the teacher. There are teachers which are always nice, help children when they have some problems, explaining but there are some teachers also who are shouting constantly, who are always in a bad mood. Also, STEM teachers' behaviour encourages boys more than girls:

- 'I don't want to study mathematics, physics or chemistry because in our class teachers have no inter-action with girls. They are mainly concentrated on boys (Akhaltsikhe ethnic minorities). '

According to the girls in the focus group discussions, teachers should encourage students. If they constantly indicate that a student does not know anything and does not need to study, of course she loses the interest. Focus group respondents are complaining that teachers have higher expectations from boys than from girls - especially when the teachers are male.

The IPM Research survey has shown that most of the members from higher education institution STEM faculties - 61.9% and TVET STEM faculty - 52.4% - disagree with the statement that professors have lower expectations of female students, while only 9.5% of university professors and 2.4% of TVET professors agree with this statement. The numbers of female and male respondents were relatively small; therefore, the gender differences in answers were not statistically significant. Overall, the analysis of the data enables us to conclude that female underrepresentation in STEM fields is strongly influenced by teacher attitudes.

According to the IPM Research survey, 95.9% of school students consider their parents' role as important in the study process. 93.8% of parents agree that parents' role in education of their children is as important as that of the teachers'. 47.6% of school and 34.5% of TVET teachers think that boys are more encouraged by parents to apply for university STEM programs, than girls.

- 89.9% of female school students and 91.8% of their parents agree that schools work hard at encouraging girls as well as boys to pursue STEM careers, 61.9% respondents from university STEM faculty and 29.8% of TVET STEM faculty agree with this statement.
- It is also noteworthy, that boys' family members are more likely to be interested in their child's performance in math, than girls. 20.3% of boys and 16% of girls say that their family member talks with their math teacher regarding their study almost every day. According to 18.3% of boys and 14.3% of girls their family members talk with their math teacher once a week (difference is statistically significant, sig=.000).
- It is also clear that parental and family attitudes also play a key role in either encouraging girls to do well in STEM subjects or not; it appears that parents are more likely to encourage boys and more likely to have contact with sons' math teachers than daughters'.

Findings of studies conducted in Georgia coincide with those of the United States. They also point to the possible causes for women underrepresentation in STEM. Attitudes of society at large, families, parents and teachers, all point to the fact that boys are more supported and encouraged to take STEM subjects at all levels of education and follow this path into professional career as the STEM field is considered as more appropriate for boys as something that naturally follows their abilities and skills. Also, girls regard themselves as less capable than boys and unfit for STEM career. However, these attitudes are contradicted by data on performance of boys and girls in STEM subjects as presented in question 1 of this study.

Study 1: Question 1.3. Organizational-structural barriers limit women's participation in post-secondary STEM programs

1. Gender differences in guidance provided to secondary-level students;
2. Gender differences in access to secondary-level STEM subjects;
3. Gender differences in scholarships for secondary (TVET Level I-III), post-secondary (TVET Level IV-V)
4. Gender differences in access to bachelor, master's and doctoral programs;
5. Gender differences in access to faculty mentors in STEM fields;

The following part provides analysis of possible organizational-structural barriers that limit women's representation in STEM programs. The analysis is based on the data from PISA 2009, 2009-2010 Unified Entry Examinations, particularly the data on received state scholarship by gender, as well as focus group discussions conducted in Tbilisi, Kutaisi, Akhaltsikhe and Marneuli, among female ethnic Georgians, ethnic minorities and socially vulnerable minorities within 9, 10, 11 and 12 grades and the data from Grade 9 National Assessment in Mathematics.

Sub-question 1.3.1: Gender differences in guidance provided to secondary-level students;

According to the IPM Research survey data, 59.2% of school students agree that the role of family and social expectations into women's career development is very strong in Georgia. According to the focus group data, the role of the family is very strong in guiding children in their educational careers, especially among ethnic minorities and (rural) ethnic Georgians in the regions.

- 'I want to become a psychologist but my mother is against it, she wants me to become a cosmetician.'
- 'Unfortunately, I can't do anything against my father's will, because everything is connected to the finances and he is paying. My father is actively involved in my life. He wants me to become a lawyer and to work in Russia but Russia is not a country for me.'(Marneuli).

The focus groups showed that parents support their children if they choose the profession their parents want. Mainly parents decide which profession to choose and children have no problems with this. The Family role in selecting the profession is very strong in Kutaisi as well. The tradition of certain professions is very strong here and children mostly choose similar professions as their parents. However the IPM Research survey of students at HEI and TVET indicated that the majority of students believed that they had selected their career on their own, notwithstanding the fact that in many cases they were dependent to some extent on their families to finance their studies.

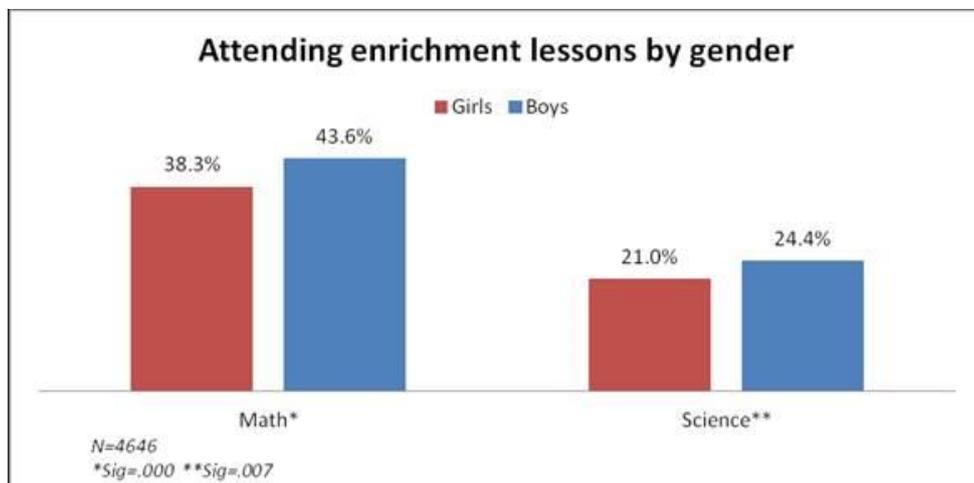
- 'The whole my family are teachers and my mother is a teacher too.'
- 'All our relatives are economists and I will be an economist too.'

The position of parents is quite clear in Marneuli, where girls are obliged to do what their fathers tell them to do. Although girls have their own opinion, still

they cannot resist and at the end they are sure that their parents want the best for them.

PISA 2009. The analysis of PISA 2009 results revealed gender differences in taking extra lessons in STEM subjects. Unfortunately, school education in today's Georgia is not satisfactory; this is well shown by results of Georgian schoolchildren on PISA 2009 Mean scores of Georgian students in all three areas were below the means attained in all OECD countries; Georgia was 5th from lowest among PISA countries. Many parents, if they can afford, use private tutoring to help their children understand and learn school subjects. Private tutors in most of the cases are not school teachers but professionals working elsewhere, or, unemployed and university students. This is true especially for large cities, while in small cities and villages private tutoring is done by schoolteachers as there are no other specialists in the field. Graph 1.25 provides the information about percentage distribution of students taking extra lessons by gender. As it is clear from the graph below, 43.6% of boys and 38.3% of girls are taking extra lessons in math and 24.4% of boys and 21% of girls – in science. According to the data, boys are more likely to be encouraged by their parents to take additional lessons in mathematics and science, than girls. This might be connected to the parents' beliefs found in the IPM Research conducted focus groups that boys need to learn mathematics, while for girls hard sciences are not so needed and will not be as much used in their future careers.

Graph 1.25 Percentage distributions of students taking extra lessons by gender PISA 2009



Similar results are provided by Grade 9 data, boys are more likely to have private tuition in STEM subjects, than girls: 5.9% of girls and 9.3% of boys – in physics (sig=.000); 3.3% of girls and 6.1% of boys – in geography (sig=.000). The only exception is math: 33.9% of girls and 30.6% of boys have private tutor in math (sig=.039). Difference between genders for chemistry and biology is not significant: 5.6% of girls and 6.2% of boys in chemistry; 3.8% of girls and 5.2% of boys – in biology.

Overall, the analysis of the three sources of data enables us to conclude that girls get less private tuition than boys and this is likely to be a causative factor in girls' decisions about STEM careers

Sub-question 1.3.2: gender differences in access to secondary-level STEM subjects;

Since the secondary level curriculum is uniform in all schools (with the possible exception of one or two "magnet" schools), this question is not relevant to Georgia.

Sub-question 1.3.3: gender differences in scholarships for secondary (TVET Level I-III), post-secondary (TVET Level IV-V)

Several statistically significant gender differences were found for TVET students in the IPM Research survey, which indicates that male students have greater satisfaction with their scholarship as well as more positive attitudes toward their career perspective than female students.

63.6% of male students and 28.6% female students held the scholarship (sig=.088). The scholarship is provided by the state and is given according to the grades applicants collect at the unified entry examinations.

On the question why they did not get the scholarship, 40% female students answered that they were not socially vulnerable, 60% - did not have high points; 25% male students answered they were not socially vulnerable, 41.7% - did not have high points, 8.3% did not apply, 25% - do not know. 28.6% female and 12.1% male students agree that the scholarship is not enough to cover their educational fees.

A Pearson chi-square test was conducted to examine whether there was a relationship between gender and satisfaction with scholarship. The results revealed that there was a significant relationship between the two variables (sig=.015). A significantly larger proportion of TVET male students report (66.6%) satisfaction with scholarship than female students (28.6%). This is not surprising, as almost three times more boys than girls receive scholarship at TVET.

There was a significant relationship between gender and positive attitude toward one's career perspective (sig=.013). A significantly larger proportion of TVET males students (93%) suppose that the education received in TVET will somehow assist them in their future career, than female students (75%).

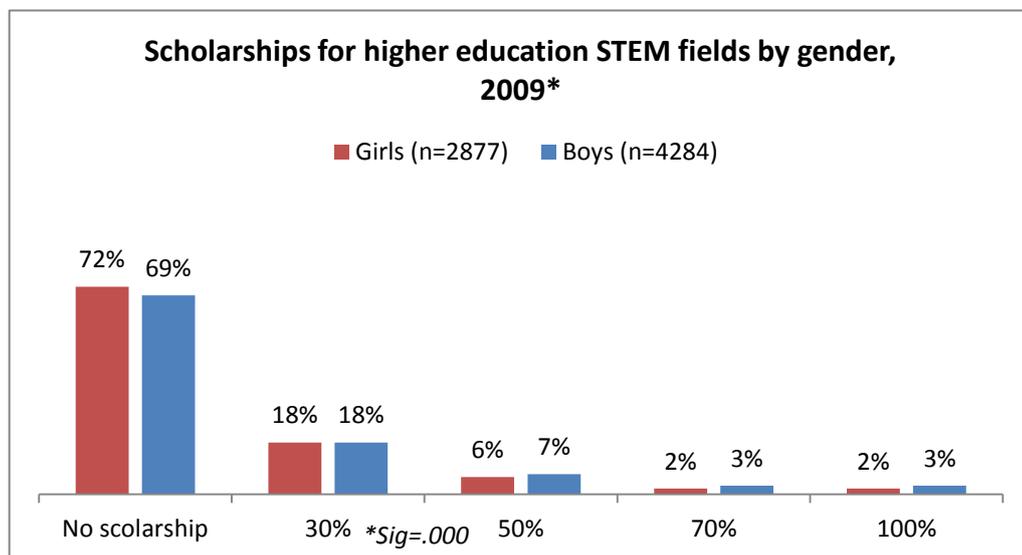
It is clear that more boys in the survey received scholarships and, respectively, they were more satisfied with this, than girls. They look at their future career possibilities with greater confidence and hopes. While girls in the survey got fewer scholarships, were less satisfied with them and looked at their career perspectives more pessimistically.

Sub-question 1.3.4: gender differences in access to bachelor, master and doctoral programs;

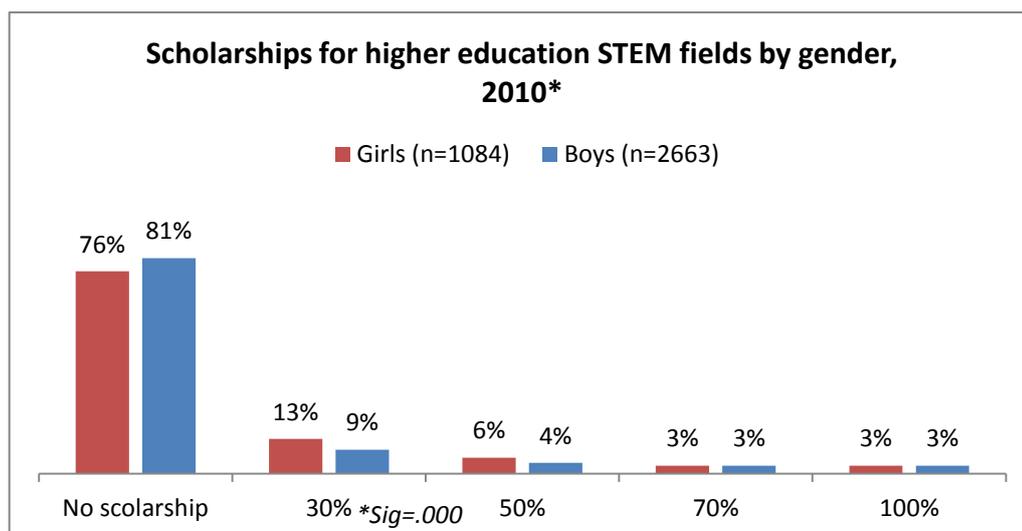
Unified Entry Examinations: Based on the scores collected in the higher education institution unified entry exams, students can receive a state scholarship to cover their tuition fee, however, its amount varies, some students receive a full scholarship, which covers 100% of tuition fee and the others receive 70%, 50% or 30% of the tuition fee. Also, the tuition fee itself

varies between public and private universities, the fee for public universities is fixed by the government and universities are not entitled to change it. The scholarship amount corresponds to the public universities' tuition fee, while the private universities tuition fee is higher. Usually, about 30% of students receive scholarship. The graphs below provide information about gender differences in scholarships for higher education STEM fields. As it is clear from the graphs, in 2009 more boys received scholarships, than girls; in contrast, in 2010 more girls received scholarship, than boys; however, the differences between the girls and boys is very small yet significant (graphs 1.26 and 1.27). Note to reader: The total number of students in STEM fields in the graphs is not the same as reported in Table 1.7; this is because the data came from 2 different sources: NAEC and the state statistics bureau, where possible NAEC statistics have been used.

Graph 1.26 scholarships for higher education STEM fields by gender 2009



Graph 1.27 scholarships for higher education STEM fields by gender 2010



According to the data above, scholarships do not create barriers to either gender in study. However, in general, there is a lack of scholarships based on

social vulnerability, or needs²³, thus, the state needs to think more in the direction of supporting underrepresented layers of society.

40.5% female and 32.4% male students in the IPM Research survey of STEM students had a scholarship while studying at university (sig=.351). This is a merit based scholarship (according to the grades the students receive at the entry examinations) provided by the state²⁴. In general, about 30% of all students receive a scholarship.

58.9% female and 45.7% male students say that scholarship is not enough to cover their educational fees; however, this difference is not statistically significant. The amount of scholarship is not enough for about 50% of the respondents disregarding their gender because, the volume of scholarship corresponds to the tuition fee in public universities, while private universities charge more.

On the question why they did not get the scholarship, the absolute majority of both male and female students answered that they had not enough grades at entry examinations. No statistically significant difference was revealed in university students' satisfaction with the scholarship. A relatively equal proportion of male (57.1%) and female (51.2%) students were satisfied with their scholarship. This argument is supported by the IPM Research focus group study finding that financial resources and material status of the family could be hindering factors in obtaining the desired profession. Many families from Kutaisi, or Akhaltsikhe, for example, find it dangerous to send their children to Tbilisi or any other places to study. Apart from the risks of personal danger, the main issue is cost (apartment, food, transportation, etc.), which many families cannot afford. As a result, a girl who wants to get medical education, which is of very low quality in Kutaisi, finds another profession, which is more or less developed locally, near to her family's home.

Analysis of western literature²⁵ revealed that conditions for study and work are different for men and women, giving more opportunities to men to pursue their careers successfully. As one of the examples, student parents need child care to succeed in community colleges. Unfortunately, limited access to child care disrupts the educational path of many mothers. Although more mothers enrol in community colleges than in four-year institutions, fewer than half of all community colleges offer on-campus child care and available slots do not typically meet student demand²⁶.

²³ Only about 800 students received such scholarships in 2011 and 2012

²⁴ It is noted that this data relates to STEM students. In general in Georgia about 30% of all students receive scholarships.

²⁵ American Association of University Women (AAUW). (2010). *Why So Few? Women in Science, Technology, Engineering and Mathematics*. Washington DC. AAUW

²⁶ American Association of University Women (AAUW). (2013). *Women in Community Colleges. Access to Success*. Washington DC. AAUW

The interviews conducted (Kvernadze, 2008)²⁷ with faculty and PhD students of three public Georgian universities showed a similar situation in Georgia: unequal conditions for men and women, especially for women with children. This prevents women's achievements, as they have to look after their children and do not have time to work. This, sometimes, results in unfinished PhD education, or long maternal leave that sometimes even leads to losing a job. Another study found that "Women's childcare obligations often impede their ability to participate in any number of reform activities. It is not insignificant that the number of pre-school programs in Georgia has been reduced dramatically and State-supported kindergartens have been replaced by a system in which childcare programs are provided by private centers on a fee basis or could be financed from the local budget" (Duban, 2010)²⁸.

In summary, there is no gender difference in receiving scholarship and it does not create any barrier in access to bachelor's, master's and doctoral programs. However, there are unequal conditions for men and women in Georgian public universities, especially for student parents that prevent their achievements on mainly doctoral level of higher education.

Sub-question 1.3.5 gender differences in access to faculty mentors in STEM fields;

Only the IPM Research survey data addresses this sub-question indirectly. According to IPM Research survey, 38.1% of university STEM faculty agree that in their group girls and boys are treated equally and only 1.2% of professors disagree with this statement. The majority of the respondents (60%) did not have answer to this question. The numbers of female and male respondents were relatively small; therefore, the gender differences in answers were not statistically significant.

In summary for this sub-section, men have better conditions and more support to enter STEM programs than women. There is no special attempt to support underrepresented groups of society. Women, especially married ones have to stay home and take care of their children, because there is lack of affordable day-care facilities. In the section below we will see that all employers surveyed reported having no day care facilities.

Study 1: Question 1.4. Bias in the Labor Market and Stereotyped Expectations about Gender Roles limit Women's Participation in STEM Occupations

- Bias in the labor market,
- Family/home expectations regarding women's roles,

²⁷ Kvernadze, S.2008. Gender difference in higher education system of Georgia. Master thesis. Tbilisi State University, gender studies program.

²⁸ Duban, Elizabeth, DevTech Systems, Inc .Gender Assessment USAID/Georgia 2010

The following part attempts to identify labor-market barriers that limit women's participation in STEM occupations. The analysis is based on the data from 2013 nationwide survey and review of other existing literature.

Sub-question 1.4.1 bias in the labour market,

For this sub-question we will mostly discuss employment bias. The information is provided directly by employers as well as indirectly, by STEM students and faculty. According to Elizabeth Duban, "In a pattern similar to that of the labor market, men and women seek degrees in distinct spheres. Women predominate in the fields of education, arts and humanities. Women are represented disproportionately in the teaching profession but due to vertical segregation there are greater numbers of women working at the public primary and secondary school levels and fewer professors at the university level" (Duban, 2010, p.27)²⁹.

According to the International Center for Education Policy Planning and Management (EPPM)³⁰ study, the likelihood of employment for men with higher education is 1.2 times higher than likelihood of employment for women with higher education. This difference is calculated within various education spheres, the gender difference remains in all spheres, be this hard sciences, or humanities. In other words, the likelihood for women's employment remains low compared to men (EPPM, 2012). There is no data on employers' attitudes to gender. We can only speculate that the general societal attitude to women in STEM fields might also be reflected in attitudes of employers preventing them from hiring women rather than men.

Based on the survey conducted with the employers, the following set of findings has been emerged. First, somewhat controversial relationship between their self-assessment of working conditions in their organizations that appeared highly promising and actual characterization of those conditions, illustrating no positive situation at all.

Employers rated working conditions for their female employees as excellent (35.3%), good (40%), average (18%), only 0.7% identified them as poor, there were no differences regarding the size and location of the organizations. Also, most of them (83.3%) have never heard of the discrimination cases against women on their organization, only 1.3% - have (mostly in medium and large organizations; located in Tbilisi and Imereti, while the remaining 15.3% have no women employees in their firms. On the other hand, up to 74.7% of the organizations have no special benefits for pregnant women, no maternity benefits (80%) and none of them have child day care facilities. In this regard, the difference was not revealed by the location of the organization, as for the size, large and medium sized organizations are more likely to provide benefits.

²⁹ Duban, Elizabeth, DevTech Systems, Inc .Gender Assessment USAID/Georgia 2010

³⁰ International Center for Education Policy Planning and Management (EPPM). 2012. Education and workforce in Georgia.

Second, employers' views do not reveal any women-friendly attitudes if not negative ones, related to the likelihood of women's acceptance in their organizations. 92% of them do not think that their organization would take any benefit from increased inclusion of women. Above (page 39) we have shown that these companies employ mostly men, 25.8% of permanent STEM jobs are occupied by women and 13% of full-time seasonal or temporary jobs are held by women. These percentages are not surprising as most of the employers do not see how they could benefit from hiring more women. Those who thought of women as beneficial for their organization explained their positive attitude by saying women have higher sense of responsibility, are very hard workers, accurate and neat.

Finally, when it comes to the attitudes and their underlying biases, employers' views reflect a perspective that does not recognize gender as a problematic issue. According to 73.3% of them gender imbalance has no place in Georgia, however, 26.7% declare that there is the gender inequality toward women. 91% of employers assume that there are not barriers to the recruitment, retention and progression of women in the STEM workforce. Those who accept that there might be some barriers preventing women from labor market, name the following: family burden, lower involvement, less security, low salary; heavy, masculine work; man's long established privilege in given occupations. The survey indicates that employers are not aware of gender bias yet their lack of interest in increased female participation in their work force taken with the lack of measures that would help this shows that gender bias is a real but unrecognized issue.

Female students of Secondary Level Schools, TVET Centers and universities were surveyed about the employers' preferences of male candidates and STEM jobs opportunities for female graduates.

It seems that secondary level STEM students' perceptions of employers' biased preferences are slightly sharper than of TVET Centers' or of higher educational institutions' students. 18.3% of secondary level STEM students agree that employers give preferences to male candidates, even if those males are less qualified. In their view, this favoritism occurs because boys are more active, thought to be better in coping with work activities, physically more capable and families do not provide free choices for women.

Up to 10% of TVET Centers' and higher education institutions' female students think that employers give preference to male candidates, even if less qualified. They themselves have never experienced an obstacle in getting job because of their gender.

46.9% of secondary level STEM female students, 28.6% of TVET Centers' female students and 26% of higher educational institutions' female students agree that many girls don't pursue STEM education because they think there is a lack of job opportunities for female STEM graduates. The reasons for this as mentioned by TVET Centers' female students are general, employment related problems; low number of factories, farms, which can require new staff but not gender itself. Higher educational institutions' female students named the general deficiency of work for men and women, as well as more gender

specific reasons such as preference given to men in technical fields, or that men are stronger than women. This has to be seen in the context of the desk research for study 3 that showed a surplus of qualified people leaving HEI and TVET over above job opportunities leading to unemployment but more frequently under employment in jobs for which they are over qualified.

The gender pay gap in all spheres of labor market is supposedly caused by a higher proportion of men in top managerial positions. According to the International Center for Education Policy Planning and Management (EPPM) 2012³¹ study, “gender has a significant impact on income and it remains even when two people with a degree in one and the same sphere are compared. For example, in the case of a man and a woman with higher education in business administration, with similar age and place of residence parameters, a man would have a salary that earns 176 GEL more than a woman”.

In summary for this sub-section, the research has emphasized existing barriers with its findings. The labour-market related obstacles to women are obviously reflected in employers’ views. While expressed unawareness of needs can be useful for strengthening women’s position on the labour market, the lack of concern to increase women’s representation means that STEM employers maintain a gender biased outlook. This is accompanied by students’ expectations to see greater opportunities for male graduates to find a job than females.

Sub-question 1.4.1 family/home expectations regarding women’s roles,

Family expectations regarding gender roles are as follows in Georgia: women are supposed to stay in a family and take care of their husbands and children, while men are supposed to support the family financially. “71.4% of respondents concurred with the statement that it is better for everyone, when a man takes up a job and woman tends to the house” (Sumbadze, 2008)³². Currently, 30% of breadwinners in Georgia are women; however, this state is not liked by the society at large. In terms of professions, being a teacher or a doctor is considered the best fit for women, as these occupations go along with their natural caring mission, while men’s natural leadership skills are said to make them better business people and politicians.

According to the 2013 study nationwide survey³³ conducted in Georgia, 20% of the population regards school education and 26% of population regards

³¹ International Center for Education Policy Planning and Management (EPPM). 2012. Education and workforce in Georgia.

³² Sumbadze, Nana, Gender and Society: Georgia, SIDA/UNDP (2008). http://undp.org/ge/new/files/24_425_824113_gender&society2008.pdf

³³ Javakhivili, N., Gachechiladze, N. ACT Georgia Gender Study, 2013 (UNDP)

university education more important for boys than for girls. Focus group discussions carried out as part of this study provided possible explanations: education gives opportunities for better earnings which are needed more for boys who should become breadwinners for their families. Also, in the case of limited resources in a family if there is a choice to be made, 44% of the Georgian population would support the education of a son rather than the education of a daughter. Only 22% of those who participated in the focus group discussion would support education of a daughter rather than that of a son.

Qualitative data also revealed suggestions behind parents' reasoning: a girl will get married so let her husband worry over her education while a son stays with the parents and therefore they have to invest in his education. Differentiated family attitudes result in more confidence in boys than girls. According to the IPM Research survey, at the university level, male students consider themselves more as an independent and confident than female students. A Pearson chi-square test was conducted to examine whether there was a relationship between gender and one's self-representation of being independent with the ability to learn a profession. The results revealed that there was a significant relationship between the two variables (sig=.001). A significantly larger proportion of University male students (99.1%) reported that they consider themselves as an independent and able to learn a profession, than female students (78.6%).

The same survey showed that most of students think they have chosen their careers independently, however, this is true more for boys than girls - 98.1% of university STEM male students and 78.6% of female students agree that they can choose their future profession independently (the difference is statistically significant, Sig=.000). As for TVET STEM faculty students, 88.9% of male and 92.9% of female students agree with this statement, the difference is not significant, meaning that boys and girls equally regard themselves as independent.

34.6% of university STEM faculty and 25% of TVET STEM faculty agree that family background plays a role in pursuing STEM careers for women. 47.6% of the higher education institution STEM faculty and 32.2% TVET STEM faculty agree that the role of family and social expectations into women's career development is very strong in Georgia (e.g. some families have generations of doctors and it is almost family obligation to pursue the medical career).

In summary for this sub-section: The family expectations cause larger investments in education for boys than girls as boys are supposed to become breadwinners later on. Differences in chances for employment and earnings for women and men also create labor market barriers for women. Employers appear to hire men for STEM jobs and promote them to decision making positions more, than women. Even more, they do not see how they and their business can benefit from more women employees.

Study 1: Question 1.5. Programs which have been effective in increasing the participation of women and girls in STEM fields, in Georgia and other countries?

Literature review of effective programs; The Queen's University Belfast, leads the way in the UK and Ireland in promoting good employment practices for women with equal representation of women in undergraduate, postgraduate, research and academic staff distribution³⁴. The number of professors is increasing considerably. The increase in female representation is a consequence of intensive mentoring, support and encouragement of women from the schools and university. They provide such favorable practices for women as special mentoring scheme for academic women; keeping gender balance in committee membership as well as nominating for honorary degrees under review; completing of exit questionnaires – to be able to draw conclusions regarding gender differences in reasons for leaving the university; teaching-free period for maternity leave returners.

Another example of good international practice is the positive attempt to achieve gender equity is defining and eliminating bias in testing and assessment (Dianne Reed, Lynn H. Fox³⁵). Bias in testing may occur when one group outperforms another on the assessment instruments, although in reality there are no differences in knowledge or ability between the groups. For example, gender differences in test performance have been found because of chosen test format or item type. If a test or assessment instrument favors any format or item type, it has a tendency to undertake gender discrimination. PISA and TIMSS tests are routinely tested to ensure no gender bias but there is no practice of this in Georgia. The research was not able to establish whether the NAEC tests have been verified for gender bias.

Principles ensuring valid and fair tests are available in Standards for Educational and Psychological Testing³⁶ which were created by the American Educational Research Association, the American Psychological Association and the National Council for Measurement in Education and are widely held to be the most important technical and legal standard for quality testing in all educational settings.

Catherine Hill with Christianne Corbett and Andress St. Rosse has contributed considerably to expanding our knowledge and understanding of gender related

³⁴ Submission for SWAN Silver Award 2011, Queen's University Belfast

³⁵ Reed, D. Fox, L. Andrews, M., Betz, N., Evenstad, J., Harris, A., Hightower-Parker, C., Johnson, J. Johnson, S. Polnick, B. and Phyllis Rosser. Gender Equity in Testing and Assessment. In: Hand Handbook for Achieving Gender Equity Through Education

³⁶ Reed, D. Fox, L. Andrews, M., Betz, N., Evenstad, J., Harris, A., Hightower-Parker, C., Johnson, J. Johnson, S. Polnick, B. and Phyllis Rosser. Gender Equity in Testing and Assessment. In: Hand Handbook for Achieving Gender Equity Through Education

issues related to women's underrepresentation in STEM fields. They have proposed several helpful strategies that can be successfully implemented as a fundamental part of attaining gender equity in work or educational contexts. One of these positive strategies deals with the pay gap, suggesting the development of more transparent pay systems as a possible remedy (Christianne Corbett and Catherine Hill)³⁷. According to the authors, greater transparency that can be achieved by simply making salary ranges for specific job titles available to all employees, providing workers with information that puts wages in context and helps them evaluate the fairness of their earnings, might be related to the greater gender pay equality found in the public sector.

Another even more tangible method Christianne Corbett and Catherine Hill have offered is conducting a pay equity study, that is, when employers assess the pay gap within their organizations and take steps to address any gender pay differences they find. For example, public-sector employers in Minnesota are required to conduct a pay equity study every few years. They use a job evaluation tool to compare the complexity of issues encountered, the depth and breadth of knowledge needed, the nature of interpersonal contacts required and the physical working conditions. This allows them to identify jobs that, despite being different, require similar levels of knowledge and responsibility. An analysis then compares wages for predominantly female jobs with those of predominantly male jobs of comparable skill levels. If the results show that women are consistently paid less than men are paid for jobs requiring similar levels of knowledge and responsibility, the employer makes the necessary salary adjustments.

Some of their advice relates to the individual's choices and behaviors. Individuals can make a difference and manage to be paid fairly, for instance, by developing negotiation skills. However, negotiation skills are especially tricky for women because some behaviors, like self-promotion, that work for men may backfire (fail) on women. Knowing what their skills are worth, making clear what they bring to the table, emphasizing common goals and maintaining a positive attitude are some negotiation tactics that have been shown to be effective for women. Beyond their personal lives, individuals can also take steps to influence employers and governments; letters to legislators and local papers, blogs and tweets are just a few examples that can help women make their voice heard and dealt with. 38

Catherine Hill and Andresse St. Rosse have also discussed how community colleges help mothers attending community colleges, exemplified/illustrated

³⁷ Corbett, Ch. & Hill, (2012). *Graduating to Pay Gap. The Earnings of Women and Men One Year after College Graduation*. Washington DC. American Association of University Women (AAUW)

³⁸ American Association of University Women (AAUW). (2012). *The simple truth about the gender pay gap*. Washington, DC

by the case taking place in Arkansas. There is the Career Pathways Initiative (CPI) program for low-income parents operating at all 22 community and technical colleges in Arkansas. This program has been designed to help poor and low income parents, mostly mothers, achieve academic and workplace success through academic advising, tutoring and job placement assistance. The Career Pathways Initiative is run by the Arkansas Department of Higher Education, which is funded with federal dollars the Arkansas Temporary Assistance for Needy Families (TANF) grant. These funds pay for staff and instructors and provide direct student support services like child care and transportation vouchers, tuition and other educational expenses. Outcomes for CPI students compared with those of other Arkansas community college students suggest that the program is effective in helping students earn degrees and certificates.³⁹

Hill, St. Rosse and Corbett also recommend encouraging a “growth mindset” viewing intelligence as a changeable, malleable attribute that can be developed through effort and is likely to lead to greater persistence in the face of adversity and ultimately success in any realm, as opposed to a “fixed mindset”.⁴⁰ Backed by Dweck’s revolutionary and powerful research findings⁴¹, the above mentioned authors emphasize the usefulness of a growth mindset particularly for girls in STEM areas, because it frees girls of the ideas that their individual mathematical ability is fixed and their ability is lower than that of boys by virtue of their gender. Dweck and her colleagues have found that for both middle school and college students, a growth mindset protects girls and women from the influence of the stereotype that girls are not as good as boys in math. In the face of difficulty, girls with a growth mindset are more likely than girls with a fixed mindset to maintain their confidence and not succumb to stereotypes. Research by Dweck and her colleagues has shown that a growth mindset promotes not only higher achievement but increased persistence in STEM fields as well. Practically speaking, a “growth mindset” can be engendered by using some specific teaching programs at any educational level. In addition to mandatory courses and subjects girls learn at school or university they might be taught the notion of intelligence that looks at their abilities and competences not as conditioned by their gender and therefore limited to certain level of achievement but as more expandable and rewording depending on their effort and determination.

Study 1: Question 1.6. Recommends for increasing Women’s Participation in STEM Occupations

³⁹ Rose, A. & Hill, C. (2013). *Women in Community Colleges. Access to Success*. Washington DC. American Association of University Women.

⁴⁰ Hill, C., Corbett, Ch. & Rose, A (2010). *Why So Few? Women in Science, Technology, Engineering and Mathematics*. Washington DC. American Association of University Women.

⁴¹ Dweck, C. (2006). Is math a gift? Beliefs that put females at risk. In S. J. Ceci & W. M. Williams (Eds.), *Why aren’t more women in science? Top researchers debate the evidence* (pp. 47–55). Washington, DC: American Psychological Association.

Recommendations as to what interventions the Government of Georgia and Millennium Challenge Corporation could use to improve women's participation in STEM occupations.

1. Girls' interest in STEM subjects is not being converted into STEM career choices:

As the results of the IPM Research survey revealed, most of the female school students are interested in STEM subjects: 57.1% of female school students say that they are interested in math and only 6.1% are not interested in math. In physics, 36.7% are interested while 12.2% - are not. In chemistry, 57.1% are interested and 10% - are not. In biology, 69.4% are interested and only 2% - are not. In geography, 75.5% are interested while only 4.1% - are not. And in informatics, 62.2% are interested and 4.1% are not interested. However, in reality only few of them choose STEM as major.

Recommendation regarding girls' interest in STEM subjects is not being converted into STEM career choices:

As this information shows that interest is not being converted into choices of STEM careers. There is a good basis for further popularizing of STEM field as a career for young people and especially, for women. Some of the recommendations given by the respondents of IPM Research survey will be discussed below as they provide good understanding of possible changes that must be crucial for getting better representation of women in STEM programs and jobs.

2. Gender stereotyping:

The IPM Research survey shows that there is a widespread belief amongst female students, faculty and parents that females have to work harder than men to prove their competence. It also shows that about 25% of faculty think that females who could enter STEM choose not to do so for societal stereotype reasons. The desk-research shows that textbooks are male orientated.

Recommendation regarding Gender stereotyping:

A school based programme to eliminate gender stereotyping.

Implemented by MOES this would include:

- Re-printing text books with equal male and female orientation
- Teacher in service training on gender
Universities and TVETs can take a positive approach to recruiting female students and a proposed gender equality officer is advised for this reason
- Positive role models of females in STEM jobs can be promoted in University and TVET information!

Addressing deeply held stereotypes in society and in ethnic minority and remote rural areas is a long term strategy with no quick fixes. A short term and uncoordinated approach will not reach all of society. The textbook authors need to be trained in gender awareness and the MOE staff also need gender equality training

3. Elimination of gender stereotyping about STEM jobs:

The IPM Research survey shows that there are social and cultural stereotypes regarding male and female professions (18% school teachers, 14% University STEM faculty & 21.5% TVET faculty). The IPM Research focus groups shows students believe that many STEM jobs are seen as more suitable for males because of perceived required physical strengths and teaching jobs as more suitable for females in accordance with perceived maternal instincts. Also there are perceived societal attitudes to females getting married rather than building a career.

Recommendation regarding elimination of gender stereotyping about STEM jobs:

An awareness raising programme to show that STEM jobs are for women as well as men. Gender awareness to be a part of ongoing teacher continuing professional development. Universities & TVETS to be encouraged to set up Gender Officer positions to facilitate gender equality in all aspects of the institutions' lives.

It is feasible but it will need professional public relations leadership and media engagement and probably a small amount of technical assistance from an international partner. There are resource implications, such a task could be put out to tender, perhaps by the Employment Service and an international donor may wish to support this; it requires technical input. The resource implications are small and technical advice could be provided from an EU or US institution. The implications are more about cultural change in the schools and education institutions.

4. Female perceptions of STEM abilities and teacher influence:

Desk Research shows that girls out-perform boys in STEM subjects at school in 8th grade (TIMMS, PISA). It also shows evidence of girls receiving less affirmation than boys in their ability in the STEM subjects and their ability to work well with difficult materials. The IPM Research survey reports that 52.7% of boys and 32.1% of girls say that they have talent and interest in this field, yet female achievement is higher than boys. This is a contradiction that defies a logical explanation other than female perceptions of STEM abilities are lower than the reality. The IPM Research survey also shows that a strong reason why girls do not pursue STEM careers is their perceived lack of ability. The focus group informs that teacher attitudes and encouragement are crucial in forming perceptions about STEM ability and that teachers tend to affirm boys more than girls. The IPM Research survey showed that 'Overall; teachers think that boys have more abilities to pursue STEM subjects.'

Recommendation Female perceptions of STEM abilities and teacher influence:

Continuing professional development for teachers to make a culture change in schools resulting in girls receiving as much attention and encouragement as boys. Such a programme appears deceptively simple yet it is far from it. Attitudes and beliefs are deep seated and often unconscious. As a result many teachers might say that they are already fully aware of the issues while their practice as shown by the surveys shows a different reality. This is about cultural change. It will not happen quickly. A short term approach is almost certain to fail. MOE can also introduce some short-term activities, like,

awarding teachers with gender equality approach. It will need monitoring and a champion at high level.

5. Parental encouragement:

The IPM Research survey shows that 47.6% of school and 34.5% of TVET teachers think that boys are more encouraged by parents to apply for university STEM programs, than girls. It also shows that schools do work hard at encouraging girls as well as boys to pursue STEM careers, so there is an issue is about parental influence. The survey also showed that students themselves were clear that they were able to make decisions about further study and career themselves, yet the focus groups confirmed that the impression remains that parental influence remains is still important particularly in rural areas and ethnic minorities. The IPM Research survey showed that many parents are more positive about investing in a son's education than a daughter's. It also showed that while 99% of male students consider themselves independent and able to learn a profession for females the figure was 78.6%. The results of the IPM Research survey and focus groups are clear; parental influence is stronger with females than males.

Recommendation regarding parental encouragement:

A public awareness programme, already proposed for Issue 3 on gender stereotyping above. It would be combined with action in schools to promote STEM careers for girls and would reach conversations between the school and parents of girls.

6. Career guidance:

It is clear that career guidance was only received by around a third of all students in the IPM Research survey. Yet socially disadvantaged students reported much higher rates, 61.9%. Awareness of specific STEM careers ranged between 22% and 37% for TVET students and 40.7% and 56.6% for University students. Only 7.3% of employers thought that schools were aware of labor market issues and trends. The IPM Research survey shows that STEM Careers are seen as attractive at school but knowledge about the reality of STEM jobs is low: 36% for University students had this awareness while at school. The corresponding figures for TVET students were in the high 30s for T and E but 22% for science and 31% for Math careers. It is clear that knowledge about STEM jobs that would enable informed career decision making needs to be improved.

Recommendation regarding career guidance:

Career guidance in schools is a clear need. It needs to be incorporated into the work of each school and should involve local employers and the Employment Service who would provide realistic and up to date information. The Employment Service may need resources to provide the information service but it should be seen as a priority as it links to international best practice as set out in the EU Bruges Communiqué. This requires the full commitment of the Employment Service, MOES, schools and local employers to work in partnership.

7. Scholarships:

The IPM Research survey shows that boys are almost twice more likely to receive a TVET scholarship than girls. However the opposite situation arises for University study where girls have the higher share and also in socially disadvantaged groups, although this can vary from year to year as it is merit based. The survey shows that information about scholarships is only reaching about half of students who go to University and only 9% of TVET students. However, socially disadvantaged students reported higher rates of being informed about specific scholarships for socially disadvantaged students (as opposed to the general scholarships). The socially disadvantaged undergraduates state that they would not have been able to continue their studies in a higher educational institution, if they had not had scholarship. Therefore, the lack of financial support can be perceived as a potential barrier for socially disadvantaged students to study STEM subjects in higher educational institutions

Recommendation regarding Scholarships:

Better information about scholarships to be available in all areas and to be made but particularly for girls and socially disadvantaged groups and target scholarships at under-represented groups (already being done for the specific socially disadvantaged scholarship)

8. Barriers to female participation in the work force:

The IPM Research survey shows that employers believe that their working conditions for females are either excellent or good (75.3%), yet 74.7% of them have no special benefits for pregnant women, no maternity benefits (80%) and according to the absolute majority they do have not child day facilities. Also 92% saw no benefit in increasing their female representation in their work forces. 26.7% of employers recognised that there is gender inequality towards women but 91% assume that there are no barriers for women joining their workforce. It is clear that employers do have barriers for female engagement but do not seem to be aware of it.

Recommendation regarding Barriers to female participation in the work force:

An information campaign for employers about:

- The benefits of increased female participation in their work force
- Clear information about what is needed to make firms friendly places for female workers (as its clear most do not know)
- Demonstrate what the barriers are and how they can be overcome

There are resource implications as a campaign such as these needs to be delivered probably, though not necessarily, by a contracted provider. Without government and industry support it is unlikely to succeed.

9 Ideas from STEM faculties:

For the question: “what kind of programs or activities would encourage the involvement of more female students in HEIs STEM?” the higher education STEM faculty members provide various ideas. Most of them say that maintaining the policy of identifying promising career opportunities for women and publicising them would encourage them to get involved in HEI STEM

programs; scholarships and exchange programs abroad might be additional incentive for this objective. Also, equal study conditions for boys and girls, increase in jobs for women in STEM companies; mobilizing finances by government to promote STEM occupations more intensely in response to the growing demand on STEM professions and skills in Georgia. The educational system should provide more scholarships, well-equipped laboratories; STEM programs should direct their focus on practical work, fostering active involvement in research. To advertise STEM professions, special open days might be organized for schoolgirls. Changes in social conditions were also mentioned as a general advantageous aspect. The Government sector was named as the most effective body for carrying out such activities, especially Ministry of Education; besides, NGOs, international organizations, World Bank, research centres and institutions were named, mostly because of their obligations and capabilities to finance these programs.

As for TVETs' the most frequent answer was the increase in employment rate, by concentrating on practical work that can be achieved by exchange programs and scholarships, internships, open doors days, relevant trainings and conferences, as well as high level of technological development. Government, UN, local and international organizations and organizations working on female issues, because of their experience and opportunities were named as the responsible organizations to carry out these activities.

As for STEM employers, the majority consider government and employers as responsible actors to encourage women in STEM fields, as well as the education sector and civil society. Apparently, more boys receive scholarship and, respectively, they are more satisfied with it, than girls. Special measures need to be developed (worked out) to attract more female students to TVET centres and universities. This does not mean to neglect boys, itself. If boys study better and get higher grades, they should also receive scholarships but there might be special scholarship for girls as an incentive to support their study and future career. As the Ministry of education is the main provider of scholarships for tuition fees that is merit based for TVET and university students, we recommend providing social scholarships, including for underrepresented layers of society.

Female school students agree that the teachers' role is important in study process. They provide various opinions on the teachers' activities that encourage students to study STEM subjects, these are: the possibility of performing more practical work, work in laboratory, teachers' positive attitudes and expectations towards students, inspiring them. It would be helpful also if teachers maintain individual approach to each student, introduce interesting additional materials and organize competitions and other subject-relevant events, as well.

Attitudes of teachers and parents can play a positive role for students to pursue STEM career determinedly. Most of the survey respondents say that boys and girls are equally treated by their parents and teachers; however, qualitative research and desk study reveal that this is not always the case. Therefore, it is very important to make parents and teachers more aware of

their attitudes and help them change in a better way, to prevent their biased beliefs from influencing their behaviours and judgments towards their children or students. Special materials can be prepared and special trainings can be carried out for this.

Guided with our research findings we can identify several actions, which might be undertaken to make current workforce more gender-balanced, for example, motivational privileges for women, by appointing them to managerial positions. Specific (educational/informational) work is needed with employers to raise their sensitivity toward gender equality and to make them concerned about female employees' needs. Employers can provide such incentives for female employees as opening day-care centers, providing good conditions for maternity leave and for young mothers to get back to their jobs smoothly after maternity leave.

STUDY 2: BARRIERS TO THE PARTICIPATION OF SOCIALLY DISADVANTAGED STUDENTS IN STEM PROGRAMS

Introduction and background:

This study has four main questions that will inform recommendations to the GoG and MCC, regarding:

- (i) The current situation for socially disadvantaged students in STEM fields and occupations in Georgia, -see the desk research for study two and qualitative research.
- (ii) institutional barriers that limit participation of the socially disadvantaged in STEM fields,
- (iii) Labor market barriers to STEM fields and
- (iv) the characteristics of effective programs to boost participation in STEM fields and occupations by the socially disadvantaged.

Study 2: Question 2.1: Present situation with respect to socially disadvantaged students in Science, Technology, Engineering and mathematics in Georgia

2.1.1 & 2.1.2 Evidence related to CAT by key categories of socially disadvantaged

This research aims to study organizational and structural barriers for socially disadvantaged students in STEM programs in Georgia.

Three socially disadvantaged groups in Georgia are considered: mountain dwellers, ethnic minorities and low-income families. By GoG definition, within the socially disadvantaged group belongs families living in low social-economic circumstances. The rules for being defined as a low-income family are, first the family must apply to the Social Service Agency for enrolment in the program. Afterwards, a representative of the Social Service Agency (Social Worker) visits the family. The social worker has a special form and evaluates the various circumstances of the family (living conditions, furniture, heating system etc.) The evaluation has a special system of scoring and every family who has a score lower than 57001⁴² will be considered as a family who needs financial support. Every family member receives monthly support from the government. Students from these families have the opportunity to apply for a special scholarship program funded by MoES.

Mountain dwellers and ethnic minorities are not as clearly defined as socially disadvantaged, although the Ministry of Education and Science has a special scholarship programs for these groups.

This state of affairs influenced the strategy of sampling for the survey. As the GoG presents low-income families as socially disadvantaged, groups of undergraduate students and secondary level students were selected from this category. Therefore students from ethnic minorities and mountain dwellers were not sampled separately. Information regarding mountain dwellers and

⁴²Until 2013 the lowest score was 71000 so the dates until this year was analyzed in this frame.

ethnic minorities was gathered by asking teachers, HEI_TVET members and employers.

CAT –Computer Adaptive Test

CAT – Computer adaptive testing system started in Georgia in 2011, the goal of the testing is to implement passing-out examinations. CAT covers all schools in Georgia. The test covers eight subjects:

- Mathematics
- Biology
- Chemistry
- Geography
- Physics
- History
- Foreign language (English, Russian, German, French)
- Georgian Language and Literature.

Within this project test results of STEM subjects were analyzed (Mathematics, Biology, Chemistry, Physics, Geography). The target groups were school students from mountain dweller families and ethnic minorities. We compared mountain dweller school students' results to the general population (other school students from all over Georgia) and we compared the school students who passed the test in Russian, Armenia or Azerbaijan languages (Ethnic Minorities) with other students. The analysis was made within the databases of CAT 2011 and 2012.

Mountain Dwellers

Mountain dweller school students were selected through the districts situated in the mountains of Georgia. These districts are: 1.Mestia; 2. Oni; 3. Ambrolauri; 4. Akhalkalaki; 5. Ninotsminda; 6. Tsageri; 7. Khulo; 8. Keda; 9. Dusheti; 10. Kazbegi (Stephantsminda); 11. Akhmeta.

The key finding is that the mountain dwellers have lower performance in all the STEM subjects comparing to the general population (not mountain dwellers).

Average score of mountain dwellers in Mathematics were 6.31 and others 6.86 in 2011, mountain dwellers 6.53 and others 7.19 in 2012. The same tendencies are in other subjects: Biology - 6.53 mountain dwellers and 7.12 others in 2011, 6.55 mountain dwellers and 7.03 others in 2012, Chemistry - 6.78 mountain dwellers and 7.22 others in 2011, 7.08 mountain dwellers and 7.41 others in 2012, Physics - 6.37 mountain dwellers and 6.93 others in 2011, 6.40 mountain dwellers and 6.99 other in 2012, Geography - 7.07 mountain dwellers and 7.55 others in 2011, 7.24 mountain dwellers and 7.51 others. Both groups got higher scores in 2012 than in 2011, except Biology where not

mountain dwellers got lower scores 7.03 in 2012 than in 2011- 7.12. (Table 2.1.)

Table 2.1. Average CAT results in STEM subjects of Mountain dwellers and others in 2011-2012

Year	Group	Mathematics	Biology	Chemistry	Physics	Geography
2011	Mountain Dweller	6,31	6,53	6,78	6,37	7,07
	Others	6,86	7,12	7,22	6,93	7,55
2012	Mountain Dweller	6,76	6,55	7,08	6,40	7,24
	Others	7,19	7,03	7,41	6,99	7,51

The second finding is that girls from mountain regions have higher average score than the boys in all STEM subjects except Physics in 2011. Girls' average scores in Mathematics were 6.39 and boys were 6.23 in 2011, girls 6.84 and boys 6.68 in 2012. The same trends are seen in other subjects: Biology - girls 6.67 and boys 6.40 in 2011, girls 6.87 and boys 6.26 in 2012, Chemistry - girls 7.04 and boys 6.53 in 2011, girls 7.33 and boys 6.85 in 2012, Physics - girls 6.36 and boys 6.37 others in 2011, girls 6.58 and boys 6.24 in 2012, Geography - girls 7.15 and boys 7.00 in 2011, girls 7.30 and boys 7.18 in 2012. (Table 2.2)

Table 2.2. Average CAT results in STEM subjects by gender in 2011-2012 for Ethnic Minorities

Year	Group	Mathematics	Biology	Chemistry	Physics	Geography
2011	Boys	6,23	6,40	6,53	6,37	7,00
	Girls	6,39	6,67	7,04	6,36	7,15
2012	Boys	6,68	6,26	6,85	6,24	7,18
	Girls	6,84	6,87	7,33	6,58	7,30

Within the group of ethnic minorities all school students who passed CAT on Russian, Armenian and Azerbaijani Languages were selected. This group of was compared to the school students who passed test on Georgian languages.

The key finding is that ethnic minorities have lower average scores than the other school students in all STEM subjects in both years (2011, 2012).

Ethnic minorities' average score in Mathematics was 6.06 and others 6.36 in 2011; ethnic minorities 6.40 and Others 6.92 in 2012. The same trends are seen in other subjects:

Biology - ethnic minorities 5.85 and others 6.69 in 2011, ethnic minorities 6.21 and others 6.71 in 2012, **Chemistry** - ethnic minorities 6.56 and others 6.83 in 2011, ethnic minorities 6.85 and others 7.20 in 2012, **Physics** - ethnic minorities 5.81 and others 6.50 in 2011, ethnic minorities 5.83 and others 6.67

in 2012, **Geography** - ethnic minorities 6.77 and others 7.15 in 2011, ethnic minorities 7.09 and others 7.31 in 2012.

The lowest average score ethnic minorities achieved was in Physics (5.81) in 2011 and the highest average score ethnic minorities achieved was in Geography (7.09) as illustrated in the table below. (Figure 3)

Table 2.3. Average CAT results in STEM subjects of Ethnic Minorities and others in 2011-2012

Year	Group	Mathematics	Biology	Chemistry	Physics	Geography
2011	Others	6,36	6,69	6,83	6,50	7,15
	Ethnic Minorities	6,06	5,85	6,56	5,81	6,77
2012	Others	6,92	6,71	7,20	6,67	7,31
	Ethnic Minorities	6,40	6,21	6,85	5,83	7,09

Students from Low Income Families

The data regarding CAT results from students of low income families was provided by the Social Service Agency.

The key finding is that students from low income families have lower scores in all subjects than all other groups. (2011, 2012)

They had the lowest scores in math (6.28) in 2011 and the highest in Geography (7.9) in 2012.

The same trends are seen in other subjects.

Biology – Students from low income families scored 6.96 whereas students from non-low income families scored 7.37 in 2011. Students from low income families scored 6.96 whereas students from non-low income families scored 7.36 in 2012.

Chemistry – Students from low income families scored 6.82 whereas students from non-low income families scored 7.25 in 2011. Students from low income families scored 7.08 and students from non-low income families scored 7.43 in 2012.

Physics – Students from low income families scored 6.84 and students from non-low income families scored 7.22 in 2011. Students from low income families scored 6.86 and students from non-low income families scored 7.28 in 2012.

Geography – Students from low income families scored 7.04 and students from non-low income families scored 7.59 in 2011. Students from low income families scored 7.09 and students from non-low income families scored 7.55 in 2012.

Table2.4. Average CAT results in STEM subjects of low income families and others in 2011-2012

Year	Group	MATH	BIO	CHEMIST	PHYS	GEOGR
2011	Low Income Family	6,28	6,96	6,82	6,84	7,04
	Non-Low income family	6,89	7,37	7,25	7,22	7,59
2012	Low Income Family	6,75	6,96	7,08	6,86	7,09
	Non-Low income family	7,21	7,36	7,43	7,28	7,55

The second finding is that the girls from low-income families performed better than the boys in all STEM subjects in both years analyzed. Girls' average scores in mathematics were 6.33 and boys were 6.23 in 2011, while their scores in 2012 were girls 7.20 and boys 7.10. The same trends are seen in other subjects: Biology - girls 7.13 and boys 6.78 in 2011, girls 7.51 and boys 7.10 in 2012. Chemistry - girls 7.06 and boys 6.55 in 2011, girls 7.60 and boys 7.16 in 2012. Physics - girls 6.84 and boys 6.83 in 2011, girls 7.28 and boys 7.17 in 2012. Geography - girls 7.08 and boys 7.00 in 2011, girls 7.52 and boys 7.46 in 2012. (Table2.5)

Table 2.5. Average CAT results in STEM subjects by gender within low income families in 2011-2012

Year	Gender	MATH	BIO	CHEMIST	PHYS	GEOGR
2011	1 Male	6,23	6,78	6,55	6,83	7,00
	2 Female	6,33	7,13	7,06	6,84	7,08
2012	1 Male	7,10	7,10	7,16	7,17	7,46
	2 Female	7,20	7,51	7,60	7,28	7,52

Additionally, the share of ethnic minorities and mountain dwellers which belong to the category of low income family was 12.3% in 2011 and in 2010, 6.4% were mountain dwellers. 3.6% in 2011 and 9.1% in 2012 were ethnic minorities. These figures show that the mountain dwellers and ethnic minorities experience a form of double-discrimination and categories overlap each other to some extent. Secondly, the share of mountain dwellers within low-income families decreased from 12.3% to 6.4% in 2012. In the group of ethnic minorities the trend was contradictory in that the share of ethnic minorities increased from 3.6% up to 9.1%.

Comparison of social disadvantaged groups with each other:

The analysis shows that all socially disadvantaged groups (ethnic minorities, mountain dwellers, low-income families) underperformed in all STEM subjects as compared with non-socially disadvantaged students in 2011 and 2012.

Comparisons within the socially disadvantaged groups indicate that ethnic minorities have lower scores in all STEM subjects than students from low income families and mountain dwellers except in Geography in 2012.

The differences between low-income families and mountain dwellers are not so large and do not exhibit stable trends. In some subjects mountain dwellers have higher scores than the low-income families and vice versa. For instance, in math in 2011 the mountain dwellers' average score was 6.31 and the low income families 6.28. In 2012 in the same subject mountain dwellers' score was 6.31 and the low-income families 6.75. The same state of affairs occurs in other subjects as well.

2.1.3 Evidence related to: average scores on UUE math and science tests, by key categories of social disadvantage

2.1.4 Evidence related to: first year enrolments in university and TVET Levels I-V STEM fields, by key categories of social disadvantage

Ethnic Minorities and post-secondary education

In this chapter analysis of the Unified National Entry Exams Results in 2011 and 2012 years is presented. The data was provided by National Examinations Center (NAEC). Unfortunately this data does not separate out ethnic minority groups. Figures for those students who passed exams in Russian, Armenian and Azerbaijani were used to shape the dataset for those from ethnic minority groups. In addition, to these figures the number of students from regions of Georgia which are populated mostly by ethnic minorities were assembled; namely students from Kvemo-Kartli and Samtskhe-Javakheti. This approach has some limitations however. The amalgamated dataset does not allow integration of those minorities from other regions or those from the capital city due to the way the NAEC data was presented and categorized. However the ethnic minority dataset does show the main tendencies in the ethnic minorities and describes the state in the regions populated mostly with ethnic minorities.

In 2011, 594 students from ethnic minorities took the unified national exams (1.8% of the total number of students sitting the examinations). In order to place this 1.8% in the context of the overall population the last Census of 2002 was examined. It indicates the total share of ethnic minorities was 17%; comprised of 6.5% ethnic Azerbaijanis, 5.7% Armenians and 4.8% others. **There was no data available which breaks these percentages down by the**

minorities which completed 11th and 12th grades. Similarly there was no data about the share of ethnic minorities within the total population of secondary school students.

In 2012, students from ethnic minorities took the unified national exams rose to 722 (2.1% of the total student number sitting the examinations) see figure 2 below. (Table 2.6)

Table 2.6. Share of the ethnic minorities within total amount of the students applied in 2011 and 2012 Kvemo-Kartli and Samtskhe-Javakheti

Year		Frequency	Percent
2011	Others	32668	98.2
	Ethnic Minorities (Kvemo-Kartli and Samtskhe-Javakheti)	594	1.8
	Total	33262	100.0
2012	Others	33709	97.9
	Ethnic Minorities (Kvemo-Kartli and Samtskhe-Javakheti)	722	2.1
	Total	34431	100.0

Ethnic minority students' enrolment and results

In 2011 from the total amount 27 students from ethnic minorities were enrolled in academic programs and 15 in TVET programs (see figure 7), 380 were enrolled in the special one year preparation program in the Georgian language after which they can continue study in post-secondary education in the Georgian language. This program received the largest amount from ethnic minorities with 64%. 172 students did not pass or did not continue to study. Nearly the same percentage was seen in 2012. It is significant that the percentage of students in the preparation program increased from 64.0% in 2011 to 69.1%; an increase of 5.1%.

Table2.7. Ethnic minorities' enrolment in academic and professional programs

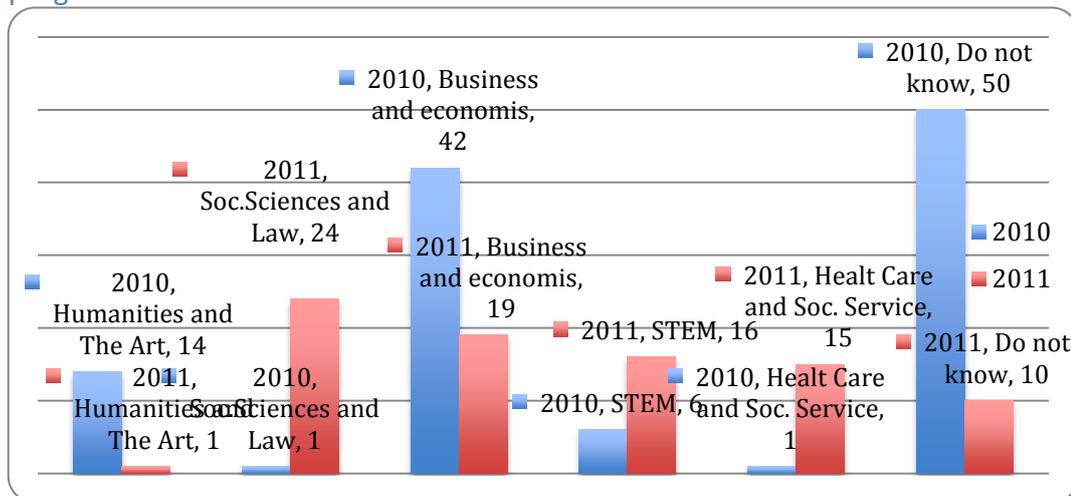
Year		Frequency	Percent
2011	Do not pass	172	29.0
	Academic program	27	4.5
	Preparation in Georgian language	380	64.0
	Professional Program	15	2.5
	Total	594	100.0
2012	Do not pass	201	27.8
	Academic program	22	3.0
	Preparation in Georgian language	499	69.1

Year		Frequency	Percent
	Professional Program	0	0.0 ⁴³
	Total	722	100.0

Role of the preparatory courses in the Georgian Language

The presented statistics show that a high percentage of students (64%) applied for the preparation courses in the Georgian language in 2011; rising to 69% in 2012. On one hand that means that the language program works well; on the other hand, it shows that there is still a challenge for ethnic minorities to get a satisfactory education in the Georgian language in secondary schools.⁴⁴

Graph 2.1. Choosing a profession by ethnic minority students after a bridging program:



The students after one year of a Georgian language preparatory course chose several programs. The greatest number applied for business and economics in 2010 (N42) and only six for the STEM faculty. The number of students who chose STEM professions increased in 2011 to a total of 16. It is difficult to present any trends here due to the facts that the program is new and we do not know what profession 50 students chose in 2010 and what profession ten students chose in 2011. Although, the number of students increased in 2011 not only in the STEM profession, but also in social sciences and law and in health care and social services.

⁴³The data relating to this program was re-checked and, according to the data which we had, nobody enrolled from this group to the Professional programs.

⁴⁴Again the Study Two team is trying to gain access to information about the number of these 380 out of 499 students who entered university and about the field of study they entered. This data has not been forthcoming in time for this report. It will be incorporated if and when it is available.

Ethnic minority share in STEM and TVET

The share of the students within STEM and TVET programs is also low (see figure 8 below). Only 5 students enrolled in STEM academic programs in 2011 out of the 27 applicants that year, followed by a further 5 in 2012 out of 22 applicants that year. A further 4 students enrolled in TVET STEM programs in 2011 and there were no applications in 2012. The data did not show what kind of further program was chosen by students who enrolled in the Georgian language preparation program in 2011.

Table 2.8. Enrolment of the Ethnic minority students in STEM academic and STEM professional programs

<i>Year</i>	<i>Program</i>	<i>Frequency</i>	<i>Percent</i>	<i>Percent from total students</i>
2011	STEM ACADEMIC	5	55.6	19%
	TVET STEM	4	44.4	27%
	Total	9	100.0	0%
2012	STEM_ACADEMIC	5	100.0	23%
	TVET STEM	n/a	n/a	n/a ⁴⁵
	Total	5	100.0	0%

From the total amount of the students from an ethnic minority 19% enrolled in STEM academic programs and 27% in TVET STEM programs in 2011. 23% of students from an ethnic minority enrolled in academic STEM programs in 2012. **A further dimension to the data is seen when the average examination scores for ethnic minority students are explored in General Skills i.e. the examination scores for ethnic minority students are 12% less than other students in 2011 and 2012 academic years.**

Table 2.9. Average scores in General Skills for ethnic minority students compared to all students

<i>Year</i>	<i>Student type</i>	<i>General skills average score</i>
2011	Others	150.28
	Ethnic Minorities (Kvemo-Kartli and Samtskhe-Javakheti)	138.37
2012	Others	150.26
	Ethnic Minorities (Kvemo-Kartli and Samtskhe-Javakheti)	138.98

⁴⁵At the time of this report there was no TVET STEM data available for 2012

The same picture continues when the average scores in STEM subjects in mathematics are reviewed. Ethnic minority students have on average 10 points less than other students: in 2011 ethnic minority students scored on average 139.93 points and in 2012 they scored 139.39 points (see Figure 10). In Biology students from ethnic minority groups scored 8 and 9 points less in the 2011 and 2012 academic years (142.61 points and 141.50 points respectively). In Chemistry average scores were 5 points less in 2011 for students from ethnic minorities at 145 points and in the 2012 academic year when they scored 145.38 points. One exception was the result for Physics in the 2011 academic year when students from ethnic minorities got 8 points more than other students (158 points) but this reversed in 2012 when Ethnic minorities achieved 3 points less than students who are not from an ethnic minority.

Table 2.10. Average scores in STEM subjects

Year			Math scores	Biology scores	Chemistry scores	Physics scores
2011	Others	Valid	11373	3473	911	349
		Missing	21295	29195	31757	32319
		Mean	150.12	150.12	150.06	150.07
	Ethnic Minorities (Kvemo-Kartli and Samtskhe-Javakheti)	Valid	59	23	2	1
		Missing	535	571	592	593
		Mean	139.93	142.61	145.00	158.00
2012	Others	Valid	10157	3430	1411	592
		Missing	23552	30279	32298	33117
		Mean	150.09	150.07	150.10	150.24
	Ethnic Minorities (Kvemo-Kartli and Samtskhe-Javakheti)	Valid	31	14	16	2
		Missing	691	708	706	720
		Mean	139.39	141.50	145.38	147.50

Conclusion

The overview of the results of the ethnic minorities shows:

- The share of the students from ethnic minorities is less than 3% of the total number of students.
- Ethnic minorities have lower scores than other students in all exams subjects except Physics in 2011
- A high proportion of students from ethnic minorities enrolled in the preparation course for the Georgian language.

Study 2: Question 2.2: Specific barriers that socially disadvantaged students face in secondary and post-secondary STEM programs

2.2.1. Differences in access to secondary-level STEM subjects by key categories of social disadvantage;

This section addresses the question: Do socially disadvantaged students face barriers that other students do not?

Practical Learning

It is clear that access to practical work in STEM subjects is important for all students but the lack of it is specifically reported by socially disadvantaged students in the focus groups.

Overall, according to IPM Research survey more than half of the secondary level students do not have practical exercises or experiments in the STEM subjects and this was confirmed by the focus groups. The findings of the qualitative research show that the students are much more interested in STEM subjects when teachers offer laboratory work and/or other kinds of experiments.

To discuss what kinds of practical work or experiments were provided in school, we can take two subjects: Physics and Chemistry. Only 30% of the students from the total amount who had partaken in any kind of experiment or exercises stated that they had conducted experiments in physics. It is not clear if the experiments were conducted in a Laboratory or in the study room. Only 2.0% of the students who mentioned that they had some experiment or practical exercises in chemistry worked in a laboratory.

While it is true that the absence of practical work affects all students, the focus group information tells us that socially disadvantaged students find the absence particularly difficult.

The school students indicated that experiments and practical exercises were used most frequently in physics (40.8%), chemistry (49%) and biology (32.7%). The lowest percentage of using practical exercises was informatics; only 2% of the students had this kind of experience.

This indicates that a special program for teachers to provide practical exercises during informatics courses should be explored. The results of the qualitative research indicate that such cases are very rare in secondary schools. Accordingly, more attention should be given to the use of laboratories and other practical activities by STEM subject teachers.

In summary: It is recommended that The MoES should support an increase in the practical portion of all courses and should support the STEM teachers that could be used in trainings implemented by the National Center for Teacher Professional Development

Text books

Sufficiency of text books

73.5% of students (Strongly agree and agree together) indicated that they agreed with the statement that there are enough text and supplementary books/materials, while 24.5% of them do not agree with that statement. 32.7%

(Disagree strongly and disagree together) of students report that textbooks are not available (see figures in database).

In summary: there are insufficient text books and this affects socially disadvantaged students as reported by the focus groups

Quality of text books

The actual quality of these textbooks and supplementary materials is evaluated as follows:

Table 2.10.1C_21_Evaluation of textbooks. Question: Do you agree or disagree that the textbooks which you use to study each subject listed below are good?

N=49	Math	Physics	Chemistry	Biology	Geography	Informatics
2 disagree	2.0	6.1	4.1	-	2.0	2.0
3 neither disagree nor agree	6.1	8.2	6.1	6.1	6.1	10.2
4 agree	61.2	59.2	59.2	61.2	63.3	24.5
5 strongly agree	30.6	26.5	30.6	32.7	28.6	16.3
Don't Know	0.0	0.0	0.0	0.0	0.0	46.9

Although there is some dissatisfaction with the quality of the text books, the majority consider them good. There are exceptions revealed by the focus groups, particularly in areas of high mountain or ethnic minorities where old and Russian language textbooks are still in use. A separate issue is the dominance of male images.

Class-rooms and facilities

42.8% of school students state that their classrooms are not equipped with modern services and equipment such as computers, internet, etc. However, 67.4% disagree or strongly disagree with the statement. (A library is provided in 93.9% of cases, however, it is equipped with modern services and facilities in only 32.6% of cases. The availability of a laboratory is much lower as only 42.9% of students state that there is a laboratory in their school and only in 38.1% of students agreed / strongly agreed that their laboratory is equipped with modern equipment

In summary: There is a mixed response on the quality of classrooms. It appears that there remain a significant number of classrooms that are not equipped with modern facilities and the focus groups suggested that they were in areas of social disadvantage (rural and mountainous area).

Laboratories

Table 2.11. C_28_Evaluation of laboratory. Question: The laboratory is equipped with modern services and utilities like different technical equipment, modern materials for experiments, reagents and etc.

N=21	Frequency	Percent
1 disagree strongly	2	4.1
2 disagree	7	14.3
3 neither disagree nor agree	3	6.1
4 agree	6	12.2
5 strongly agree	2	4.1
99 Don't know	1	2.0

N=21	Frequency	Percent
Total	21	42.9
Total	49	100.0

The data shows that a) in around half the cases the classrooms are not equipped with modern services; b) in more than half the cases, the libraries are not modernized; c) the laboratories are most outdated in the schools and need modernization. These environmental/infrastructural obstacles might be one of the main barriers to teaching STEM subjects properly. Consequently, modernization of the above mentioned should be a goal of the MoES.

Overall, more than half of the school students evaluated the quality of education in their school as good (61.2%); 36.7% of respondents are neutral and only 2% regard it as of low quality.

Generally, all the secondary school students who attended FGDs (100%) agree that their teachers' role is important in the study process and suggest that teachers should provide more practical work and experiments to encourage students to study STEM subjects (see the database).

TVET_HEI equipment

85.7% TVET and 64.2% HEI students agree that their TVET_HEI Center does have the necessary equipment to meet the future needs of technical vocational education and the future training needs of our employers. There was a minority who disagreed and there were some observations about the need for more journals and microscopes.

The equipment which HEIs lack are: experimental materials, electronic journals, field equipment, laboratories to do analysis, spectrophotometers, microscopes, modern technical equipment, advanced server technology, electronic books, projectors, chemicals, and networks labs. The equipment/resources which TVETs most commonly lack are: modern laboratories, having tighter contacts with local businesses and being more oriented to the current labour market's needs.

In summary: It does not appear that facilities at TVET and HEI form barriers.

Psychological barriers at home

Parental influences are high in this group

39% of secondary school students who were interviewed indicated that they have already chosen their profession and state they have made this decision themselves (37.5%) or were influenced by their father and mother or other family member (50.1%).

This fits the finding of the focus group discussions (FGDs) that parents and family have the highest influence on choice of profession.

Table 2.12 C12_Who most influenced the decision about future profession

	d1 Gender of the respondent		Total
	1 Male	2 Female	
1 Mother	16,7%	20,0%	18,8%
2 Father	33,3%	20,0%	25,0%
3 Other family member		10,0%	6,3%

	d1 Gender of the respondent		Total
	1 Male	2 Female	
4 I made decision myself	50,0%	30,0%	37,5%
5 Friend		20,0%	12,5%
Total		100,0%	100,0%

Subjects favoured by Socially Disadvantaged students

The most interesting subjects for them are biology, Georgian language and literature and foreign languages, while they are least interested in chemistry, physics and math. The data shows interesting differences between girls and boys; the girls are more interested in Math (51.9% very interested, 22.2% extremely interested). The same trend occurs in the case of physics and chemistry. Informatics appears to be an unknown subject for over a quarter of respondents.

81.6% of school students state that their STEM subject teacher teaches them only one subject.

Table 2.13C16_Interest in subjects. Question: To what extent are you interested in the following subjects?

	Gender	1	2	3	4	5	99
		Not interested at all	Not interested	Somewhat interested	Very interested	Extremely interested	Don't know
Georgian language and literature	1 Male	0.0%	0.0%	27.3%	45.5%	27.3%	0.0%
	2 Female	0.0%	0.0%	29.6%	37.0%	33.3%	0.0%
	Total	0.0%	0.0%	28.6%	40.8%	30.6%	0.0%
History	1 Male	0.0%	0.0%	31.8%	27.3%	40.9%	0.0%
	2 Female	0.0%	7.4%	37.0%	29.6%	25.9%	0.0%
	Total	0.0%	4.1%	34.7%	28.6%	32.7%	0.0%
Foreign Language	1 Male	0.0%	9.1%	22.7%	54.5%	13.6%	0.0%
	2 Female	3.7%	0.0%	22.2%	33.3%	40.7%	0.0%
	Total	2.0%	4.1%	22.4%	42.9%	28.6%	0.0%
Math	1 Male	0.0%	13.6%	54.5%	9.1%	22.7%	0.0%
	2 Female	0.0%	3.7%	22.2%	51.9%	22.2%	0.0%
	Total	0.0%	8.2%	36.7%	32.7%	22.4%	0.0%
Physics	1 Male	0.0%	18.2%	54.5%	22.7%	4.5%	0.0%
	2 Female	0.0%	14.8%	48.1%	29.6%	7.4%	0.0%
	Total	0.0%	16.3%	51.0^	26.5^	6.1^	0.0%
Chemistry	1 Male	0.0%	13.6%	45.5%	31.8%	9.1%	0.0%
	2 Female	0.0%	14.8%	25.9%	37.0%	22.2%	0.0%
	Total	0.0%	14.3%	34.7%	34.7%	16.3%	0.0%
Biology	1 Male	0.0%	0.0%	27.3%	40.9%	31.8%	0.0%
	2 Female	0.0%	3.7%	22.2%	37.0%	37.0%	0.0%
	Total	0.0%	2.0%	24.5%	38.8%	34.7%	0.0%
Geography	1 Male	0.0%	4.5%	31.8%	31.8%	31.8%	0.0%
	2 Female	3.7%	0.0%	25.9%	44.4%	25.9%	0.0%
	Total	2.0%	2.0%	28.6%	38.8%	28.6%	0.0%
Informatics	1 Male	0.0%	4.5%	18.2%	22.7%	22.7%	31.8%
	2 Female	3.7%	7.4%	14.8%	29.6%	22.2%	22.2%

	Gender	1 Not interested at all	2 Not interested	3 Somewhat interested	4 Very interested	5 Extremely interested	99 Don't know
	Total	2.0%	6.1%	16.3%	26.5%	22.4%	26.5%

With reference to the table 2.7 below: according to the students the easiest subjects for students are: Georgian language and literature, Biology and Geography. The hardest subjects for them to study are: Foreign language, Math and Physics. Physics and chemistry were also discussed in the focus groups as subjects which are both of low interest and difficult to study.

More boys (40.9% hard and 9.1% very hard) than girls (18.5% hard and 7.4% very hard) think that math is hard to study. The same trend is present in physics and chemistry.

Both of these dimensions, ease of study and interest in studying STEM subjects, indicate that socially disadvantaged girls have a greater interest in studying STEM subjects than boys and less think that some STEM subjects are hard to study.

To summarize: Physics and math are the most difficult subjects. This finding is worthy of greater attention by the relevant educational program decision-makers in order to increase interest in these two important STEM subjects.

Table 2.14 C 17_Easiness of subjects. Question: Is it easy or hard for you to study the subject?

N=49	Gender	1 Very easy	2 Easy	3 Neither easy nor hard	4 Hard	5 Very hard	99 Don't know
Georgian language and literature	1 Male	22.7%	45.5%	22.7%	4.5%	4.5%	0.0%
	2 Female	18.5%	55.6%	22.2%	3.7%	0.0%	0.0%
	Total	20.4%	51.0%	22.4%	4.1%	2.0%	0.0%
History	1 Male	22.7%	40.9%	13.6%	13.6%	9.1%	0.0%
	2 Female	3.7%	37.0%	40.7%	18.5%	0.0%	0.0%
	Total	12.2%	38.8%	28.6%	16.3%	4.1%	0.0%
Foreign Language	1 Male	0.0%	27.3%	31.8%	31.8%	9.1%	0.0%
	2 Female	0.0%	22.2%	33.3%	44.4%	0.0%	0.0%
	Total	0.0%	24.5%	32.7%	38.8%	4.1%	0.0%
Math	1 Male	9.1%	13.6%	27.3%	40.9%	9.1%	0.0%
	2 Female	11.1%	18.5%	44.4%	18.5%	7.4%	0.0%
	Total	10.2%	16.3%	36.7%	28.6%	8.2%	0.0%
Physics	1 Male	9.1%	27.3%	22.7%	36.4%	4.5%	0.0%
	2 Female	0.0%	18.5%	44.4%	25.9%	11.1%	0.0%
	Total	4.1%	22.4%	34.7%	30.6%	8.2%	0.0%
Chemistry	1 Male	4.5%	27.3%	36.4%	27.3%	4.5%	0.0%
	2 Female	7.4%	25.9%	40.7%	14.8%	11.1%	0.0%
	Total	6.1%	26.5%	38.8%	20.4%	8.2%	0.0%
Biology	1 Male	13.6%	50.0%	27.3%	4.5%	4.5%	0.0%
	2 Female	14.8%	33.3%	37.0%	11.1%	3.7%	0.0%
	Total	14.3%	40.8%	32.7%	8.2%	4.1%	0.0%
Geography	1 Male	22.7%	50.0%	22.7%	0.0%	4.5%	0.0%

N=49	Gender	1 Very easy	2 Easy	3 Neither easy nor hard	4 Hard	5 Very hard	99 Don't know
	2 Female	3.7%	48.1%	37.0%	11.1%	0.0%	0.0%
	Total	12.2%	49.0%	30.6%	6.1%	2.0%	0.0%
Informatics	1 Male	13.6%	18.2%	18.2%	9.1%	0.0%	40.9%
	2 Female	3.7%	48.1%	18.5%	3.7%	3.7%	22.2%
	Total	8.2%	34.7%	18.4%	6.1%	2.0%	30.6%

In summary:

Structural barriers at school

- The majority of the students noted that the laboratories (57.1%), libraries (44.9%) and other facilities are missing or are unsatisfactory at their schools. This is one of the important obstacles which must be addressed as this is also reported in the findings of the focus groups which show the number of students in STEM subjects is much higher when students have experiments in well-equipped laboratories.
- Consequently, two main themes emerge which need to be considered as budgets and policies for improvements are formulated in government; a) modernization of school equipment; b) the role of well-equipped laboratories and other supporting materials are seen as basic requirements to better integrate STEM subjects into the learning process.

Psychological barriers at school

- Students say Physics (38.8%) and Math (36.8%) are the most difficult subjects within STEM and the students have a lower interest in studying them.
- All students indicate the importance of the role of the teacher in the study process. This means that the improving participation in STEM subjects depends greatly on the teachers.
- It is recommended that opportunities for additional training are integrated into the teachers' existing continuous professional development plans to assist teachers to better understand how to increase interest in STEM subjects with students.

School Teachers about socially disadvantaged students and STEM Subjects

The evidence comes from the responses of school teachers. About half of school teachers say that they have socially-disadvantaged students in class, while approximately 46% of school teachers responded that they do not have socially-disadvantaged students. Approximately 8% indicated that they do not know if they have socially-disadvantaged students in their classes.

The majority of school teachers (54%) disagree that "*socially-disadvantaged students study STEM subjects better.*" 40% neither disagree nor agree with this statement. Only 5% agree that socially-disadvantaged students study STEM subjects better.

The majority of school teachers (58.3%) agree that "there is no difference in studying STEM subjects between socially-disadvantaged and other students," while 12.1% disagree with this and 26% neither disagree nor agree that "there is no difference in studying STEM subjects between socially-disadvantaged and other students."

To summarize: This indicates that teachers are not aware of any differences involved in teaching socially disadvantaged students which is surprising given the language issues attached to ethnic groups and the modest level of parental involvement identified by teachers. It indicates the need for awareness raising and subsequent in-service learning and development.

Barriers that socially disadvantaged students face according to the teachers

The most commonly cited answer is that socially-disadvantaged students do not have any barriers which affect their success in STEM subjects at schools (76.2% of respondents). The second most commonly cited answer is that “parents do not allow students to continue education” (7.1%) and in third place “students do not have the money to buy textbooks” (4.8%).

The majority of teachers (51%) evaluate socially-disadvantaged students’ parents’ involvement in the study process as 3 on the 1 to 5 grade scale, where 1 means not involved at all and 5 – very much involved. 12% evaluate it as 1 or 2 and 29% as 4. Only 8% of teachers evaluate parents’ involvement as very much involved, 5.

To summarize: This indicates that the majority of teachers think that parents could be more involved in their socially disadvantaged children’s’ education. 76.2% of teachers think that the socially disadvantaged students do not experience barriers to success. This indicates that the teachers have a low understanding of what kind of problems the socially disadvantaged students are faced with.

Table 2.15_TEACH_SCHO_T90: Please, evaluate on the scale from 1 to 5 to what extent are the parents of socially-disadvantaged students involved in study process of their children?

N=84		Frequency	Valid Percent
Valid	1 Not involved at all	3	3.6
	2	7	8.3
	3	43	51.2
	4	24	28.6
	5 Very much involved	7	8.3

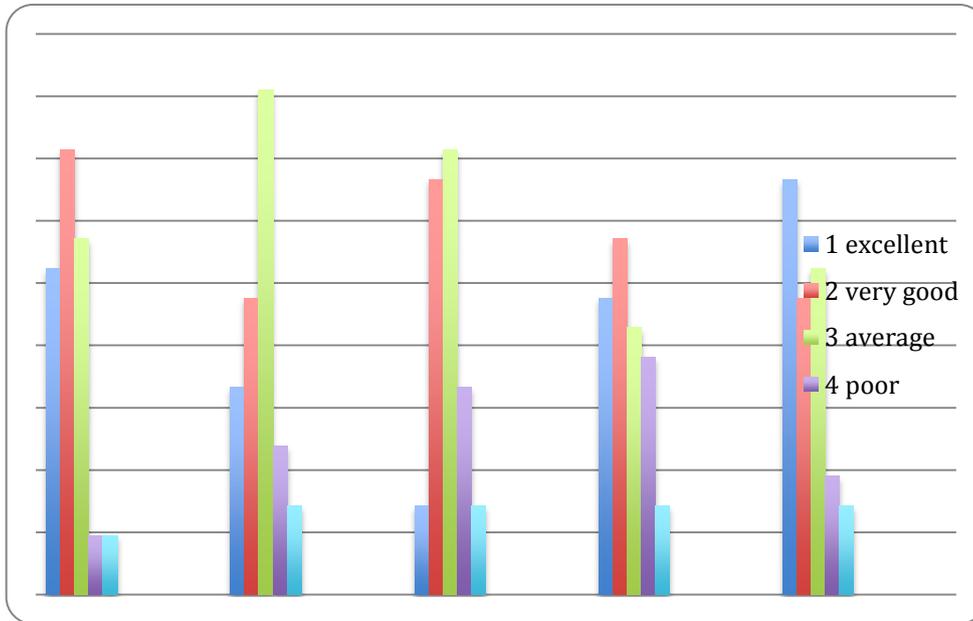
According to teachers the most commonly cited answer to the question: “what should be done to increase parents’ involvement in students’ performance?” is “parents’ financial support.” Since only ten respondents answered this question it is difficult to draw definitive conclusions although the results of earlier focus groups also mentioned that financial issues are major elements in the decision-making of students and their families when choosing the students’ next steps.

Evaluation of teaching quality of the STEM subjects at the schools by socially disadvantaged students of HEI and TVET:

One of the organizational-structural barriers that might limit socially disadvantaged students from participating in STEM programs is the role that the schools play. Therefore, questions addressing the role of schools were asked of the undergraduates and TVET students who are currently studying in order to assess the quality of preparation from schools.

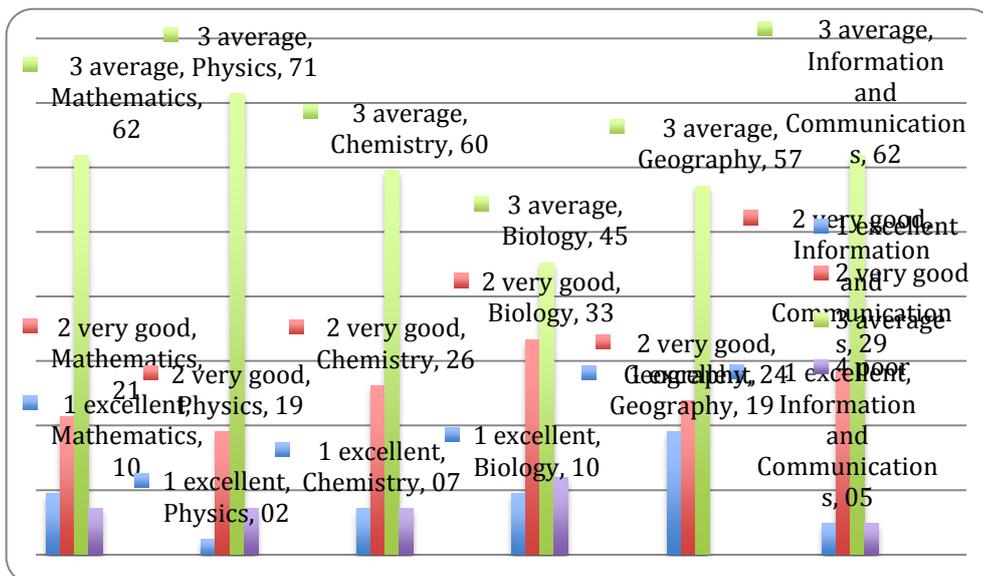
The quality of STEM subjects as evaluated by the undergraduates as more or less satisfactory at school. This is further supported by their perception regarding the assistance of these subjects for passing exams because 92.9% of undergraduates stated that knowledge gained at school assisted them in passing their exams.

Graph 2.2 Q13.The Quality of STEM Subjects Taught at School Evaluated by the Undergraduates



As for the TVET students, the evaluation of STEM subjects supplied at school is evaluated as average as compared to undergraduates. It should be noted that 28.6% of TVET students did not have to pass entrance examinations and among those who had to take those exams, it was stated that knowledge of STEM subjects from school assisted them in this process.

Graph 2.2.1 Q13.The Quality of STEM Subjects Taught at School Evaluated by the TVET Students



These results indicate that socially disadvantaged students who went to HEI rated their STEM school education as excellent or very good but those that went to TVET rated the education as average. This conforms to the results of the population as a whole (see study 3) where it is clear that high performing students who go to HEI are very satisfied with their school education but TVET students less so. This could indicate a teaching issue that could merit further study.

2.2.2 Differences in guidance provided to secondary-level students by key categories of social disadvantage;

The evidence from desk research is that socially disadvantaged students actually receive more advice on STEM subjects and relevant career choices than mainstream students (as reported in the focus group discussions) but the net benefits are not felt among socially-disadvantaged students due to a poor command of the Georgian language.

This suggests that secondary schools are aware of the problem faced by socially-disadvantaged students and that the schools are trying to help but the benefits are not yet being felt.

It is noted that the FGD participants were from three of the four social-disadvantage groups; ethnic minorities, high mountain regions and those of low income families.

2.2.3 Differences in scholarships for higher education STEM fields by key categories of social disadvantage;

The Admissions Process, Scholarships and Career Guidance

The evidence for this section comes from socially disadvantaged students from HEI/TVETs.

78.6% of socially disadvantaged undergraduates stated that they received information regarding the university admissions process at school, which was most frequently provided by the principal, booklets/magazines/forms, or through the school administration more generally. This percentage is much lower for TVET students as only 26.2% of them received the information which was mostly supplied by the principal, a teacher or by a representative of the TVET itself. In a case of not socially disadvantaged students the trends are almost same 34% of the students received the information at school. The percentage was lower in a case of TVET only 14% of the students received information from schools.

Career guidance was supplied to 61.9% of socially disadvantaged undergraduates in a case of not socially disadvantaged students career guidance was provided for 35.3%. It should also be noted that those undergraduate socially disadvantaged students who received such guidance name the following sources for the supply of such information: school administration/teacher, parents and friends the same trend is in the case for students who are not socially disadvantaged. This tendency is much lower in the case of TVET institutions as only 19% of students have received career guidance. In a case of students who are not socially-disadvantaged 31% received guidance at school (see the figures in database)

When socially deprived undergraduates were making a decision regarding the continuation of studies in the STEM fields in higher educational institutions they had more information regarding the opportunities in institutions which were in their local area as compared to information regarding the opportunities in institutions in their wider region.

Table 2.16. Q22_Q23. Availability of detailed information about Higher Educational Institutions opportunities while making the decision to continue education in STEM fields, regional and local institutions

N=42	Information on Regional Institutions		Information on Local Institutions	
	Frequency	Percent	Frequency	Percent
1 Disagree Strongly	1	2.4	1	2.4
2 Disagree	6	14.3	1	2.4
3 Neither Disagree or Agree	16	38.1	8	19.0
4 Agree	15	35.7	24	57.1
5 Strongly Agree	4	9.5	8	19.0

Regarding technical and vocational education and training opportunities in the region, 69% of socially disadvantaged TVET students agreed that they had received the required information. 59.5% of socially deprived undergraduates stated that they did not receive information about government scholarships for studying in higher educational institutions at school. As for the 33.3% of students who stated that they had received such information it was most frequently provided by the school administration or the principal. Compared to general information on scholarships the information regarding the scholarships available specifically for socially disadvantaged students was provided more frequently as 85.7% of undergraduates had received this information.

The scholarships that the socially disadvantaged undergraduates had heard about include scholarships for: socially unprotected people, for large families and for students from the high mountain regions.

As for the government scholarship information, in the case of TVET students, only 14.3% of students had the access to government scholarship information opportunities from school with the main sources being the school administration and TVET representatives. TVET students were more aware of the scholarship opportunities in specific TVETs as 50% of them stated that they had received such information. The main source of information was the representatives of the TVET itself. 90.5% of socially disadvantaged undergraduate students have had scholarships while studying at higher educational institutions. In most cases it was provided by the state/government.

It should be noted that more than half of the socially disadvantaged undergraduates (55.2%) stated that they would not have been able to continue their studies if they had not had that financial support.

Table 2.17. HEI_STUD_Q57. Assessment of Scholarship by Higher Educational Institution Undergraduates

N=38		1 Disagree Strongly	2 Disagree	3 Neither Disagree or Agree	4 Agree	5 Strongl y Agree
I wouldn't be able to continue studying without my scholarship;	Frequency	2	4	11	14	7
	Percent	5.3	10.5	28.9	36.8	18.4
The scholarship is not enough to cover my educational fees;	Frequency	9	10	9	7	3
	Percent	23.7	26.3	23.7	18.4	7.9
The scholarship doesn't cover my participation in different activities like conferences etc.	Frequency	6	7	11	12	2
	Percent	15.8	18.4	28.9	31.6	5.3

The rate of financial assistance for TVET students is the same as in the case of undergraduates as 90.5% of TVET students had a scholarship during their studies which was provided by the state. The scholarship is quite important for TVET students as well considering that 66.7% of them stated that they would not have been able to continue studies unless they had financial support.

Table 2.18 Q57. Assessment of Scholarship by TVET Students

		1 Disagree Strongly	2 Disagree	3 Neither Disagree or Agree	4 Agree	5 Strongl y Agree
I wouldn't be able to continue studying without my scholarship;	Frequency		4	3	11	3
	Valid Percent		19.0	14.3	52.4	14.3
The scholarship is not enough to cover my educational fees;	Frequency	5	11	1	4	
	Valid Percent	23.8	52.4	4.8	19.0	
The scholarship doesn't cover my participation in different activities like conferences etc.	Frequency	9	6	3	3	
	Valid Percent	42.9	28.6	14.3	14.3	

52.6% of undergraduates and 76.2% of TVET students stated that they are absolutely satisfied with their scholarships.

Table 2.19. Q58. Satisfaction with the Scholarship. Question: How would you evaluate your satisfaction with your scholarship on a 5 grade scale where 1 means absolutely dissatisfied and 5 means absolutely satisfied?

	Undergraduates (N38)		TVET Students (N=21)	
	Frequency	Percent	Frequency	Percent
1 Absolutely Dissatisfied	2	5.3		
2 2	3	7.9	1	4.8
3 3	11	28.9	2	9.5
4 4	2	5.3	2	9.5
5 Absolutely Satisfied	20	52.6	16	76.2
Total	38	100.0	21	100.0

The majority of the undergraduate students or their families have received information regarding the university admissions process. However, information regarding scholarships was less frequent, which might be regarded as a barrier for socially disadvantaged students in higher educational institutions.

While undergraduates are supplied with information about admissions, TVET students have this opportunity less frequently as only 26.2% of them received information on the TVET admissions process. This might hinder the participation of socially disadvantaged young people in STEM subjects and can be regarded as a barrier for them. Consequently, the quality and availability of information about the admissions process and opportunities available for disadvantaged groups should be improved.

The majority of the socially disadvantaged undergraduates (61.9%) stated that they had not received career guidance at school, which can be one of the obstacles for them to make a decision about the continuation of their studies in STEM subjects in higher educational institutions. This indicates that there is a need for planned guidance for students about STEM professions and the advantages of these professions.

While making a decision about the continuation of their studies in STEM fields in higher educational institutions, socially disadvantaged undergraduates have more information about their local institutions and do not have as much information about regional opportunities, which might be a barrier for participation in STEM programs.

More than half of the socially disadvantaged undergraduates state that they would not have been able to continue their studies in a higher educational institution, if they had not had scholarship. Therefore, the lack of financial support can be perceived as a potential barrier for socially disadvantaged students to study STEM subjects in higher educational institutions. As for the TVET students, the majority of them (76.2%) did not have information regarding scholarships, which can be perceived as a barrier for potential STEM students from a socially disadvantaged family.

To summarize: Focus should be placed on improving the dissemination of information regarding access to scholarships and career advice among all student demographic groups at secondary, TVET and HEI levels; if necessary in other relevant languages. The information needs to include regional opportunities which would be more affordable to low income families if scholarships aren't available.

Students about teachers

Evidence is coming from the students of TVET/HEI

The socially disadvantaged undergraduates from STEM subjects in higher education institutions positively evaluate their teachers and faculty members.

Table 2.20 Q46_Evaluation of faculty members by undergraduates. *Question: Would you agree that faculty members are:*

N=42, (Percentages are provided in the figure)	1 Disagree Strongly	2 Disagree	3 Neither Disagree or Agree	4 Agree	5 Strongly Agree	99 Don't Know
Focused on the real job opportunities in this region	11.9	14.3	26.2	19.0	14.3	14.3
Involved in students' employment	9.5	19.0	33.3	14.3	19.0	4.8
Are good professionals		2.4	14.3	42.9	40.5	
Try to explain all details that students do not understand	2.4	2.4	14.3	47.6	33.3	
Develop needed skills	2.4	4.8	9.5	52.4	31.0	
Are well aware of labour market demands and give students practical advise		7.1	21.4	35.7	31.0	4.8

As for the assessment of TVET students, they are also satisfied with the TVET administration and faculty members.

Table 2.21 Q46. Evaluation of TVET administration and faculty members. *Question: Would you agree that TVET administration and faculty members are:*

N=42(Percentages are provided in the figure)	1 Disagree Strongly	2 Disagree	3 Neither Disagree or Agree	4 Agree	5 Strongly Agree	99 Don't Know
Focused on the real job opportunities in this region	2.4	2.4	14.3	40.5	26.2	14.3
Involved in students' employment	4.8	11.9	16.7	45.2	16.7	4.8
Are good professionals			2.4	45.2	52.4	
Try to explain all details that students do not understand		2.4	2.4	42.9	52.4	
Develop needed skills		2.4	4.8	45.2	47.6	
Are well aware of labour market demands and give students practical advise		2.4	2.4	42.9	50.0	2.4

Overall 59.5% of socially disadvantaged undergraduates studying STEM subjects in higher educational institutions stated that the quality of education is high in their institution, while only 4.8% of them rated the quality as poor. In terms of the improvement of the quality of education, undergraduates suggest the following: provision of textbooks and supplementary materials, equipping of study rooms with modern facilities and library, provide more practical work and summer jobs.

As for the TVET students, none of them rated the quality as poor and 92.9% stated that the quality of education is good. As for the improvement of the quality of TVET education, students suggested the following: provision of textbooks and supplementary materials, equipping of study rooms with modern laboratories, provide more practical work and summer jobs.

To summarize: The quality of education is seen as good / very good and the teachers and their institutes are to be commended. The slightly poorer scores regarding involvement in students' employment is perhaps understandable as tutors and lecturers may not be directly involved in placing students in the student's first employment.

2.2.4 Differences in access to master's and doctoral programs by key categories of social disadvantage

The information is not available and no analysis is possible.

2.2.5 Differences in access to faculty mentors in STEM fields by key categories of social disadvantage;

Institutions' Involvement in Assessment of the Socially Disadvantaged

The role of the institution in assessing and providing for the respective needs of the socially disadvantaged is an important factor for the studies of students. These questions are concerned with the perceptions of students and were asked in Study Two in questions 77-80.

The analysis of the perception of students regarding the negative impact of being socially disadvantaged on their career suggests that the majority of students, both from higher education institutions and TVETs, do not see it as a hindering factor for their professional development in the field of STEM subjects. As for those who perceive it as a hindering factor for their careers (less than 5%), they name a lack of financial resources as well as a lack of available positions in these professions.

The results of the survey suggest that socially disadvantaged students both from higher educational institutions and TVETs find their institutions supportive of their career. According to undergraduates from higher education institutions, their institutions are least supportive in terms of creating new networks and employment. As for the TVET students, they find their institutions least supportive for improving living conditions in the future, creating new networks and career development.

Table 2.22. Q79. Assessment of Institutions' Assistance. Question: Do you agree with the following statement: the higher educational institution helps me to:

N=42 (Percentages provided in the figure)	Undergraduates		TVET students	
	1 Agree	2 Disagree	1 Agree	2 Disagree
Create new networks	78.6	21.4	71.4	28.6
To increase my qualifications	88.1	11.9	92.9	7.1
Improve my living conditions in the future	90.5	9.5	71.4	28.6
Get employed	85.7	14.3	83.3	16.7
Assists me in my career development	92.9	7.1	76.2	23.8

The role of the higher educational institution administration in assisting students when they experience different types of problems is rather weak. Most frequently, socially disadvantaged students stated that they have received help from the administration in the case of obtaining books (26.1%).

Table 2.23. Q80. Assessment of Assistance from Higher Education Institutions' Administration. *Question:* To what extent do you agree with the following statement: the higher educational institution administration helps me when I have difficulty in:

N=23 (Percentages provided in the figure)	2 Disagree	3 Neither Disagree or Agree	4 Agree	5 Strongly Agree	88 Does not apply
Obtaining books	52.2	4.3	26.1	4.3	13.0
Getting /paying for dwelling	56.5	17.4	4.3	4.3	17.4
Language problems	26.1	26.1	13.0	4.3	30.4
With other expenses connected with studying	60.9	17.4	8.7	4.3	8.7
Problems with social integration	39.1	26.1	8.7	4.3	21.7

As for the TVET students, they believe that their administration is most helpful in terms of obtaining books.

Table 2.24. Q80. Assessment of Assistance from TVET Administration. *Question:* To what extent do you agree with the following statement: the higher educational institution administration helps me when I have difficulty in:

N=30 (Percentages provided in the figure)	1 Disagree Strongly	2 Disagree	3 Neither Disagree or Agree	4 Agree	5 Strongly Agree
Obtaining books	0	3.3	16.7	80.0	0
Getting /paying for dwelling	23.3	43.3	30.0	3.3	0
Language problems	16.7	26.7	53.3	3.3	0
With other expenses connected with studying	10.0	36.7	33.3	20.0	0
Problems with social integration	3.3	20.0	50.0	23.3	3.3

- Supplementary textbooks and materials, modern facilities, library services and modern technologies are less available at higher educational institutions than at TVETs.
- Various academic activities are less frequent in TVETs.
- The students of higher educational institutions and TVETs suggest the following for the improvement of the quality of education: provision of textbooks and supplementary materials, equipping of study rooms with modern facilities, laboratories and libraries, as well as the provision of more practical work and summer jobs.

To summarize: socially disadvantaged students are satisfied with the support they receive on networks, employment and career but less with the day to day issues of student life such as getting-by financially, books, language problems and social integration. Socially disadvantaged students look for more support from their institution in the personal, social and financial needs as opposed to educational where they are satisfied.

2.2.6. Other topics as appropriate to Georgia.

Other topics which we explored or encountered during Study 2 are presented here.

Study Environment in HEI and TVET: Faculty opinions

25% of TVET faculty think that there are not enough text and supplementary books/materials to teach and 29.8% think that such materials are not available. Though, the actual quality of these materials is assessed as good by the majority of faculty members (77.4%). The majority of faculty members stated (91.7%) that their TVETs' study rooms are equipped with modern services and utilities such as computers, internet, etc. A library is provided according to 97.6% of faculty members; in most cases (89%), the library is equipped with modern services and utilities. 89.3% of faculty stated that there is a laboratory available in their TVET, which in most of the cases (96%) is equipped with modern utilities.

In the case of HEI, the attitudes are almost the same. Overall, faculty members think that there are enough resources for the students to get a high quality education. One half of the respondents disagree with the statement that "There are not enough text and supplementary books/materials to teach."

31% neither disagree nor agree with this and only 19% agree. 54% disagree with the statement that "the text and supplementary books/materials are not available (are not sold at the Universities or book stores, or these materials are not translated,)" while 31% agree with this and 16% neither disagree nor agree. 76% agree that "the text and supplementary books that are used for teaching my subjects are good," while 20% neither disagree nor agree and only 4% disagree with the statement. 62% agree that "the study rooms (auditoriums) are equipped with modern services and utilities, like computers, internet," while 24% neither disagree nor agree with this.

Only 14% disagree and 86% agree that "*the library is equipped with modern services and utilities, like internet, all books that I need are available*" 11% neither disagree nor agree with this and only 4% disagree. 81% of respondents say that they have a laboratory for practical work.

To summarize: The above-presented data shows that both HEI and TVET representatives think that there are satisfactory resources (laboratories, auditoriums, libraries etc) in their place of study.

Study 2: Question 2.3: The Labor Market is not geared up for socially disadvantaged people

2.3.1 Present evidence regarding bias in the labour market

Participants in the employers' survey responded as follows to question A12. **Do you have an employee in your organization, who is a representative of an ethnic minority?** The employer survey showed that 30.0 % of employers have ethnic minorities in their company.

Employers say they rarely have difficulties due to a language barrier when hiring representatives of ethnic minorities. Only 2.7% of employers had this problem. It could be that non-Georgian speakers just don't apply, just as disabled people might not apply

It is assumed that this is connected with the low level of implementation of special programs for socially disadvantaged groups at HEIs and TVETs; 23.8% of HEIs and 33.3% of TVETs have special programs for socially disadvantaged groups. Furthermore, within this group only one case was found where there

is support for finding placement in a company. It could be that younger people from low income families would also have greater pressure to remain at home to help out; especially female family members. The qualitative report indicates that the role of the family is very strong in this context as well, especially among ethnic minorities and (rural) ethnic Georgians in the regions. Importantly the students are more likely to choose a career that their parents support.

The practice of encouraging students from low-income families is very rare. Only 2.7% of employers (4 cases) have this kind of strategy. A form of support was training (three cases) and 1 case of hiring a student from a low-income family was also present.

Employers and social disadvantage

In the employer survey only 1 out of 150 firms had any program for supporting ethnic minority students and also only one firm had a program for students from high mountain areas.

56.0% of the employers strongly agreed that it is very positive for the image of companies to employ students from low-income families. 44.7% of employers disagree with the idea that the profit of companies is primary and secondary is the employment of low income families. These attitudes indicate that around half of all companies have a positive attitude towards supporting students of low-income families.

54.0% of employers agree that the integration of ethnic minorities is important for the country and only 13% agree that ethnic minorities are a threat to the country. 84.7% think that what is most important is professionalism and not ethnicity when they plan to hire new employees. This indicates that the attitude regarding ethnic minorities is positive and if students from ethnic minority groups are professionally prepared, employers can employ them.

Half of (50.0%) employers stated that students from mountainous regions have to go back to their area of origin.

By comparison, companies are more likely to support and implement such activities as the assistance of religious organizations (40.0%) and the rehabilitation of historical monuments (20.0%). This indicates that companies have an attitude towards social responsibility but that it is not often translated into positive action. The most likely reason for this (drawing on experience from other countries) is a lack of insight into the real needs and also into what practical actions they could take.

Most companies do not have a practice wherein they support socially disadvantaged students in Georgia. This extends to all types of socially disadvantaged students (ethnic minorities, low-income families, mountain dwellers). Specifically, only 30% of firms have an employee who is a “representative of an ethnic minority.” Furthermore only 2.7% report having a program for employing those from low income families. Moreover, there are no firms which have a special program for supporting ethnic minority students or students from high mountain regions.

Companies have experience in supporting projects for religious organizations, the rehabilitation of historical monuments etc. This experience indicates that some companies have a socially responsible approach and if lobbying was conducted for socially disadvantaged groups through intensive interaction with TVET/HEI or other agencies the projects supporting socially disadvantaged students probably could be implemented or ameliorated.

To summarize: Employers currently are taking few steps to support socially disadvantaged people into employment but they do have an awareness of the issue and openness to the issue of corporate social responsibility (CSR). This can be built on with an organized program to develop CSR.

Table 2.25 sd5 Does your HEI/TVET have any special program for socially disadvantaged students?

N=150		HEI Faculty members		TVET Faculty members	
		Frequency	Percent	Frequency	Percent
Valid	1 Yes	20	23.8	28	33.3
	2 No	48	57.1	56	66.7
	Total	68	81.0	84	100.0

The practice of supporting or placing ethnic minorities in companies is highly uncommon. 98.7% responded that they do not have such a practice. This state of affairs is also true for students from mountainous regions. 98.7% of companies do not have such a practice.

2.3.2 Employment expectations, job quality and involvement in further educational institution by Secondary school students

In assessing the role of a TVET centre or University in future employment opportunities, the majority of the school students believe that the higher quality education they get, the easier it will be for them to find a job (61%). All of the students (100%) believe that after completing their studies they will be working in the same field as they have chosen for a profession and almost half of them (48%) say that they would like to work in the public sector.

Table 2.26C77 . The sectors school students would like to work.

N=41	Frequency	Percent
1 Private	14	34.1
2 Public	20	48.8
3 Self employed	5	12.2
4 NGO	2	4.9

89.8% of school students believe that their school is doing a good job forming firm foundations in math and sciences for its students.

Table 2.27C81 . Question: This school is doing a good job forming firm foundation in math and sciences to its students, do you agree or disagree?

N=49	Frequency	Percent
2 disagree	2	4.1
3 neither disagree nor agree	3	6.1
4 agree	35	71.4
5 strongly agree	9	18.4

The school students do not hold definite perceptions regarding the role of media in creating favourable images of various fields.

Table 2.28C82. Question: The media create more favourable images of other types of jobs than STEM jobs, do you agree or disagree?

N=49	Frequency	Percent
1 disagree strongly	1	2.0
2 disagree	9	18.4
3 neither disagree nor agree	16	32.7
4 agree	7	14.3
5 strongly agree	4	8.2
99 Don't know	12	24.5

To summarize: Secondary school students positively evaluate the role of the school for further education. The students plan to work within their field of education after graduation.

2.3.3 Other findings in relation to employer attitudes towards socially disadvantaged students questions A97 – A102

Special programs for socially disadvantaged students implemented by TVET (TVET members 33.3% from total amounts) are as follows – 25% is financial support, other activities have a low share of the total and are less than 2% such as transportation, supporting participation in the trainings of international organizations, making special training courses and postponing the dates when they have to pay tuition. It is important to mention that 33% of the respondents reported that they do not know what kind of special program(s) they have. Within the HEI institutions the type of programs are similar, although the percentage of financial support is lower (4.6%) than in TVET. Other programs which are lower than 2% include additional courses for socially disadvantaged students, vocational education, one-term financial assistance and a foundation created by professors to support socially disadvantaged students. The programs available in TVET as in HEI are of the same variety, although the share and coverage of these programs is low.

Study 2: Question 2.4: Programs which have been effective in increasing the participation of socially disadvantaged students in STEM fields, in Georgia and other countries?

Review the literature on effective programs.

The literature review which is detailed in the desk research concentrated mainly on the UK and Canada and it did not identify any specific programs that could be replicated in Georgia. The studies showed that while poverty and ethnicity can be barriers that these are addressed in the schools in providing the educational support needed to enable students to apply for higher education if they choose. The literature revealed that there are no in depth studies in Georgia.

Study 2: Question 2.5: Programs which could be implemented in Georgia to improve socially disadvantaged students' participation in STEM occupations

2.5.1 Based on answers to Questions 2.1-2.4 provide recommendations as to what interventions the GoG and MCC could use to improve socially disadvantaged students' participation in STEM occupations.

The analyses of the three dimensions of the research (desk research, qualitative research, quantitative research) shows some barriers that need to

be addressed in order to improve equality of opportunity for the socially disadvantaged students in HEI and TVET institutions in STEM subjects.

Procuring information about socially disadvantaged students:

One of the main obstacles during the desk research was the inability to collect appropriate databases about the socially disadvantaged groups. Data bases were limited or in some cases not accessible. Following actions could be implemented for improving data bases for socially disadvantaged groups.

Recommendations for HEI_TVET:

- Collect and integrate the information about the students and integrate in the data bases. Such dimensions could be addressed: gender, living place, scores of CAT, scores of UEE, Parents education, ethnicity/home language, belonging to the low-income family (if she/he belong), scholarship awarded from UEE, scholarship as a socially disadvantaged. This information could be collected when the student is doing online registration. If some cases the universities do not have online registration the paper registration could be implemented.

Recommendation for MoES

- MOES has a special scholarship program for socially disadvantaged students. This could be used to improve their database of scholarships through adding the following information: Gender, Parents address, Faculties/specialization which the scholarship holder chose.

Recommendations for NAEC

- NAEC can record information about the status of applicants, namely if applicant belongs to the low-income families group.
Recommendation for Social service agency
- The social service agency has a database of all low- income families, there is a possibility to record the information of these students, specifically what kind of scholarship they got according to the UEE.

Recommendation for City halls and municipalities:

Some city halls (for example Tbilisi) have small scholarships for socially disadvantaged students although appropriate information for this scholarship is not available. It is recommended to record and make available information within these municipalities about the Gender, Faculty of scholarship holder, Number of scholarship and the type of socially disadvantaged students

School and STEM Subjects

All three parts of research shows that the socially disadvantaged groups have some special barriers with STEM subjects. There are some general barriers which influence the whole population and some specific obstacles within the groups for socially disadvantaged. The data shows that

- in more than half cases the classrooms are not equipped with modern services
- in more than half cases the libraries are not modernized the laboratories are most vulnerable in the schools and need modernization.

Ethnic minorities have specific barriers in education. The qualitative research and desk research shows that the average score on the CAT in STEM subjects is almost 10 points lower than the total population. The share of ethnic minorities in the total amount of students is very low (2%). The average scores of ethnic minority students are lower than others (for detailed information, see desk research). This information indicates that special programs have to be implemented for the supporting of students of ethnic minority backgrounds. The bridging program is effective and should be continued although it is not enough for the equity of access of ethnic minorities in HEI_TVET programs. Also there is no information available about the results of this program in terms of educational or employment pathways followed on completion and this should be addressed in order that evaluation of the effectiveness of the program can be done.

The desk research about scholarships shows that:

- The highest number of socially disadvantaged students applying for scholarship is within the category of the low-income families. However, the percentage of funding of the students in the low-income category is the lowest in all years except 2010, compared with other categories.
- The percentage of funding of the students from low-income families is not stable and there are significant differences between years.
- In general, there is a tendency that the number of scholarship applications is increasing but the percentage of funded students is decreasing or staying the same.

These data indicate that a larger contribution of financial resources is necessary to increase the share of socially disadvantaged students.

Employment and socially disadvantaged students:

- Most companies do not have a practice wherein they support socially disadvantaged students in Georgia. This extends to all types of socially disadvantaged students (ethnic minorities, low-income families, mountain dwellers). Despite this, companies have experience in supporting projects for religious organizations, the rehabilitation of historical monuments etc. Furthermore, 54.0% of employers think that the integration of ethnic minorities is important and 84.7% think that the most important factor in hiring a candidate for them is professionalism and not ethnicity.

The above mentioned factors indicate that some companies have a socially responsible approach and hold positive attitudes about the integration of socially disadvantaged groups. It is probable that if lobbying was conducted for socially disadvantaged groups through intensive interaction with TVET/HEI or other agencies, projects supporting socially disadvantaged students could probably be implemented or improved.

Study 2 recommendations

1. Teaching for socially disadvantaged students at school

Many teachers are clearly familiar with teaching socially disadvantaged students (45%). Teachers agree that socially disadvantaged students do not study STEM subjects as well as other students, yet the majority do not take

special measures to teach socially disadvantaged students and do not seem to be aware of any special needs they may have. Given the obvious disadvantages that many socially disadvantaged school students have this statement by teachers cannot reflect realities; instead it must reflect a lack of awareness of the needs.

Socially disadvantaged student feel the negative impact of general shortcomings in education more than the other because they have no way of overcoming them such as parents paying for enrichment classes or buying extra books. Libraries, school rooms and laboratories are reported to be unsatisfactory generally and again these factors impact more on the socially disadvantaged.

The research makes it clear that socially disadvantaged students find Math and Physics difficult. This points to the need to improve the teaching of STEM subjects in schools. There is a clear issue about the quality of STEM teaching particularly for those that are not in the top deciles and likely to go to University. The research shows that while socially disadvantaged students who went on to University were satisfied with their teaching, those that went to TVET were not.

The recommendation regarding teaching for socially disadvantaged students at school

There needs to be an organized plan to enable socially disadvantaged students to study on an equal basis with all other students. This would involve:

- A clear identification of the problems socially disadvantaged students face in STEM subjects
- An in service teacher training program to make teachers aware of the issues and develop plans to address these
- To scope the need for any enrichment teaching that socially disadvantaged students may need and then a decision about how best to address this need. This may include, as other countries have done, having specially trained teachers who provide this enrichment teaching to bring the disadvantaged student up to the standard of the rest
- Any program needs to address the particular needs of children not to be perceived as different by their peers. It would also need to understand and commitment of parents, school directors and teachers.
- A plan to upgrade school facilities over time to the standard of the best schools in urban areas: poorly equipped schools that serve socially disadvantaged students should be a priority.
- A program to improve STEM teaching to those not in the top deciles and this should include upgrading of facilities and teaching methodologies that are updated regularly and are disseminated through in service teacher training.

2. Scholarships

The IPM Research survey shows that boys are almost twice more likely to receive a TVET a scholarship than girls. However the opposite situation arises for University study where girls have the higher share and also in socially

disadvantaged groups. The survey also shows that information about scholarships is only reaching about half of students who go to University and only 9% of TVET students. However, socially disadvantaged students reported higher rates of being informed about specific scholarships for socially disadvantaged students (as opposed to the general scholarships). The socially disadvantaged undergraduates state that they would not have been able to continue their studies in a higher educational institution, if they had not had scholarship. Therefore, the lack of financial support can be perceived as a potential barrier for socially disadvantaged students to study STEM subjects in higher educational institutions

Recommendation regarding scholarships:

Better information about scholarships to be available in all areas in a planned and organized way particularly targeting girls and socially disadvantaged groups.

3. Ethnic groups and language

There is clearly an issue of disadvantage arising from not knowing the Georgian language. It arises in schools in the Azeri and Armenian communities. The government has introduced a special one year language program for ethnic minority students that once passed allows them to apply for post-secondary education. However there is no information available about the pathways wither education or employment that the graduates of this program follow.

The recommendation regarding ethnic groups and language:

Socially disadvantaged ethnic minority students need strong language support in school and these needs to be organized possibly using special language 'enrichment' teachers. The one year language programme is an important initiative. It needs to be evaluated with regard to what it enables its graduates to do and it is advised that this be done.

4. Parental influence

The focus groups made it clear that parental influence is very strong for socially disadvantaged groups; so strong that for many it would be the determining factor in career decisions and this can lead to a loss of talent that the country needs.

The recommendation regarding parental influence:

This is a cultural issue that will not respond to external pressure easily. It will need a long term strategic approach that will have 3 strands:

- Schools need to build relations with the parents to enable them to understand the importance of education and taking up of opportunities and also to encourage parents to take a greater interest in and support of their children's education. This needs a clear program with objectives, standards and in service training
- The promotion of education as a value within socially disadvantaged communities and community leaders
- The barriers that students face such as access to books, falling behind the class and losing motivation as a result, lack of self belief and lack of role

models with face validity in their own communities need to be addressed in an organized way by MOES

5. Career guidance and information about STEM careers

The survey showed that schools have worked to improve career guidance for socially disadvantaged students but this is necessary to counter the adverse cultural influences in their communities where it is the norm for children to follow careers (or maybe not) according to their parents' direction.

Recommendation regarding career guidance and information about STEM careers:

Career guidance needs to be further improved with the addition of more engagement between schools and the providers of post-secondary education and the publicising of role models.

6. TVET

Socially disadvantaged students at TVET reported that no special programs are available to support them at TVET but that the overall teaching quality is good whereas the provision of textbooks and supplementary materials, equipping of study rooms with modern laboratories needs improvement. They would also appreciate more practical work and summer jobs. While the comments of socially disadvantaged students are echoed in those of their fellow students, the areas lacking bear more heavily on them.

Recommendation regarding TVET

A TVET facility improvement programme is already under way. It needs to continue and be reinforced with a program that identifies the special needs of socially disadvantaged students with the aim of meeting those needs that can practicably be met. The same findings in TVET hold true for HEI and the recommendation is the same also.

7. Employment and social disadvantage

The IPM Research employer survey showed that most companies do not have any measures to facilitate socially disadvantaged people in getting employment. However 54.0% of employers think that the integration of ethnic minorities is important. Employers are aware of the issue but are seem unaware about how to do anything about it.

The recommendation regarding employment and social disadvantage

This is a Corporate Social Responsibility (CSR) issue that needs to be addressed through a planned approach. In the UK, this is led by NGOs such as the Prince's Trust (known as Youth Business International <http://www.youthbusiness.org/where-we-work/>) and Business in the Community with the support of Chambers of Commerce. Large firms become pioneers and role models so that the benefits of taking action are shared and understood. It is not seen as a responsibility of government although government supports through implementing CSR itself. It will need a partnership approach between the government and a leading NGO such as the Chamber of Commerce and a scoping study should be commissioned. This may fit with the mission of the Eurasia Partnership Foundation.

8. Data bases about students from socially disadvantaged groups are poor or non-existent

A search for the Desk Research showed that much of the information needed was not available.

We cannot find information about students from socially disadvantaged groups that fail UEE nor can we accurate information about the destination of students from ethnic minorities who do the one year Georgian language conversion course.

Information is necessary in order to understand the needs and plan for them.

Recommendation regarding databases about students from socially disadvantaged groups

MOES with institutions, NAEC, Universities, TVETs collect and integrate the information about the students and integrate them in the data bases that could be made available to all government departments that work in this field.

STUDY 3- LABOR MARKET DEMAND FOR STEM OCCUPATIONS

This study has four main questions that will inform recommendations to the GoG and MCC, regarding:

- (i) employer demand for and skill shortages in STEM occupations,
- (ii) student perceptions of demand for STEM occupations,
- (iii) past and projected trends in demand for skill shortage STEM occupations and
- (iv) types of programs that could address the skill shortages. This study would cover TVET Levels I –V Introduction Study 3.

The study has three main sources of information:

There were 3 quantitative surveys carried out, one with 150 STEM employers, one with 150 Higher Educational STEM students and 100 TVET students. These surveys were comprehensive and the main methodology was to ask fixed choice questions although there was the opportunity for respondents to give 'free' information in addition.

The 150 employers were in the fields of manufacturing and specifically manufacturing of electrical and optical, transport equipment, construction, electricity, gas and water supply, transport, storage and communication, computer and related activities and agriculture, hunting and forestry. They were 42% small, 32% medium and 26% large firms, the urban and rural mix was 89.3% urban, 5.4% rural and the rest a combination of urban and rural. There was a clear spread of respondents across the country but with the majority 51% in the region of the capital.

The students at University were studying at levels 3 & 4 from 7 institutions including 2 from Batumi and one from Telavi. 71% were studying in the region of their parents' home. 2.7% were from a socially disadvantaged group and the male / female composition was 72% / 28%. All interviews were carried out in the Georgian language.

The TVET students were studying at levels 3, 4 and 5 and were from 15 centers. 80% of the students were studying in their home regions. The male / female balance of respondents was 72% / 28%. And 4% were socially disadvantaged.

The qualitative focus group discussions have also been reviewed along with the desk research.

The study attempts to provide a clear picture against all of the factors affecting employer demand in STEM occupations and student perceptions. In some cases, there is consistency between the three sources of information but in others this is not the case. Where there is disagreement the study states this clearly and considers the implications.

Of the three sources the quantitative surveys are considered to be the prime source of information and conclusions are primarily but not exclusively drawn from them.

Fundamentally the issue remains that the majority of employers say they are not able to recruit young people with the skills, knowledge, attitudes and competences that they need and that they must provide this themselves. Employers remain sceptical about the provision of higher and vocational

education. The view persists that faculties are not working with them and are not in touch with the labor market.

Yet, students are more optimistic about their life chances in STEM jobs and more positive about the education they received at school and at university or TVET. They think that their faculties are in touch with the labor market and modern trends. This optimism is not borne out by desk research that shows that there is an oversupply of qualified young people seeking to enter the labor market and that many are under employed in jobs for which they are over qualified.

Employers when asked about future needs are less precise than anticipated. They find difficulty in articulating future needs and given their scepticism about the educational providers are less interested in specific qualifications but more interested in the actual skills they can see in use in their firms. In the main they were not able to comment on the impact of future developments on the skill mix requirements for existing and new staff. Employers generally have little contact with the further education institutes and certainly the industry – education partnerships that exist in many EU countries are at best at informal levels.

Employers are positive to the idea of supporting socially disadvantaged workers but do little in practice to make it happen. The evidence is that their attitude to women workers is neither positive nor negative; they welcome women workers but make little specific provision for their needs, neither do they think that increasing female representation in their work force is a priority for them.

When analyzing the responses of employers, those of male and female respondents have been analyzed separately. In the majority of cases, female and male respondents' answers were almost the same. There were some important differences and these have been indicated in the text.

Study 3: Question 3.1: What is the current employer demand for STEM occupations?

3.1.1 Present evidence regarding the types of technical and professional STEM occupations (see footnote 10 of ToR) that are in high demand by employers but in short supply in Georgia.

The evidence available comes from the employer survey findings and maps to desk research findings where appropriate. The employer survey engaged 150 employers from across all STEM sections and geographical areas. The survey question 103 identifies all respondents were either board members (directors) or senior financial, human resources or sales managers. The evidence is presented in a sequence which maps to the terms of reference rather than the sequence of questions in the questionnaire. The complete survey findings are available as a separate data file.

The desk research sources available to the Study Three research team on specific skill shortages were deemed to be too old. Based on 2009/10 data we know occupations employers can and cannot fill therefore in employer questionnaire we sought to find if situation has changed since 2009/10. The

ETF report⁴⁶ that was reviewed as part of the desk research phase mainly focused on improving VET but it does state that approximately 25% of business leaders said their business is held back by the lack of suitable recruits (2012). Much the same could be said of the World Bank 2013 study which is strong on macro analysis but does not attempt to address the micro issues of skill shortages or mismatches that were addressed in earlier papers.

Findings in relation to employer skills shortages. Ease of recruiting of the three skills sets; questions A12 – A20

Participants in the employers’ survey responded as follows to statement A12. “We are able to recruit the **STEM skilled operator skills** in case of necessity”; (see methodology at³ the employer survey showed that employers continue to experience skills shortages as illustrated in their responses to question a12.

Table 3.1.A12. We are able to recruit the STEM skilled operator skills in case of necessity

N=150		Frequency	Percent
Valid	1 Disagree strongly	6	4.0
	2 Disagree	42	28.0
	3 Neither disagree or agree	46	30.7
	4 Agree	47	31.3
	5 Strongly agree	9	6.0
	Total	150	100.0

Using the two lowest scores and the two highest scores we find that employers have an even mix of difficulties in recruiting **STEM skilled operators**; 32.0% disagreed with the statement and 37.3% agreed with the statement. In a sample of this size these figures are within expected margins of error of approximately $\pm 10\%$ so they are essentially the same value. The overall picture is clear, only 37.3% are satisfied that they can recruit STEM operators when needed.

For those that disagreed i.e. are unable to recruit STEM skilled operators, the reasons stated were recorded as follows:

Table 3.2.A13. Why aren’t you able to recruit STEM skilled operators upon need?

N=56	Frequency	Percent
1 there is shortage of specialists in this field in Georgia	32	66.7%
2 Professions needed in my field are not taught in any institution	5	10.4%
3 quality of education is not at a level which corresponds to the quality we need	4	8.3%
4 the faculty [where students come from] is not prestigious	1	2.1%
5 non-professionalism	2	4.2%

⁴⁶European Training Foundation (2012), Strategy for reform of vocational education and training (2009-2012); Report on main outputs and outstanding challenges

6 lack of practical work [experience]	1	2.1%
7 education fee is expensive	1	2.1%

The most common reason cited was “there is shortage of specialists in this field in Georgia” followed by “Professions needed in my field are not taught in any institution”. The skills which they find difficult to recruit were recorded under A24a.

The total that offered free comments, all of them negative, was 46 out of 150, approximately a third. These employers think that the educators are not providing the skills they need at operator level.

Table 3.3.A24a. which STEM positions are hard to fill?[Top 12 only shown; for complete list refer to original data-set]

N=150	Frequency	Percent
1. Software Engineer	20	13.3%
2. Engineer	16	10.7%
3. Technician	11	7.3%
4. Electrician	9	6.0%
5. Fitter	8	5.3%
6. Mechanic	5	3.3%
7. Locksmith	4	2.7%
8. Welder	3	2.0%
9. Programmer	3	2.0%
10. Specialist Of Electrical Appliances	2	1.3%
11. Instructor	2	1.3%
12. flatting/rolling technologist	2	1.3%

The size of the sub-sample precludes detailed analysis.

Table 3.4.A 24b.Skill shortage in other (non-STEM) fields[only 5 job types suggested]

N=150	Frequency	Percent
1. Driver	4	2.7%
2. Designer	2	1.3%
3. Finance specialist	2	1.3%
4. Accountant	2	1.3%
5. Sales manager	1	.7%

Employers only suggested 5 other skills shortages as shown above. The numbers provided are so small as to preclude analysis.

Employers’ recruitment activities for ‘hard to fill’ positions

When asked what employers do about these hard to fill positions the majority of employers indicated as follows:

Table 3.5.A25a-c.A25a for STEM employees what is the action you take?

N=150	Frequency	Percent
Ask colleagues to recruit such staff	111	74.0%
I find with help of acquaintances	6	4.0%
Announce a job vacancy	41	27.3%
Get in touch with HR Agencies	7	4.7%

Ask Universities or TVETs to provide me with candidates	12	8.0%
I offer better conditions than other employers	4	2.7%

78% of employer respondents use their peer group to find a STEM employee while around 34% use a HR or Job agency; the remaining courses of action for STEM employees include “Ask Universities or TVETs to provide me with candidates” 8% while just 4 employees (ca. 3%) consider “offering better conditions (for work or contracts) than other employers”. Further analysis shows that asking colleagues and acquaintances is the most common methods for all sizes of firm; the breakdown by size of employer is small 85%, medium 71% and large 60%. Announcing vacancies using the internet is widely used by large employers – 38% but less so by small firms, 18%. 32% of medium sized firms do this.

The picture is clear, employers in the main, use their own contacts to recruit STEM employees, only 8% ask Universities or TVETs.

Table 3.6.A25b. Skill shortage in other non-STEM fields

N=150	Frequency	Percent
Ask colleagues to recruit such staff	104	69.3%
Announce a job vacancy	32	21.3%
Get in touch with HR Agencies	5	3.3%
Ask Universities or TVETs to provide me with candidates	8	5.3%
I find with help of acquaintances	6	4.0%
I offer better conditions than other employers	3	2.0%

For non-STEM positions employers of all sizes essentially use the same tactics as for STEM recruits.

Table 3.7.A25c. When you are recruiting new employees for STEM you...

N=150	Frequency	Percent
1 Can find an operators whose qualifications meet your demand	66	44.0%
2 Can find a technician whose qualifications meet your demand	58	38.7%
3 Can find a technical managers whose qualifications meet your demand	57	38.0%
4 Have to hire an unqualified person and train him/her yourself	47	31.3%
5 I ask colleagues to look for appropriate staff	1	.7%
6 We have to hire less qualified staff	2	1.3%
7 Looking for old employees and training	1	.7%

For each of the three skills levels 44% of employers report they can recruit an operator with the right qualifications; it appears to be slightly more challenging to recruit technicians and technical managers with 38% of employers indicating they can find the technicians and technical managers with right qualifications but the percentages are essentially the same statistically. The differences between employers related to size were insignificant.

These results confirm that the majority of employers find difficulty in recruiting qualified people

Other actions employers take for hard to fill positions

When participants were asked what actions they take to recruit these missing skills the following responses were recorded.

Table 3.8.A14. What action do you take to get the skills you need?

N=48	Frequency	Percent
1. Conduct Internal training	35	72.9%
2. Send people on external training	6	12.5%
3. Recruit skilled staff from abroad	3	6.3%
4. specialists are brought from abroad	4	8.3%
5. recruiting old employees	3	6.3%
6. skilled staff come themselves	1	2.1%
7. we ask acquaintances	1	2.1%

Employers are highly likely to use internal training or external training for an existing employee - in almost eight out of every ten cases (85.4%); this figure comes from the combined scores for the first two answers. Employing candidates or specialists from outside Georgia accounts for 14.6% of responses; this figure comes from the combined scores for the third and fourth most common answers.

A similar picture emerges for **STEM skilled technician skills**¹ where 30% of employers disagreed with the interviewer’s statement, while 34% agreed. When asked to suggest why this was the case approximately two out of three (66%) of those who disagreed indicated that “there is a shortage of specialists in this field in the country”; the **same** explanations were offered as for STEM operators.

The same pattern of responses was seen for the actions employers take with 89% “using internal or external training for existing employees” although “employing candidates or specialists from outside Georgia” accounts for 8.7% of responses; this is still within the margins of error for this sub-sample so essentially the courses of action are the same as for operators.

When employers were asked to agree or disagree with the statement “a18 We are able to recruit the skilled **STEM technical managerial skills** we need in case of necessity” just 20% disagreed and 42.9% agreed; this **is statistically significant** for a sample of this size; suggesting **STEM technical managerial skills** can be recruited more easily when needed.

Reasons given by those who found difficulty recruiting technical managerial skills (31 respondents) make it difficult to draw detailed conclusions, however, “there is shortage of this field specialists in the country” accounted for 25 of the 31 respondents (83%); a reason which is similar to the previous skills.

Use of internal training for each skill area

Employers recorded the following percentages of **STEM operators** who received internal formal training. Of the 150 employers, 27 (18%) provided internal training to **all** of their staff; 96 employers (64%) provided **no** training at all. The remaining percentages of training were all very small with just over 12% of employers running training for them.

The level of internal training provided for **STEM skilled technicians** showed largely the same spread of percentages as above. For **STEM technical managers** the percentage which received **no** internal training rose to 73% with a corresponding decrease in the percentage to 16% who indicated all of their STEM technical managers received internal formal training. This appears to contradict their earlier statements about providing internal training. Yet these figures are clear; the majority of employers in reality provide little or no internal training.

Use of formal external training for each skill area

The responses from employers for all three skills areas indicate that around 90% of employers offered **no** formal external training to their employees.

Recruitment from outside Georgia for each skill area

The responses from employers for all three skills areas indicate that just 1 or 2 employers recruit from outside Georgia as indicated in questions a23.1 to a23.3.

Recruitment experiences with young recruits and the match of their skills to the vacancies

Table 3.9. A43. When young people come into their first operational job to your firm/organization do they have the skills, knowledge, attitudes and work habits that will make for success?

N=150	Frequency	Percent
1 Yes	76	50.7
2 No	46	30.7
3 Difficult to answer / Don't Know	28	18.7
Total	150	100.0

Half of the employers surveyed (50.7%) indicate that young recruits have the skills, knowledge, attitudes and work habits that will make for success; just under one-third (30.7%) indicated that young recruits do not have the skills, knowledge, attitudes and work habits that will make for success. Just under one in five (18.7%) found the question difficult to answer or didn't know the answer.

Question 3.1: Conclusions drawn from the above findings

- There is a mixed picture on employers' ability to recruit the STEM operators they need with as many saying that they are able to recruit as are saying that they have difficulty, around just under a third of employers in each category. However the number of employers who took the 'don't know' option was also around a third. The fact that around a third of employers do report difficulty in recruitment indicates that this is a relevant issue for Georgian business. It is notable that employers' main strategy for recruiting skilled STEM workers is to ask colleagues to help and the second one is to announce a vacancy. Only 8% ask TVETs or Universities to provide candidates.
- Recruitment of technicians is somewhat more challenging than recruiting operators but the statistical difference is minimal.

- Recruitment of technicians gives a similar picture. Here the main reason cited is that ‘there is a shortage of specialists in the country’, indicating that it is not a general problem but one that is related to the specialisms of the employer. The top three specialisms in short supply are **software engineer, engineer and technician**.
- Recruitment of technical managers is less problematic with 42.9% agreeing that they could recruit the technical managers in case of need. 20% did report difficulties citing the lack of specialists in the country
- When employers are unable to recruit people with all of the skills they need the majority use internal training 72.9% the next most favored approach is to use external training, 12.5%. However it should be noted that only 58 out of 150 employers were able to answer the question as to what they do when they can’t recruit the skills they need. This shows that employers can find it difficult to deal with inability to recruit needed skills.

Study 3: Question 3.2: Current student demand for STEM occupations

This section will examine and analyze the evidence from the student surveys and the focus group discussions held with students to identify:

- How attitudes to STEM occupations are formed in school
- The interface between school and university and TVET
- How attitudes and aspirations for STEM occupations are formed at universities and TVETs

All of these factors are important in understanding the demand for STEM education and professions.

The surveys were carried out with 150 university STEM students and 100 STEM TVET students over a two week period. Students were chosen at random over the period of the survey⁴⁷.

It will also link student opinion with those of the employers in the employer survey of 150 firms, described in TOR Question 1.

Taken together, the views of students and employers give a clear picture of the issues that affect the supply of student demand for STEM occupations.

How attitudes to STEM occupations are formed in school

In this section the following will be considered:

- What influences choices about further education
- Student evaluation of the quality of teaching of STEM subjects
- Relationship between teaching quality and examination results
- How students are informed about further education opportunities and by what means are they informed
- How well-informed students are about scholarships

⁴⁷For the details of sampling methodology please refer to annex 5, chapter sampling Methodology, pp. 150-152

Choices about further education

The evidence of the survey shows that the main motivation for choosing a course of study is 'I have a talent or interest in the field'; 46% of University and 47% of TVET students cited this.

The survey invited students to select reasons for choice of further education that were related to finding a job and career and these reasons were also highly cited.

Table 3.10. Reasons for choice of further education by students

	Higher chance to find job in the field	Chance to develop a career	Increase opportunity of finding a job	To become a skilled specialist
University(N=150)	26%	35%	30%	25%
TVET(N=100)	35%	22%	35%	18%

The influence of friends and family is modest; family tradition accounting for 5% University students, 2% TVET students while friends and relatives accounted for 13% University 18% TVET. Parental demand as a reason for choice is higher in TVET students at 19% than in Universities 4%. Although a lesser cited choice family and particularly parental influences are important for a small group of students.

Overall there are few gender differences reported by the students except for TVET STEM students where 52.8% of boys and 32.1% of girls say that they have talent and interest in this field. It is noteworthy that girls' confidence in their talent and interest is lower for TVET students, given that girls outperform boys in STEM subjects, it is disappointing to see that girls' confidence in their talent and interest had fallen by the time they were applying for TVET places.

The conclusion is that school students are mainly motivated by job and career aims.

93% of University students and 90% of TVET students either agreed or strongly agreed that they are independent thinkers and can make career choices on their own. In another question 92% (University) and 90% (TVET) students said that they could make their choices on their own; supporting the above conclusion.

However the qualitative studies contradict this with parental influences being perceived as strong particularly regarding girls' freedom of choice. The focus groups were carried out at school level so perhaps it is to be expected that parental influence would be stronger at school than later at University. We recommend caution when considering the results of the quantitative surveys as there is evidence from the focus groups and desk research that parental influences are significant.

Student evaluation of the quality of teaching of STEM subjects

Students were asked to evaluate the teaching at school using a 5 point scale, 5=Excellent, 4=Very Good, 3=Average, 2=Poor and 1=Very Poor. Please note

that these results are about University and TVET students' perceptions about the teaching they received at school and not at their current institution.

The tables below show the combinations of the upper and lower two evaluations; the average is the difference between these and 100%. The tables below show these aggregated scores for each STEM subject.

Table 3.11. Mathematics; Student evaluation of the quality of teaching of STEM s

	Excellent and very good	Male	Female	Poor and very poor	Male	Female
University(N=150)	66.7%	68.5%	61.9%	7.3%	5.6%	11.9%
TVET(N=100)	25.0%	19.4%	39.3%	8.0%	8.3%	3.6%

The difference between University and TVET students is notable; one can conclude that the quality of teaching for those not in the top deciles warrants attention. This is supported by the results of the focus groups.

Table 3.12. Physics; Student evaluation of the quality of teaching of STEM s

	Excellent and very good	Male	Female	Poor and very poor	Male	Female
University(N=150)	32.7%	37.0%	21.4%	20.0%	17.6%	26.2%
TVET(N=100)	20.0%	18.1%	25.0%	33.0%	36.1%	25%

The percentage in the excellent and very good evaluation is below a third for University students and a fifth for TVET students. This is corroborated by the focus groups that reported Physics as extremely difficult to learn particularly because of the lack of practical work in modern laboratories and good text books printed in Georgian.

Table 3.13. Chemistry; Student evaluation of the quality of teaching of STEM s

	Excellent and very good	Male	Female	Poor and very poor	Male	Female
University(N=150)	27.3%	25.9%	31.0%	25.3%	26.9%	21.4%
TVET(N=100)	25.0%	19.4%	39.3%	15.0%	16.7%	14.3%

Once again this indicates a low student evaluation that suggests attention is warranted.

Table 3.14. Biology; Student evaluation of the quality of teaching of STEM s

	Excellent and very good	Male	Female	Poor and very poor	Male	Female
University(N=150)	46.7%	45.4%	50.0%	13.3%	11.1%	19.0%
TVET(N=100)	36.0%	29.2%	53.6%	8.0%	6.9%	10.7%

These results are corroborated by the focus groups; students find Biology easier and they find Geography the easiest of the scientific subjects.

There are some interesting gender differences. There is a minor difference between males and females now at University in their excellent and very good evaluation of Math (68.5% and 61.9% respectively) and there is a similar small difference in the poor and very poor evaluation (5.6% and 11.9%) but these are statistically quite close although interesting. Twice as many females as males

report Math teaching at school as poor or very poor. These differences are reversed for TVET students. As According to the focus groups TVET students are likely to be in lower achievement levels than University students; () it is interesting that girls substantially rate their teaching in Math as higher than boys. TVET students were asked about Information and communications technology (ICT); 35% classed this as good or very good and 5% as poor or very poor. This also is an area that warrants attention; 58% of students surveyed class the teaching quality for ICT as average; a finding which surely needs improvement.

Employer views on STEM education in schools

Employers were asked if they thought that schools were doing a good job of building the foundation STEM skills needed for a career. 22.6% thought that the schools were doing a good job but 28.7% thought that they were not. The rest were undecided or couldn't say. When asked what employers thought were the reasons their main criticism was that schools don't give sufficient priority to STEM skills but this was from a small sample as most (107 out of 150) couldn't give reasons.

When employers were asked if they thought that teachers were aware of labor market issues and trends, 7.3% thought that they were, 27.3% thought that they were not. There was little variation in responses related to employer size. The remainder either didn't know or couldn't give an opinion. Female respondents were less likely to offer an opinion with a significantly higher percentage saying that they did not know 40.8% female, 30.7% male

In summary this whole area needs attention as many of the excellent and very good ratings are less than one might expect.

Relationship between Teaching and Examination Results

90% of University students interviewed and 80% of TVET students interviewed said their learning at school helped them to pass their examinations. This to some extent contradicts the focus groups that reported that many students found that they could not pass the examinations with only their school learning and that many topped-up their learning with private tuition. 13.3% of University students interviewed reported getting private tuition in this way.

As the quantitative survey was done with students who had achieved entry to further education it is clearly not a general sample in the way that the qualitative survey was. Therefore the findings of the qualitative survey suggest greater relevance when they say that 'the majority of students found difficulty with the teaching and needed top-up education from a private tutor.'

How students are informed about further education opportunities

The main source of information is the school as selected by 64.7% University students and 73.3% TVET students. This shows that significant numbers did not receive the information at school.

Teachers, School Administration and Directors were the main informants. Also Higher Education Institutes came to the schools to explain their courses to students in very few cases (around 1%). 64.7% of University students got the

information from the school on how to register for higher education but the corresponding percentage for TVET students is only 15.0%. 35.3% of University students received career guidance at school; the figure for TVET was 31.0%.

Employers were asked if they thought that school students received sufficient detailed information to enable them to make informed career choices. 36.7% thought that they did. 11.4% thought that students did not receive this information and the majority of all sizes either did not know or could not say. 17 employers volunteered their thoughts on the reasons for lack of this STEM career information and the majority cited lack of contact between schools and local businesses.

In summary; it is clear that the area of careers guidance and information about how to move to further education is an area for attention.

The Interface between School and University and TVET

It is noteworthy that only 34.0% of University students received information about specific institutions at school and that the Institutions themselves only informed 14.4% of students (half of this information came from web sites). For TVET the numbers receiving information from the schools was lower at 14.0% with the main source of information being parents and friends (32.0% and 27.0%).

Conversely TVET students interviewed reported they were sufficiently informed 59.0% but University students thinking they were sufficiently informed was lower at 42.6%.

When university students were asked if they had detailed information about career opportunities in STEM 28.0% thought that they did and 36.6% thought they did not. The figures for TVET were 29.0% thought they had detailed information about career opportunities and 34.0% thought they did not.

TVET students surveyed reported they were not very aware of STEM career opportunities while at school; the numbers citing that they were aware were: Science 22.0%, Technical 37.0%, Engineering 31.0%, Math 25.0%.

For University students the numbers citing that they were aware were: Science 40.7%, Technical 56.6%, Engineering 48.7% and Math 54.7%.

It is notable that University students, when at school, were much better informed than TVET students when at school.

Employers were asked for their views on provision of information about TVET in school to enable students to make informed decisions about TVET. 48% could not give an opinion on this but 40.7% thought that schools did give sufficient information on TVET. Female respondents were more critical; 38.7% agree that schools were informing students about TVET while 49.5% of male employer respondents thought schools were doing a good job in this regard.

Employers were asked if schools were doing enough to encourage students to aim for STEM jobs. The majority of all sizes were not able to comment.

When asked about the linkage between schools and TVETs, 50.7% could not give an opinion. 28% thought that the linkage was effective but 21.3% thought it was not.

Awareness of pay rates for STEM professions amongst school students was 28.4% (University) and 25% for TVETS.

When asked about how STEM jobs pay compared to others only 35.3% (University) and 29% (TVET) were aware of this when at school.

In summary: the area of information about STEM opportunities at Universities and particularly TVETs warrants attention. In particular the institutions could do more to inform schools and hence students about the specific opportunities they offer. The fact that only 14% of TVET students received information at school but mainly relied on informal information from friends and families is not acceptable. The absence of strong working relations between industry and education is clearly seen.

Knowledge of Scholarships

42.0% of University students interviewed were sure they had received information about scholarships at school while 47.3% of University students interviewed were sure they had not received information about scholarships at school. For TVET students the figures were 9.0% had received information and 84.0% had not received information about scholarships at school.

In summary: this is an area that warrants attention as it is possible that able students who need scholarships do not apply because they do not have the necessary information, particularly for TVETs

Attractiveness of STEM Jobs

Students were asked about how attractive they thought STEM careers were when at school.

Table 3.15. How attractive STEM careers are perceived when students are at school, TVET / university

University(N=150)	Science	Technical	Engineering	Math
At school	51.3%	68.0%	56.0%	53.3%
At University	52.7%	70.0%	62.3%	54.7%
TVET(N=100)				
At school	42.0%	55.0%	47.0%	38.0%
At TVET	52.0%	65.0%	56.0%	50.0%

Gender stereotypes play a role here: 16.3% of female school students agree that there are social and cultural stereotypes regarding male and female professions in Georgia. 71.4% of female school students' parents and 57.1% of school STEM teachers disagree that stereotypes of male and female professions exist among school students. However, 17.9% of school STEM teachers think that stereotypes about gender specific professions exist, the most spread stereotype among their students is: "STEM subjects are for men".

The summary of findings are:

- The attractiveness of STEM jobs was quite high at school for students that went to University but not so high for students that went to TVET

- There was an increase of around 10% in the perceived attractiveness of STEM jobs with TVET students once they were at TVET.
- More could be done to work against gender stereotypes and to create awareness of STEM jobs at school, particularly among those who are not going to University.

However when tested about knowledge of the STEM jobs, these were the results:

Table 3.16. How knowledgeable are students about STEM jobs when they are at school, TVET / University

University students(N=150)	Science	Technical	Engineering	Math
At school	35.7%	54.6%	51.3%	52%
At University	79.3%	87.3%	77.3%	78.7%

TVET students(N=100)				
At school	22%	39%	36%	31%
At TVET	58%	80%	69%	58%

It is noteworthy that boys **at school** had a clearer knowledge than girls of what STEM jobs are like.

Table 3.16a The percentage agreeing and strongly agreeing that they had knowledge of what STEM jobs would be like

	Science	Technical	Engineering	Math
Boys	38.9%	62.0%	59.3%	51.9%
Girls	28.6%	35.7%	31%	52.4%

It is clear that girls have less knowledge about STEM jobs than boys, except for math jobs where there is no real difference. However, once in post-secondary education these gender differences disappear with very high levels of knowledge about STEM jobs for both males and females. When asked for their views about schools encouraging students to follow STEM professions, 17.4% of employers thought that schools did encourage but 27.4% thought that they did not.

The summary of findings is: that awareness of what STEM jobs are, particularly Science, is quite low at school and generally low for those that became TVET students and lower for girls than for boys; again this points to the need for better quality information about STEM careers especially for girls and potential TVET students

How Attitudes and Aspirations for STEM Occupations are formed at Universities and TVETS Facilities at Universities: are they an issue?

47% think that more and better text books are needed but (66%) reported that what is available is good. Opinion is split about the quality of study rooms. All university students surveyed have access to libraries and 54% of university

students report that the libraries are well-equipped. 81.3% of university students report that laboratories exist and 49.1% think the laboratories are modern and well-equipped.

Facilities at TVET: are they an issue?

66% of TVET students report there are sufficient text books and 79% of TVET students report the text books are good or very good. 78% of TVET students report that the study rooms are good or very good and well-equipped. Only 7% of TVET students reported no library access and 68.8% of TVET students think their library is well-equipped. 65% of TVET students report that they have laboratories and of those 80% are satisfied with the services provided in laboratories.

The replies suggest that the quality of facilities at University or TVET is not a constraining factor in the development of STEM students for STEM jobs, however employers disagree.

Higher Education Focus on Real Job Opportunities

42.6% of university students interviewed reported that there was this focus on real job opportunities and 63% of TVET students interviewed share this opinion. 36% of university students interviewed reported that their institution is involved in student employment; for TVET respondents the figure is 51%.

The employers in their survey reported that 78.7% had no relationship of any kind with local universities. 12% reported that they take placements from them and 7.3% talk to universities about their training needs.

Institutions could do more in the area of facilitating the transition from institution to career and the lack of relationships with employers is striking and is a negative result that requires attention.

Quality of Teaching in STEM at University and TVET

80% of university students interviewed think their teachers know their subjects well; for TVET respondents the figure is 94%. The ability of teachers to explain subjects to students is rated at 72.7% with university respondents and 91% with TVET students interviewed. Teachers' ability to develop the skills of the student is rated as good by 68% of university respondents while 91% of TVET students interviewed rate their teachers' ability to develop the skills of the student as good.

Teachers' awareness of the Labor Market was reported as good by 71.3% of university students interviewed while 88% of TVET students interviewed reported their teachers' awareness of the Labor Market as good. Students' overall rating of the quality of teaching (combining points 4 & 5 on a 5 point scale) was 60.6% for university respondents and 88% for TVET students. When asked if the students thought their education was value for money only 38.7% of university students thought so when the two upper agreement scores were aggregated while 84% of TVET students agreed their education was value for money. Socially disadvantaged students (a very small percentage of the IPM Research survey -7 altogether) thought that the quality of education is high in their institution.

The results of the survey suggest that socially disadvantaged students both from higher educational institutions and TVETs find their institutions supportive of their career. According to undergraduates from higher education institutions, their institutions are least supportive in terms of creating new networks and employment. As for the TVET students, they find their institutions least supportive for improving living conditions in the future, creating new networks and career development.

When employers were asked if they thought that faculty members at the local Higher Educational Institutions have the skills and insights into modern industry to do a good job of preparing young people for jobs here, there was a mixed answer with 24% unable to say and for large firms it was 34% unable to say.

34% thought that most faculty members did have the skills and insights, 36% thought that some faculty had the skills and insights. Female respondents were markedly less critical, 42.9% thought that part of the faculty did have the skills and insight into modern industry but only 32.7% of male respondents thought so. For TVETs 70% were unable to say if the TVETs faculties had the skills and insights into modern industry to do a good job of preparing young people for jobs here. There were no significant differences in responses between sizes of firms.

Employers were asked if they thought that local higher education institutes were doing a good job.

Table 3.17: Employer views about higher education institutes

N=150	Agree & strongly agree	Neither disagree or agree	Disagree or strongly disagree	Don't know or can't say
Doing a good job of developing the skills needed in your firm?	32.6%	20%	29.3%	18%
Doing a good job of developing the skills needed in your area of activity?	33.3%	23.3%	26%	17.3%
Correctly focused on the real job opportunities in this region?	18.7%	32.0%	25.3%	24.0%

These findings indicate that employers do not hold a strong positive opinion about the teaching quality, however, the high number of don't know or can't say responses affirms that the connections between the institutions and employers are not strong.

Female respondents were less critical than males; 40.9% of female employers had a positive opinion about higher education institutes developing the skills needed in the firm as opposed to 28.7% of male employers. The same trend continued through the other two questions relating to the area of activity and the region.

However, there was a difference in views according to size with only 17% of large firms disagreeing with the point about Universities doing a good job of developing the skills needed in your firm.

This indicates that the negative views on this are mainly but not exclusively with the small and medium sized employer. When asked about whether Universities were doing a good job of developing skills needed in their sector there were no significant differences between different sized firms. When asked the same question about the region large firms were the main respondent in the 'don't know' category and small firms were the main responder in the disagree category.

When employers were asked what the problems with what the institutes offer were, only 21 out of 150 offered a view; 10 said that institutions do not consider STEM professions to be trendy and 7 said that the institutes don't care about student employment.

Employers were asked if they thought that faculty members had the skills and insights into modern industry to do a good job of preparing young people for STEM jobs. 33.3% thought that they did. 36% thought that some have the skills and insights and some not. 6.7% expressed a negative view about this.

Overall 75% of responses said *"I do not have any kind of relationship with local universities"* and this was 10% higher for female respondents.

Employers were asked the same questions about TVETs. When viewed by organisation size the responses are largely similar; 73% in large organisations and 77% in small organisations. Medium sized organisations selected this explanation in 86% of responses. For TVETs there was no difference between the opinions of male and female respondents.

Table 3.18. Employer views about TVET

N=150	Agree & strongly agree	Neither disagree or agree	Disagree or strongly disagree	Don't know or can't say
Doing a good job of developing the skills needed in your firm?	24.0%	16.0%	32.0%	28%
Doing a good job of developing the skills needed in your area of activity?	24.7%	16.0%	28.7%	30.7%
Correctly focused on the real job opportunities in this region?	25.4%	21.3%	21.4%	32.0%

These views also indicate low satisfaction levels. The high don't know or can't say responses indicate at least 30% of employers having little or no contact with TVETs. When asked directly if they have any relationship, the 90% negative response is shared across the 3 size sectors. The disagreement that TVETs are doing a good job of developing the skills needed in the firm is across all sizes but the highest response rate is in the medium sized sector with 43% and the lowest response is in the large employer sector with 17%.

The responses to the other questions related to the employer's area of activity and the region followed the same trend with larger firms generally being more positive than the others. The 'don't know' responses on TVETs focused on the real job opportunities in the region were consistent across the size sectors.

When asked for their opinions about whether TVET teachers have the skills and insights into modern industry to do a good job of preparing young people for jobs, 20% thought that they did, 9.3% thought that they did not and the rest either didn't know or couldn't say. There were no significant differences between responses according to size of firm. National Occupational Standards were introduced in Georgia from 2011 onwards. In this survey 50.7% of the employers reported that they have information about the national standards that apply in their sector, 49.3% indicated that they did not have this information. 90% of employers said that they have little or no relationship with TVETs.

Cooperation with Local Research Institutions and STEM Employers

69.3% of university students interviewed thought that there was this cooperation with local research institutions and STEM employers while just 28% of TVET respondents thought that there was this cooperation with local research institutions and STEM employers.

When asked about cooperation with foreign research institutions and employers the figures were 62% for university students yet just 21% for TVET respondents. The student findings were not borne out by the employers who took the opposite view.

Summary of main findings in this sub-section: the findings from the students indicate that teaching quality is not the main issue constraining the flow of STEM students into jobs; it is more about the linkage between education and industry. Employers take a more negative view both of the institutes and the TVETs. Work to develop national occupational standards had only reached 50.7% of the respondents. **Contact between employers and TVETs occurred in only 10% of replies.** This relates to the World Bank findings; that Georgian industry needs to develop through creating higher skilled jobs and educators need to educate for those skills and at the moment there is a disconnect between the two and this is harming the Georgian economy and the life chances of young people leaving further education.

Funding for Students

92% of university students reported they must pay a fee while 82% of TVET students interviewed reported they must pay a fee. It is noteworthy that for university students 71% report their fees are covered mainly by their parents. 15.2% of university students interviewed share the financial load with their parents and 10% university students cover the costs themselves. Only 2.9% of the sample university students had a scholarship. For TVET 82.9% of those interviewed report they are dependent on their parents for fees but 13% of TVET students interviewed have scholarships.

A similar picture arises in all other areas of expenses.

The summary for this section is: the majority of students in the IPM Research survey are getting by financially mainly with help from their parents with scholarships playing a minor role for TVET and a minimal role for university students. Yet the quantitative analysis showed that school students from remote and low income families (and particularly those from high mountain areas) found the financial issues of further education overwhelming.

Policy makers may wish to consider how to better help potential students from poor and geographically remote families to get better access to further education.

Gender Attitudes

The university students interviewed are generally of the view (77.7%) that gender is not a barrier to STEM jobs per se. TVET students are less sure with 61% agreeing that their gender is not a barrier but 18% think it is. This may reflect wider societal issues that were picked up in the focus groups where parental and societal attitudes in specific and more geographically remote areas were seen as a barrier to STEM jobs. Since parents are the main source of financial support this is an issue that requires attention.

76% of university students interviewed report that there is no gender bias in schools regarding STEM careers and that girls are encouraged as much as boys. 86% of TVET students reported the same findings. Yet the desk research shows that, while girls tend to outperform boys in STEM subjects, their participation in STEM jobs is less.

However the qualitative analysis did show that there are societal and parental attitudes that do impact school students' freedom of action in choosing further education for careers and that gender attitudes do restrict choices for females. This analysis also showed that girls' motivation and ability to learn is heavily influenced by the teacher so that if teachers have a less encouraging approach to girls than boys (and there is evidence from Study 2 to indicate that this can happen) then girls' achievements can be adversely affected

Summary of findings for this sub-section: the respondents of the IPM Research survey don't feel this is the fault of the schools, yet the qualitative work shows that there can be almost unconscious attitudes of teachers that adversely affect girls' achievements in STEM subjects. The qualitative work also showed the strength of parental attitudes and their importance when the female student is dependent on family finances for further education financing.

University and TVET Students' Perceptions of STEM Jobs

There is no evidence to suggest that students both at university and TVET perceive STEM jobs to be less secure than other jobs. When asked about demand for STEM jobs in the labor market the answers were overwhelmingly 'don't know'.

Regarding career prospects university students report that with the exception of scientific jobs, STEM jobs have better prospects than others they know about. 72.7% of university students interviewed think Technical jobs are better. For the other jobs their selections are; Engineering 62%, Math jobs

54.7% while 45.4% of university students interviewed think Science jobs are better. A similar pattern was found with TVET students but here the percentage of 'don't know' was the dominant response.

All students were asked what they thought about pay in STEM jobs, would it be higher than other jobs? Once again the dominant answer was 'don't know' for science and math jobs but there was the view that Technical and Engineering jobs are better paid; the scores were 63.4% for Technical jobs and 63.3% for engineering jobs respectively. A similar pattern emerged for TVET students but here with Technical and Engineering jobs being rated as better paid by 44% and 43% respectively.

The qualitative work conducted with school students reveals attitudes to careers where the following professions are perceived as prestigious: Law, Economics, Business, Medicine, Tourism and (very rarely) Construction and Pharmacist.

Summary for this sub-section: the dominance of the 'don't know' response indicates that STEM University and TVET students are not fully aware of job pay rates in STEM subjects and that school students are not aware of STEM jobs, considering other jobs as more prestigious.

Students Were Asked About Attractiveness Of Stem Jobs.

Table 3.19. What is the attractiveness of STEM jobs?

	Science	Technical	Engineering	Math
University(N=150)				
More attractive	43.3%	74.7%	66.0%	48.0%
Can't say	53.7%	34.7%	30.7%	50.0%
TVET(N=100)				
More attractive	32.0%	42.0%	43.0%	31.0%
Can't say	60.0%	49.0%	55.0%	63.0%

Again the predominance of the 'can't say' response is notable amongst TVET students but not so much amongst university students. For university students Technical and then Engineering jobs are perceived as the most attractive; a similar but less pronounced pattern is seen with TVET students. When asked the reasons why any of the STEM jobs were not attractive the number of students who gave answers was so low as to be insignificant: in other words students did not give positive reasons, it's just an impression.

There were some gender differences in perceptions of attractiveness.

50% of high education STEM male students and 59.5% of female students agree that science jobs are attractive; 73.1% of male students and 61.9% of female students agree that technical jobs are attractive; 63.9 % of male students and 59.5% of female students agree that engineering jobs are attractive; 50.9% of male students and 64.3% of female students agree that mathematical jobs are attractive;

As for TVET STEM students, 58.3% of male students and 35.7% of female students agree that science jobs are attractive (Sig=.046); 72.2% of male students and 46.4% of female students agree that technical jobs are attractive;

69.4% of male students and 21.4% of female students agree that engineering jobs are attractive (Sig=.000); 59.7% of male students and 25% of female students agree that math jobs are attractive (Sig=.000).

Summary for this sub-heading: the issue of scientific jobs appearing somewhat less attractive than the other STEM jobs may benefit from further investigation.

Student confidence in getting a STEM Job

Students are confident of getting a STEM job, 76% of university students and 78% of TVET students indicated this. Of those that are not confident there are a range of reasons given, the most important being 'a belief that their profession is not in demand' and 'a lack of confidence'.

All students interviewed believe that a STEM qualification will help get a job in another field; the respective frequencies were 75.3% university students and 82% TVET students.

76.7% of university students are confident of getting a well paid job; for TVET it is 72.0%.

94.7% of university students and 85% of TVET students intend to make their career in STEM professions.

Summary: students in general think that their studies will lead to a career.

How Further Education institutions help students get employment

University students believe that their institution helps most by organizing internships and also through their regular contact with employers (32.7% and 20% respectively), however, 18.7% report that 29% send students to firms on student placements.

29% of TVET students indicate that their institution helps by sending students on placements with firms and 29% of TVET students indicate their institution helps through contact with local firms. 12% of TVET respondents report that their TVET plays no part in this at all.

When asked directly if they think their institution will help them find a job, 34.6% of university students say Yes while with TVET students 42.9% say Yes.

However only 33.4% of employers think that higher education institutions and 20% of TVETs do a good job of preparing students for jobs.

Summary of findings for this sub-heading: the large number of students who do not report that their institution has strong links with employers or provides help with employment is an area for attention. This is corroborated by the employers in their survey

What Type of Employer do the Students favor?

42% of university students interviewed are aiming for the large employers; for TVET students the figure is 34.0%. TVET students are more likely to target small employers (23.0%) than University students (14.0%). The public sector is reported as attractive for 31.3% of university students and 28% of TVET students interviewed.

Salary Expectations

The majority of university students expect to earn less than 1000 L with 50% expecting less than 500L as a starting salary. 65% of TVET students expect to start on less than 500L.

The majority of university students expect to be earning between 1,000L and 1,500L within 3 years of starting; for TVET students their expectation is lower, between 500L and 1000L.

Summary of findings for this sub-heading: these salary expectation levels need to be compared to actual levels in the real STEM economy and the information fed back to educators.

TVET Students, Studying Away From Home

The majority of students found no barriers to studying away from home. There was a minority mainly related to the respondents' perceived low quality of education at the student's secondary school with 10.3% of TVET students selecting this reason. Finances were reported as a barrier to studying away from home by 15.5% of TVET students but finances were consistently reported in the focus groups as a serious barrier that would probably lead to students entering further education at home even though the institutions there were not as prestigious as those in the capital.

Summary of findings for this sub-heading: This is a real issue for those who have to study away from home where family income is low.

Masters Intentions

129 out of 150 University students were considering doing a Masters degree. 76.7% would choose to do so in their profession. 82.6% see the benefit as being about deepening their professional knowledge.

TVET students also believe that further education will deepen their professional knowledge -56%. 74.3% of TVET students believe a Masters will enhance their job and career prospects. 75.3% think it will lead to a better paid job.

Employer Respondents

16% of all of the respondents who were all senior people either were recruited from abroad or had been trained abroad.

Employer views on improvements necessary to improve the supply of student demand for STEM occupations

57.3% of employers thought that higher education institutes, TVETs should work in close cooperation with potential STEM employers.

50% advocated the introduction of modern technologies at TVETs and Universities.

43% of employer respondents thought that the qualifications of teachers at all levels from school to university should be improved.

18% advocated recruitment of university and TVET teachers from abroad.

Employer gender issues

38% of the firms interviewed had NO women in senior positions. The responses differed according to the size of the firm with 51% of small firms having no women in senior positions, the responses for medium and large firms were 32% and 23%.

Some respondents reported they have five or more women in senior positions as specified: 5 large organisations have five or more women with one of the large organisations reporting 25 women in senior positions; 2 medium sized organisations report five or more women in senior positions; none of the small organisations has five or more women in senior positions. 45% had only one or two women in senior positions.

Where the respondent was female (and therefore a senior person in the firm), the number of firms with no women in senior positions was 26.7% with correspondingly higher numbers of senior female staff.

92% of all firms regardless of size reported that the organization would NOT benefit from employing more women. 8% thought that there would be benefits. There was no significant difference between male and female responses, in fact 94% of females agreed with the statement compared to 91% of males. Where females thought there would be a benefit, the answer 'women are harder workers' was most selected. Males thought that women workers had a higher sense of responsibility. However these responses were small, taken from the 8% that agreed that there would be benefits so there is no statistical significance even though the comments are interesting.

When asked if there is a gender imbalance in general in Georgia in the work force, 73% thought there was not, with 27% agreeing that there was. The percentage of respondents thinking that there were no barriers to female recruitment, retention and progression was the same for both genders (91%). When those who thought there were barriers were asked to name them, female respondents named 'busy with families', 'the work is hard and masculine', 'women are paid less' and 'males have more privileges' as barriers. Male employers did not agree with these points, mainly answering 'don't know'; however some said that they thought women would not be secure in the work place. Over one-third (37%) of employers thought that women of child-bearing age were NOT suitable for senior management, this was mainly found in the medium sized firms. However 43% did not agree and this figure rose to 58% of large firms. Female respondents disagreed 55.3%.

When asked about what mechanisms, procedures or actions are in place to create an appropriately balanced gender work force, 69% could not answer the question regardless of gender, regardless of size of firm. 15% saw no need for such measures regardless of gender.

When asked what mechanisms, procedures or actions could be put in place the number of those who could not answer rose to 85% and 8% thought no such actions are necessary regardless of gender. Only 10% of firms reported that they took special measures to enhance career opportunities for women and these by size were 20% large, 7% medium and 6% small. Again there was no difference between male and female respondents.

Three-quarters (75%) of firms overall did NOT have special benefits for pregnant women (such as reduced working hours or maternity leave) but this was 53% for large organizations, 80% for medium sized firms and 85% for small firms. However 16.7% of female respondents indicated that a woman's workplace would be kept while she was on maternity leave and no male respondents said this. Also 16.7% of female respondents said that shorter hours would be made available to pregnant women as opposed to 5.6% of men. Of those that did have special benefits for pregnant women, 52% offered maternity leave, 39% decreased working hours. Maternity benefits were offered by 20% of the firms in the survey (35% of the large firms). When these firms were asked to name them the usual answer was that they were in line with their organization's statutory obligations. Large organisations comprised almost 50% of the respondents who indicated that their organization's special maternity benefits are 'unpaid maternity leave' or 'shortening of the working day'. 24.5% of female respondents indicated that their firm did have special maternity benefits; the figure for men was 17.8%.

No firm reported having childcare available.

When asked 'Do you think currently there are barriers to the recruitment, retention and progression of women in the STEM workforce?' 91% said no and this did not vary across sizes of firm. When the 9% were asked about the barriers they replied that they were no clear answers. Employers did not think that there was gender based discrimination (83%) in their firms and 93% disagreed with the stereotype that women have to work harder than men in order to succeed. However, students disagreed: 32.6% of female school students and 22.4% of their parents, as well as 26.2% of TVET students and 25% of university STEM faculty agree that women need to work harder than men to prove their competence and professionalism.

The percentage of respondents thinking that there were no barriers to female recruitment, retention and progression was the same for both genders (91%)

Employers were asked "who should be responsible for encouraging female participation into STEM fields in Georgia?" The most common answer was the government 39% with large firms at 58%. 30% thought that employers themselves had responsibility. 30% thought that there should be changes in the law to encourage female participation in the work force but 70% thought not. There were minimal gender differences on these points.

When asked 'What in particular needs to change to make existing employment more attractive?' only a third replied at all and of that number the majority said that they didn't know. Changes in the Labor Code and increases in maternity leave were mentioned by a few (5). Employers were asked to rate their working conditions for female employees (even if they had none at the moment) and 75% rated them as good or excellent. 2% rated their working conditions as poor or very poor. The differences between sizes of firm were not significant.

Summary of findings for this sub-heading: Employers are not, in the main, creating welcoming conditions for women to enter their work forces and this is reflected by the low participation of women in senior positions. Large firms do

better than the others but still over half of them have no women in senior positions. Employers seem to be unaware of the benefits of having a gender balance in their work force and the majority is not putting in place any measures that would help, most do not know what those measures could be.

Benefits for pregnant women and mothers are rare and limited to statutory obligations in most cases. Most employers think their working conditions are good or excellent for women and that there is no gender discrimination. There is a clear disconnect between what employers think is an acceptable situation and what would be considered acceptable in most EU States.

This is an area that requires major attention. Employers need to be persuaded of the benefits of increasing female participation in their work forces and they need to be enlightened about what it would take to make employment attractive to women. They need guidance on the measures that could be taken to make their work places woman friendly and also on how to ensure that there is equality of opportunity for women as well as men.

Most employers think that this is an area that the Government of Georgia should lead.

Question 3.2, conclusions from the above findings:

At school

- The teaching of STEM subjects at school needs to be improved
- Most students think that their teaching does help them pass school examinations but many (13%) are taking private top-up lessons which is not a good indicator
- Around a third of students are getting career guidance
- Employers think that schools need closer links with local business to give them more insight into the labor market
- Employers think that schools could give more encouragement to students to choose STEM careers
- Awareness of STEM education and Career opportunities at school is low and needs to be improved across the board but particularly for TVETs
- Knowledge of scholarships is around 45%; this could be a lot higher
- Real awareness of what STEM jobs are, particularly Science, is quite low at school and generally so for TVET students; again this points to the need for better quality information about STEM careers

At University and TVET

- Teaching facilities and materials are not serious impediments to STEM studies
- Cooperation with STEM employers is low and is a key area for attention as this is also reported by GIZ, ETF, MCA and the EU Bruges Communiqué as a key factor in enabling education to equip students for real jobs in industry. Employers also state strongly that this is an area for improvement.
- Institutions could do more in the area of facilitating the transition from institution to career

- The findings from students indicate that teaching quality is not the real issue constraining the flow of STEM students into jobs; it is more about the linkage between education and industry. However employers are more sanguine. They do think that higher education institutes and TVETs need to improve the job they do in preparing students for STEM jobs in their own firms and in their own sectors. They also think that the educators should be more focused on the real job opportunities in the region.
- Policy makers may wish to consider how to better help potential students from poor and remote families to get better access to further education.
- Respondents did not think there were significant gender barriers to STEM occupations and that schools encouraged girls as well as boys
- Students are not really aware of pay rates for graduates but they do have expectations that may or may not match the labor market
- The results on the attractiveness of STEM jobs showed that some STEM jobs are thought more attractive than others with Technical and Engineering rating higher than Science and Math with Science particularly low. Students need more information on Science and Math jobs
- The number of students who report their institution does not have strong links with employers or provide help with employment are areas for attention
- Employers have views about improvements that are necessary to improve the flow of students through the educational system into STEM careers. They favor much stronger, regular and organised links with educational providers, the introduction of modern technologies in education and improving the qualifications of teachers
- Employers are unaware of the issues of gender in their work force and they are not in the main creating an environment that is conducive to women entering their work forces and certainly not facilitative to career development. This is an area for government attention.

Study 3: Question 3.3: What are current and future trends in labor market demand for STEM skill shortages?

3.3.1 Identify trends in labor market demand with respect to the skill shortages identified under Questions 3.1 and 3.2 above (“Skill Shortages”)

3.3.2 Including a trend analysis of the current and projected (over 10 years) number of people needed to fill each Skill Shortage area

3.3.3 Including earnings of skilled workers in such shortage

The evidence available comes from selected findings from the employer survey; namely: answers to questions A60-A64. The employer survey engaged 150 employers from across all STEM sections and geographical areas. The survey question 103 identifies all respondents were either board members (directors) or senior financial, human resources or sales managers. 67% of employer participants were male and 33% female.

The absence of responses to questions about ten year projections precludes reporting on ToR 3.3.2 in any detail.

The evidence is presented in a sequence which maps to both the terms of reference and the sequence of questions in the questionnaire. The complete survey findings are available as a separate data file.

Findings in relation to future employer skills needs

Assessment of the need for new skills in coming years

Table 3.20. A61. Thinking about your firm’s future plans: to what extent do you agree that new skills will be needed in next two years?

N=150	Frequency	Percent
1 Disagree strongly	18	12.0
2 Disagree	32	21.3
3 Neither disagree or agree	30	20.0
4 Agree	61	40.7
5 Strongly agree	9	6.0
Total	150	100.0

Combining the two ‘agreement’ scores indicates around 47% of employers agree that new skills will be needed in the next two years. Approximately 33% (one in three employers) disagree that new skills will be needed in the next two years.

Assessment of need for new STEM skills in coming years

The nominated new STEM skills were recorded under question A62a as shown below:

Table 3.21. A62a New STEM skills which will be required in the coming years

N=122	Frequency	Percent
Technologist	9	12.9%
Engineer	9	12.9%
Electrician	9	12.9%
Mechanic	7	10.0%
Operator	6	8.6%
Welder	6	8.6%
Construction engineer	4	5.7%
Metallurgist	3	4.3%
Technician	3	4.3%
Fitter	3	4.3%
Plumber	3	4.3%
Architecture	3	4.3%
Refrigeration industry	3	4.3%

In comparing this list with that recorded in study 3.1 “which STEM professions are hard to fill”, Software Engineer is the only genuinely new skill in the top six skills named from study 3.1. This suggests that in the next two years employers will have demand for skills which are only new to their specific organisation and already known to be difficult skills to recruit.

Assessment of need for new Non-STEM skills in coming years

The employers were asked to predict the **non-STEM skills** they would need in the coming two years. 74 respondents answered this question. The findings are shown below:

Table 3.22.A62b New Non STEM skills which will be required in next two years

N=74	Frequency	Percent
Driver	5	7.1%
Field of Marketing	4	5.7%
Veterinary	2	2.9%
Welder	1	1.4%
Accountant	1	1.4%
Economist	1	1.4%

The most popular skill mentioned by respondents is Driver, followed by Marketing. The numbers in each category are too small to permit deeper analysis. Employer participants were asked if the skills required would be completely new to their organisation.

Table 3.23. a63 Will these new skills needed for your firm /organization

N=150	Frequency	Percent
Be entirely new	9	6.0
The enhancement of existing skills	41	27.3
Combine existing skills with other also already existing skills	20	13.3
Total	70	46.7
Non-responses or excluded by routing	80	53.3
Total	150	100.0

The above supports the interpretation of the previous table's data in that around 27% of employers will see the new skills they need as enhancements of existing skills or a blend of existing skills as indicated by 13% of employers.

Employers showed a lack of communication with their industry peers and other organisations. The table below illustrates this:

Table 3.24. a64. Have you talked to other firms' representatives regarding skilled employer shortages in STEM fields in your sector?

N=150	Frequency	Percent
1 Yes	45	30.0
2 No	105	70.0
Total	150	100.0

70% of employers surveyed had not communicated with colleagues in other organisations in their sector. This is an unexpected finding bearing in mind the recommendation to establish sectoral committees in Georgia to facilitate communications.

Question 3.3 conclusions from the above findings

About half of the employers 47% agreed that their firm will need new skills in the next two years. However, most found it difficult to be specific about what these skills would be. Less than half could give any answer and of those that did the majority spoke non-specifically about combining existing skills with other existing or new skills. In fact 88 out of 150 (59%) were unable to specify any new skills that they would need. Of the remaining 41% a large list of jobs arose, many of them with less than 4 entries. Software engineer is the only genuine new skill mentioned by employers.

Due to the lack of specific projections from the employer organisations in the quantitative survey it is not possible to project skills requirements for ten years. This will be carried forward in recommendations.

Few employers were able to be specific about any of their future plans regarding new skills or the wage rates that would be likely in the future. As a source of information about future development in skills or future pay rates, this survey was not successful in finding useful information. It has not been possible to find this information from published sources either. Employers are frequently unwilling to talk to outsiders about their pay rates for the obvious reason that they do not want this information to be in the public domain: it may increase pay demands from their staff, it may lead to other employers poaching their staff. In practice it is unlikely that employers in any EU country

would be very open about these issues and any information that an expert group could provide would be likely to be speculative.

In summary, the employer survey did not provide much specific information although in the next section all of the specific information that was given has been summarised. It appears that employers think about the immediate future and do not think in time scales of more than two years and even then their answers are disappointingly unspecific.

Study 3: Question 3.4: Types of post-secondary education programmes that could reduce the STEM skill shortage

- For each occupation/specialty, present evidence of the degree/certificate level required
- For each occupation/specialty, present evidence of the economic sector and industry for which there is demand

The evidence available comes from two sources, desk research and the employer survey. The employer survey engaged 150 employers from across all STEM sections and geographical areas.

The Ministry of Education and Science (MOES) has prepared its strategy for TVET 2013-2020. This strategy embraces a key principle of the EU Bruges Communiqué (see desk research Study 3) which is that the development of post-secondary education programmes must be based on an ongoing partnership between education providers and industry, something that the employer survey demonstrated is currently weak in Georgia. The MOES strategy makes a commitment to partnership:

The reinforcement of full social partners, employers, professional associations and civil society participation at all levels of the system in decision-making as well as in the whole process of VET education: NVETC, TWG, Boards, working groups; ensure balanced and equitable composition of social partners in the development and delivery of VET reforms, with the sustainability and transparency of the functioning of all these units within the system embodied regulation and operational procedures¹

The strategy intends to build on the work already done in the development of the National Qualifications Framework (NQF), the sectoral bodies and the development of occupational standards and qualifications. It aims to develop nationally and internationally recognized awards and qualifications that are based on the real needs of the current and future Georgian economy.

This study has indicated that the strategy is needed and that the principles and aims set out in the strategy meet the needs of employers, clearly articulated in several studies, to ensure that post-secondary education provides the skills, knowledge and attributes that are needed in Georgian industry and that this is done in partnership with employers.

The employer survey showed that employers want contact with education providers because it is very much in their interests; they know that the quality of their workforce is the basis of their business success.

The MOES strategy also commits to other objectives that the survey shows to be needed:

- well qualified educators and market-oriented flexible programmes
- facilities of high quality and efficiently and effectively managed
- increasing the overall capacity of the network through diversification of authorized quality providers within both the public and private sector
- a more optimal national network of institutions both in terms of geographic spread and availability of disciplines/specializations
- preparation and training/re-training of VET teachers according to modern standards and the latest developments in teaching

All of these commitments are important and to support this, the survey indicates the priority areas for action.

The employers that participated in the survey were in the following fields:

- Mining and quarrying 20%
- Construction, electricity, gas and water supply 18.7%
- Manufacturing 16%
- Transport, storage and communication 16%
- Computer and related activities 12%
- Manufacturing of electrical and optical, transport equipment, other manufacturing 8.7%
- Agriculture, hunting and forestry 8.7%

When asked about the skills that were hard to recruit the employers said:

66% said that there was a shortage of skilled specialists in their field.

The hard to recruit skills were (in rank order, highest first).

- Software engineer 13%
- Engineer 10.7%
- Technician 7.3%
- Electrician 6%
- Fitter 5.3%
- Mechanic 3.3%

The percentage figure shows the number of employers citing this skill as hard to recruit.

When asked at what level the shortages were, employers gave the following information:

Table 3.25. Employers say that they can recruit the skills they need

Level(N=150)	Percentage of Employers who say that they can recruit
Operator	44.0%
Technician	38.7%
Technical Manager	38.0%

It appears that operators are marginally easier to recruit than technicians and technical managers. Nonetheless, this information indicates that over 60% find difficulty in recruiting technicians and technical managers.

When asked about their future skill needs, these skills were indicated:

- Technologist 12.7% (note employers used the term technologist and technician interchangeably)
- Electrician 12.7%
- Engineer 12.7%
- Mechanic 10%
- Welder 8.6%
- Metallurgist 3%
- Fitter 3%
- Plumber 3%

The desk research found similar patterns. The 2010 GTZ survey found that utilities (electricity, gas and water / sewage), mining and processing, chemicals and pharmaceuticals, rail and logistics are growing sectors where skill shortages will be a constraint. These sectors were represented in the employer survey and the GTZ findings were corroborated.

GIZ in 2012 found a large share of firms seeking to recruit are unable to hire craftsmen, technicians and managers, with the requisite skills and qualifications. It is important to note that these issues relate to all STEM jobs from operational through technician to manager levels.

The Millennium Challenge Account found in 2013 that TVET provision is still largely focused on agriculture, construction and transport and not on the sectors found by GIZ to be growing.

The 2010 GTZ survey found that TVET activity was not targeted at the following sectors where large employers are to be found.

- Chemicals and pharmaceuticals
- Electric production and delivery (electricians are trained but mostly for the construction industry)
- Gas transportation and delivery
- Water and sewage
- Mining and processing
- Logistics and rail

This is corroborated by the Employer survey where employers said the following: “Educators are not so interested in our fields as they are not considered trendy: 26.3%” “The system is not designed correctly: 28%”

Summary of findings for this sub-section: Within the context of the MOES’ strategy for TVET 2013-2020 and its commitment to partnerships that engage employers and educators in identifying the specifics of current and future

needs, the following are priority areas for the development of post-secondary education programmes:

- Software engineer
- Engineer
- Technician
- Technologist
- Electrician
- Engineer
- Metallurgist

At technician and technical manager levels. And at operator and technician levels

- Electrician
- Fitter
- Mechanic
- Welder
- Plumber

And with the following industrial sectors:

- Chemicals and pharmaceuticals
- Electric production and delivery (electricians are trained but mostly for the construction industry)
- Gas transportation and delivery
- Water and sewage
- Mining and processing
- Logistics and rail
- Computer and related activities
- Manufacturing of electrical and optical, transport equipment and, other manufacturing

When considering the level of education that should be provided we can look to the experience of other countries such as EU members where the twin tracks of technical vocational education and training (TVET) and university education can be found. At TVET qualifications are obtained that are often although not always deemed to be at the equivalent level to a Bachelor degree. In the UK there are National Vocational Qualifications (NVQs) that are competence based. They have underpinning technical knowledge but primarily assess what the person can do related to an agreed standard. The NVQs are based on agreed national standards developed by employers and educational providers and tested in industrial settings. In the UK Level 5 is deemed to be equivalent to a Bachelor degree. The actual level required for any technical profession is agreed with employers but level 5 is the norm for all of the above professions. It appears that Georgia is following a similar approach.

Universities also provide technical Bachelor degrees in these areas. The employer survey showed that approval levels of University and TVET providers are low, around 25%, which means that around 75% of employers have little confidence that these providers can deliver. Therefore any projections of numbers of post-secondary courses would be pointless as this would not reflect any reality in the economy. At this stage we can say that the professions indicated above are and will be in demand and that post-secondary courses at Bachelor degree or TVET equivalent should be developed with employer participation as envisaged in the MOES strategy.

When considering numbers required, it is impossible to project these from the information that is available. The reasons are:

- Employers themselves don't really know what skills they are going to need in the future. They are unsure about how the economy is going to develop but they do say that their skill needs will change. This is somewhat in contradiction with the World Bank report that states that qualified young people are still, in 2013, entering traditional jobs that haven't changed for years.
- Employers have little confidence in the providers of TVET and higher education; only about 25% believe that as currently constituted these institutions can deliver what is needed and so they are not able to forecast what they might need from them
- The World Bank 2013 report states that there is an over supply of trained educated people entering the labor market and that many take jobs for which they are over qualified. Although that report does not concentrate on STEM jobs, it is a clear indicator that more courses are not the answer to Georgian labor market needs but more tailored courses to emerging highly skilled needs could be. The World Bank assert that :
- For high productivity jobs to be created, workers need to have the right skills, not only diplomas. The modern sector will expand if workers have the skills that make investments in high value-added activities profitable. This means that the education sector in Georgia needs to change so as to provide high quality education and become more responsive to the changing labor market demands. Graduates need to have not only degrees but also the skills and competencies required by employers in modern firms. It is necessary to foster the demand for highly skilled labor but the demand will materialize only if there is an adequate and swift supply response.

We take the World Bank study to confirm our view that getting fine grained numbers and specifications from employers is not possible and that a more strategic approach to employer / State / educational provider partnerships focused on the real needs, starting with the professions outline above is the right course. Concerning migration the Georgian GeoStat web-site gives good information about migration and it is clear that:

- There is no definite pattern of migration, there are big year on year variations and projections could not be found

- Migration in 2012 was predominantly in the male 20-29 sector, followed by females on the same age sector. No reasons are given but if we collate this information with the World Bank information about high numbers of unemployed but highly qualified young people, it is logical to assume that many such people choose to find work outside the country. To this extent, Georgia is currently training people and other countries are reaping the benefit of that. This indicates that the issue is not a supply of skilled young people issue, more a demand for skilled young people issue and even more a mismatch of the skills developed in institutions and the employers' perceptions of what is required.

Question 3.4 conclusions from the above findings

The main findings for this sub-section are: The list of professions in demand is reliable as are the requirements at the three levels, operator, technician and technical manager. It is not possible to give finer grain than this but it is possible to recommend that these professions become the starting point for serious and strategic partnerships that flesh out the detail on a specific case by case basis.

Overall Recommendations for Study 3

There are seven recommendation areas:

1. Quality of teaching of STEM subjects in schools
2. Employment and gender balance
3. Employers continue to say that they cannot recruit the skilled staff they need
4. Employers want to see STEM HEI and TVET improved
5. Skill Shortage areas
6. Career guidance at schools
7. Interface between schools and Universities and TVETS

These are expanded in the sub-sections below:

1. Quality of teaching of STEM subjects in schools

The issue:

The IPM Research survey shows that students are not impressed with the quality of the practical teaching, laboratories or the text books they have.

The survey also shows a big difference between student perceptions of the quality of STEM teaching at schools. Those that go to University think the quality is good 66.7% while only 25% of those that go to TVET agree. This difference points to a teacher concentration on the higher ability students but not for those of more moderate abilities; this is confirmed by the QL The focus groups point to students' ability in STEM subjects being linked to teacher capability and teacher belief. There was a clear indication that teachers give more positive feedback and encouragement to boys than to girls even though girls actually outperform boys in STEM subjects and particularly in Math.

The focus groups also pointed to the use of private tutors as a common practice, reflecting students' inability to learn sufficiently at school. This relates to the PISA and TIMMS results that show Georgia as below the OECD average in student achievement in math and science.

The employer survey showed that only 22.6% thought schools were doing a good job of teaching STEM subjects.

The recommendations for: Quality of teaching of STEM subjects in schools are:

A STEM school teaching improvement programme to be implemented by MOES that would include:

- Gender awareness training for teachers
- Improved text books that are gender neutral
- Specialized in- service training for teachers on a range of specific STEM teaching challenges led by experts with a strong reputation
- Up grading of practical teaching including use of laboratories

This is a complex and resource intensive issue. Should MOES decide to implement it, it would be a major project with strands to do with improvement of teaching facilities, text books and teacher training. It would need to be implemented over a period of years. It would require a project and business plan that would be resourced and managed by a specialist unit. Decisions would need to be made on priorities in terms of regions, order of implementation and project management. This may need international funding. As a complex programme the risks of poor implementation are high. These risks could be minimized through a professional programme management approach such as PRINCE 2. The availability of resources is another key issue as is the order in which plans are implemented. For example, improving facilities without improving teachers' ability to use them well would be counter-productive.

2. Employment and gender balance

The issues

The evidence from the employer survey is clear: most employers do not take any actions to make their work places attractive and suitable for women workers and also that they are not aware that there is any need for them to do so. Even if they were aware, it is clear that almost all employers have no idea how they might address gender imbalance.

The absence of special benefits for pregnant women, absence of child care facilities, minimal maternity leave and support all point to an unawareness of gender issues and indeed an unwillingness to value having a gender balance.

The number of women in senior positions is small; over a third of firms have none and 45% had only one or two. None of the small firms had any women in senior positions. This does constitute a barrier to female employment and this is something of which the wider population as shown by the focus groups is aware. Also firms are losing out as they are only primarily recruiting males and not attracting able females. Their preferred recruitment practice is to ask colleagues rather than to organize systematic recruitment: this can only

exacerbate the situation. This situation will only change when either the government legislates for anti-gender discrimination or when industry becomes convinced that it needs to change.

The recommendations for: Employment and gender balance are:

Develop a gender awareness programme:

- Such a programme would engage employers and find a select number who are willing to implement gender balance programmes in their organisations and to allow the results to be known. The approach develops role model firms who can demonstrate the benefits in business terms that other businesses can understand.
- This can be done through NGOs such as Chambers of Commerce with some encouragement and support from government.
- A similar approach is widely used in EU countries to encourage employers to employ socially disadvantaged workers.
- The programme could work both on gender and social disadvantage but with different NGOs leading each.
- This would require a programme to be developed with a NGO given some funding to lead it with a clear and agreed project and business plan. Such a NGO would need to have or quickly build face validity with employers.

3. Employers continue to say that they cannot recruit the skilled staff they need.

The issues:

The research survey shows that only 37.3% of employers say that overall they can recruit the skills they need. This breaks down into 44% saying they can recruit at STEM operator level, 38.7% at technician level and 38% at technical manager level. The survey shows that 77.1% say the reason for the problem is that there is a shortage of skills and people are not being trained effectively for these skills. Confronted with this 73% operate their own internal training as the solution. This is corroborated by the Desk Research where a number of studies confirm this.

The recommendations for: Employers continue to say that they cannot recruit the skilled staff they need are:

A strategic development of TVET and University vocational education and training is needed in order to address these endemic issues in partnership with government and employers. The Government of Georgia has developed a strategy for TVET that includes partnerships with employers, educators and government. A National Qualifications Framework has been set up and the work of developing national standards has begun. This needs to also engage the University sector and also to develop strong partnerships between employers and educators at national strategic level and at local operational level. It is important to note that employers have a sceptical view about the providers of technical vocational education. They need to be engaged but they need to see results in order to overcome the sceptical view.

The World Bank study indicates that employers do not always know what their future skill needs are and that when asked about this focus on immediate needs The Bank advises that industry / education / government partnerships are set up to consider not just current needs and not just identifiable future needs but also generic 'learning to learn technical skills' that will enable graduates to adapt to future needs. The Bank also advises that a holistic approach that brings together industrial development and technical skills strategies together is the most likely way to meet the country's needs for a modern competitive industrial economy.

4. Employers want to see STEM HEI and TVET improved

The issues:

50% of employers thought that the technologies employed in the institutes need to be upgraded. 43% thought that the qualifications of STEM teachers at all levels need to be improved, with 18% advocated recruitment of teachers for Universities and TVETs from abroad. There is a gap between perceptions of the employers and faculty staff who do think that they prepare students for the real jobs that exist. 57% of employers say that they want to work in closer cooperation with Universities and TVETs.

The recommendations for Employers want to see STEM HEI and TVET improved are:

An upgrading of teaching skills and facilities at TVET and Universities: A Scoping Study linked to the skill shortage areas reported by employers.

This recommendation links to recommendation 3 above. It calls for a root and branch review of the skills and knowledge needed by educators not just in relation to current shortages but also future needs.

The World Bank 2013 made the following recommendation on this:

Future jobs are bound to differ in terms of skills requirements from their current jobs. The only way to prepare students for a long working life is to provide them with a solid foundation of generic skills, including the critical learning-to-learn, analytical and problem-solving skills. Thus, a balance needs to be struck between providing students with generic skills vital for their future job careers and technical and vocational skills required by employers in existing jobs.

Our recommendations therefore are for a scoping study that follows the guidance of the World Bank and results in clearly defined improvements in curricula, targeting to those sectors that are growing, teacher skills and qualification and ongoing links with employers. The risks of a scoping study are modest but the well-known scepticism of employers on this point means that their engagement and careful management of their expectations is crucial.

The risks of implementation are to do with failure to meet expectations that themselves will change as the economy changes and maintaining the balance between meeting employers' needs of today while building the generic skills for the future.

Also there is likely to be resistance to change and the project management unit will need strong change management skills.

As financial resources are always finite, clear priorities will need to be set and the programme implemented in a phased way that delivers value for money in a demonstrable way.

5. Skill Shortage areas

The issues:

Employers report skill shortages in key areas at operator, technician and technical manager levels. The specific skills are;

- Software engineer 13%
- Engineer 10.7%
- Technician 7.3%
- Electrician 6%
- Fitter 5.3%
- Mechanic 3.3%

And in the future:

- Technologist 12.7% (note employers used the term technologist and technician interchangeably)
- Electrician 12.7%
- Engineer 12.7%
- Mechanic 10%
- Welder 8.6%
- Metallurgist 3%
- Fitter 3%
- Plumber 3%

The recommendations for Skill Shortage areas are:

All of the above skill areas are in short supply and need attention at all three levels. Operators need to be developed to levels of competence to be agreed by TVET and employers. Competence standards need to be agreed on a sectoral basis but would set out specific areas of work and the industry standards to be achieved along with the skills and underpinning knowledge. Technicians normally need to achieve either bachelor degree or vocational education equivalence with competence standards also agreed on a national sectoral basis. Technical managers need to achieve bachelor degree status and post graduate management education. Once again, policy makers need to work closely with employers who are generally skeptical about existing vocational education providers' ability to deliver. This approach needs to have short, medium and long term result goals built in that will be reported on in a way that builds employer confidence

6. Career guidance at schools

The issues:

It is clear from the IPM Research survey that career guidance was only received by around a third of all students. Yet socially disadvantaged students reported much higher rates, 61.9%. Awareness of specific STEM careers at school ranged between 22% and 37% for TVET students and 40.7% and 56.6% for University students. Only 7.3% of employers thought that schools were aware of labor market issues and trends. The IPM Research survey showed that knowledge about the reality of STEM jobs while students were at school was reported by on average a third of students. It is clear that most students at school are not getting the career guidance that will allow them to make informed choices.

The recommendations Career guidance at schools are:

Career guidance in schools is a clear need. It needs to be incorporated into the work of each school and should involve local employers and the Employment Service who would provide realistic and up to date information. Without the full commitment of the Employment Service, MOES, schools and local employers this will remain problematic.

7. Interface between schools and Universities and TVETs**The issues:**

34% of students at University in the QN got information from the school about University, for TVET students it was 14%. This indicates that information at school about higher education should be improved.

The recommendations for Interface between schools and Universities and TVETs are:

Improved information packs about further vocational education in STEM fields distributed to schools. The Universities and TVETs need to be encouraged to coordinate their efforts on this and also to engage more strategically with schools. In many countries, further education providers build links with schools, visit them and speak to students and parents to enable them to make informed choices

ANNEX 1. CAT PERFORMANCE

Table 1 Female and male performance per CAT grading scale 2011

2011	Boys					Girls				
Subject	5-5.99	6-6.99	7-7.99	8-8.99	9-10	5-5.99	6-6.99	7-7.99	8-8.99	9-10
<i>Mathematics</i>	35.90%	25.74%	18.57%	14.21%	5.57%	28.93%	27.07%	22.67%	15.50%	5.83%
<i>Chemistry</i>	18.60%	43.22%	19.66%	12.61%	5.90%	7.63%	33.77%	26.38%	21.12%	11.10%
<i>Physics</i>	15.23%	31.07%	38.62%	9.55%	5.53%	11.95%	29.33%	40.37%	11.96%	6.39%
<i>Biology</i>	15.40%	37.82%	26.75%	13.12%	6.92%	10.38%	25.83%	28.20%	21.60%	13.99%

Table 2 Female and male performance per CAT grading scale 2012

2012	Boys					Girls				
Subjects	5-5.99	6-6.99	7-7.99	8-8.99	9-10	5-5.99	6-6.99	7-7.99	8-8.99	9-10
<i>Mathematics</i>	14.26%	36.98%	28.34%	13.81%	6.62%	10.91%	33.49%	33.91%	16.23%	5.45%
<i>Chemistry</i>	7.71%	42.78%	31.29%	12.18%	6.03%	2.61%	27.93%	38.37%	20.37%	10.71%
<i>Physics</i>	12.84%	33.33%	32.57%	15.67%	5.58%	10.34%	31.19%	34.21%	18.80%	5.46%
<i>Biology</i>	9.73%	41.60%	30.64%	12.36%	5.68%	5.33%	29.20%	34.87%	20.63%	9.97%

ANNEX 2. ADMISSIONS FOR TVET, BACHELOR, MASTER AND DOCTORAL LEVELS OF EDUCATION

Table 1 Admission for TVET's Degree

	Admission - 2009-10 *			admission - 2011-12*			admission - 2012-13*		
	Science	Engineering, manufacturing and construction	Agriculture	Science	Engineering, manufacturing and construction	Agriculture	Science	Engineering, manufacturing and construction	Agriculture
Female	-	82	-	130	22	19	104	33	2
Male	-	531	-	369	258	33	154	285	6
Total	-	613	-	499	280	52	258	318	8

*Sig=.000

Table 2 Admission for Bachelors' Degree

	admission - 2009-10*			admission - 2011-12*			admission - 2012-13*		
	Science	Engineering, manufacturing and construction	Agriculture	Science	Engineering, manufacturing and construction	Agriculture	Science	Engineering, manufacturing and construction	Agriculture
Female	846	672	412	1307	223	31	1076	346	145
Male	1385	1593	653	1889	860	136	1981	1230	260
Total	2231	2265	1065	3196	1083	167	3057	1576	405

Sig=.000

Table 3 Admission for Masters' Degree:

	admission - 2009-10*			admission - 2011-12**			admission - 2012-13*		
	Science	Engineering, manufacturing and construction	Agriculture	Science	Engineering, manufacturing and construction	Agriculture	Science	Engineering, manufacturing and construction	Agriculture
Female	226	77	13	214	87	29	111	56	1
Male	234	243	31	277	160	57	303	197	8
Total	460	320	44	491	247	86	414	253	9

*Sig=.000; **Sig=.041

Table 4 Admission for Doctoral Degree

Year	Science		Engineering, manufacturing construction*		Agriculture	
	Female	Male	Female	Male	Female	Male
2007	-	-	20	13	12	10
2008	84	77	40	59	13	10
2009	133	122	90	161	81	52
2011	103	72	32	79	0	0
2012	80	85	45	92	2	0

*Sig=.024

ANNEX 3. GRADUATIONS FOR TVET, BACHELOR, MASTER AND DOCTORAL LEVELS OF EDUCATION

Table 1 TVET IV-V level program graduates

	Graduates 2009-10			Graduates 2011-12*			Graduates 2012-13*		
	Science	Engineering, manufacturing and construction	Agriculture	Science	Engineering, manufacturing and construction	Agriculture	Science	Engineering, manufacturing and construction	Agriculture
Female	7	0	0	109	13	8	117	22	28
Male	8	0	0	229	132	10	317	207	49
Total	15	0	0	338	145	18	434	229	77

*Sig=.000

Table 2 Bachelors Degree earned in STEM fields

	degree holders 2009-10*			degree holders 2011-12*			degree holders 2012-13*		
	Science	Engineering, manufacturing and construction	Agriculture	Science	Engineering, manufacturing and construction	Agriculture	Science	Engineering, manufacturing and construction	Agriculture
Female	612	305	79	812	238	253	674	193	104
Male	687	708	264	730	655	512	558	618	238
Total	1299	1013	343	1542	893	765	1232	811	342

*Sig=.000

Table 3 Masters' Degree earned in STEM fields

	degree holders 2009-10*			degree holders 2011-12*			degree holders 2012-13*		
	Science	Engineering, manufacturing and construction	Agriculture	Science	Engineering, manufacturing and construction	Agriculture	Science	Engineering, manufacturing and construction	Agriculture
Female	205	121	10	262	80	9	193	64	8
Male	149	286	17	200	162	18	213	150	85
Total	354	407	27	462	242	27	406	214	93

*Sig=.000

Table 4 Doctorates earned in STEM fields

	Science		Engineering, manufacturing and construction		Agriculture	
Year	Female	Male	Female	Male	Female	Male
2007	7	0	12	19		
2008	8	5	5	11		
2009			2	2		
2011	21	16	29	26	0	0
2012	35	28	26	39	4	7

ANNEX 4.THE TERMS OF REFERENCE

The work had 3 components

Study 1: Barriers to Female Participation in STEM post-secondary programs

Within this Study there were 6 questions

Question 1.1: What is the present situation with respect to women and girls in Science, Technology, Engineering and Mathematics in Georgia?

Question 1.2: What social-psychological barriers limit women's participation in post-secondary STEM programs?

Question 1.3: What organizational-structural barriers limit women's participation in post-secondary STEM programs?

Question 1.4: What labor-market barriers limit women's participation in STEM occupations?

Question 1.5: What programs have been effective in increasing the participation of women and girls in STEM fields, in Georgia and other countries?

Question 1.6: What programs could be implemented in Georgia to improve women's participation in STEM occupations?

Study 2: Barriers to the Participation of Socially Disadvantaged Students in STEM Programs

Within this study there were 5 questions:

Question 2.1: What is the present situation with respect to socially disadvantaged students in Science, Technology, Engineering and mathematics in Georgia?

Question 2.2: What organizational-structural barriers limit socially disadvantaged students' participation in secondary and post-secondary STEM programs?

Question 2.3: What labor-market barriers limit participation in STEM occupations by socially disadvantaged groups?

Question 2.4: What programs have been effective in increasing the participation of socially disadvantaged students in STEM fields, in Georgia and other countries?

Question 2.5: What programs could be implemented in Georgia to improve socially disadvantaged students' participation in STEM occupations?

Study 3: Labor Market Demand for STEM Occupations

Within this study there were 3 questions

Question 3.1: What is the current employer demand for STEM occupations?

Question 3.2: What is the current student demand for STEM occupations?

Question 3.3: What are current and future trends in labor market demand for STEM skill shortages?

The approach IPM Research took in agreement with MCC

There were 3 main components of the work carried out by IPM Research

Desk research into the current situation in Georgia and also into good practice worldwide.

Qualitative analysis using focus group discussions with students at school

Quantitative analysis using surveys with employers, students (including socially disadvantaged) and faculty at University and TVET, school students (including socially disadvantaged from urban, village and mountain schools), school teachers and parents

The aim was to provide a balanced answer to the questions drawing on all three components.

The desk research of Georgian publications was carried out in all three studies and perhaps inevitably there were gaps in what the publications could provide. While there was much valuable information such as the take up of scholarships, access to further education by gender and socially disadvantaged groups and actual skills in short supply, there were gaps, such as we could not find data about those school students who do not pass UEE, what happens to students from ethnic minorities who do the one year Georgian language course that when successfully passed can lead to further education and what skills are in short supply in 2013 and beyond.

The international education benchmarking exercises such as PISA and TIMSS gave much useful information about the quality of teaching of STEM subjects in Georgia and educational outcomes for girls compared to boys.

The qualitative work involving 24 focus groups across the country (8 for gender and 16 for social disadvantage) took place at the end of the summer as students were returning to school. The focus groups were carried out by trained moderators who were able to initiate discussion and elicit responses without imparting any bias of their own.

The quantitative analysis involved surveys with face to face interviews with employers, school, TVET and University students, teachers and parents. The interviews were carried out by trained interviewers following a procedure that had been agreed with MCC. The questions were standardised and show cards were used. The information was analysed using SPSS software.

Each study has been prepared to provide as much information as possible in relation to the questions in the TOR.

ANNEX 5. DATA COLLECTION METHODS

Studies of Labor Demand, Barriersto Participation in STEM Education Programs and Occupations in Georgia consisted of several components:

Desk research

Qualitative research

Quantitative Research

Each component had its own method of data collection, which are described below

Desk research

To gain the information set in TOR and needed to analyze the study issues official letters with information request were sent to different agencies, such as MoES, NAEC, EQE, SSA, GeoStat, different city halls and etc.

Obtained databases were processed at IPM Research using SPSS software and provided to the experts for further analysis.

The following databases obtained from different agencies were used in desk research

1. TIMSS 2011 provided by NAEC
2. PISA 2009 provided by NAEC
3. Grade 9 National Assessment in Math provided by MCA Georgia
4. University Entry Exams (2009 – 2012) compared with database of Social Service Agency in order to identify students from low income families provided by NAEC
5. CAT 2011 - 2012 compared with database of Social Service Agency in order to identify students from low income families provided by NAEC
6. MoES data on 2012 GoG N300 decree by key categories of socially disadvantaged students (compared with same type decrees from 2009 – 2011 years) provided by MoES
7. National Olympiad Results 2011-2012 provided by NAEC
8. Bridging program results 2011-2010 provided by EQE
9. Admissions and graduates by programs (HEI, TVET, Master's and doctoral programs) provided by GeoStat
10. Student Support program database by Ministry of Education, Culture and Sports of Autonomous republic of Ajara

Literature and articles used in desk research are provided in **ANNEX 7**

Qualitative research

Qualitative researches were conducted for study 1 and study 2 using focus group discussion method. As the respondents of the study were the secondary school students the study was conducted using small FGDs (attended only by 6 respondents).

The students were recruited using snowballing method. School administrations were not contacted but in one case in Akhalkalaki. Where the director's help was essential as the population of Samtskhe -Javakheti (Akhalkalaki) region is considered to be hard to reach.

Group composition was designed taking into consideration the ethnical composition of communities/regions.

The qualitative study was conducted in Tbilisi, Imereti (Kutaisi), Samtskhe-Javakheti (Akhalsikhe, Akhalkalaki) and Kvemo Kartli (Marneuli). The locations for group conduction were selected for the below listed purposes:

Tbilisi(1) was selected as a control group to compare the gender issue perceptions and perceptions of Tbilisi inhabitant socially disadvantaged secondary school students with other regions;

Imereti-Kutaisi (2) was selected as a common Georgian region where ethnical minorities represent minorities in the region, to understand what barriers such ethnical minorities may have. Besides what are the perceptions of low income family children, female, high mountainous and rural secondary school students of a common Georgian region may face when choosing profession, studying at school and other barriers that are interesting in the scopes of the project.

Samtskhe Javakheti-Akhaltsikhe and Akhalkalaki (3) was selected as a region which is compactly inhabited by ethnical Armenians who are not minority in the region. Two locations were selected in Samtskhe-Javakheti as, although both settlements are inhabited mostly by Armenians the knowledge of Georgian language differs significantly in these 2 settlements. In Akhaltsikhe most secondary school students speak Georgian as well as Russian and Armenian, while in Akhalkalaki most secondary schools students speak only Russian and Armenian. In order to cover rural secondary school students in Akhalkalaki IPM Research also conducted 2 in-depth interviews with Akhalkalaki rural students. Focus Groups and in-depth interviews in Akhalkalaki were conducted in Armenian Language.

Marneuli (4) was selected as a region which is compactly inhabited by ethnical Azeris who are not minority in the region. Focus Groups of Socially disadvantaged -ethnical Azeris in Marneuli were conducted in Azeri Language.

In total 24 groups were conducted. Respondent selection criteria were as follows:

Criteria for respondent selection for study 1.

- Female students from the urban area -ethnic Georgians and ethnic minorities (9-12th grades)
- Female students from rural area ethnic Georgians and ethnic minorities (9-12th grades)
- Female students from mountainous area ethnic Georgians and ethnic minorities (9-12th grades)

Only in case of Kutaisi all mountainous students were ethnical Georgians due to population composition.

Criteria for respondent selection for study 2.

- Female students from the urban area low income families/ethnic minorities (9-12th grades)
- Female students from rural area/ low income families/ethnic minorities (9-12th grades)
- Female students from mountainous area /low income families/ethnic minorities (9-12th grades)
- Male students from the urban area low income families/ ethnic minorities (9-12th grades)
- Male students from rural area/ low income families/ ethnic minorities (9-12th grades)
- Male students from mountainous area /low income families/ ethnic minorities (9-12th grades)

Quantitative research

Qualitative research consisted of three components which were broken down into specific sub groups:

(a) Study 1. Barriers to Female Participation in STEM post -secondary programs

1. Secondary-level female students and their parents in urban, village and mountain schools
2. Secondary-level teachers of math and science in urban, village and mountain schools
3. Women faculty in secondary (TVET levels I-III) and post-secondary TVET (Levels IV-V) programs
4. women faculty in university STEM fields
5. STEM employers
6. Undergraduate women in university STEM fields
7. Secondary and Post-secondary students in TVET STEM fields

(b) Study 2. Barriers to the Participation of Socially Disadvantaged Students in STEM programs

1. Secondary-level students and their parents in urban, village and mountain schools(SEC_LEV_Q)⁴⁸;
2. Secondary-level teachers of math and science in urban, village and mountain schools(Teach_School);
3. Faculty in secondary (TVET levels I-III) and post-secondary TVET (Levels IV-V) programs(TVET_Fac);
4. Faculty in university STEM fields(HEI_FAC);
5. STEM employers
6. Socially disadvantaged students in university STEM fields
7. Socially disadvantaged students in secondary and post-secondary students in TVET STEM fields(TVET_STU);

Study 3. Labor Market Demand for STEM Occupations

1. STEM employers
2. STEM students (both gender and ethnical minorities).
3. 100 TVET -150 University

Sampling methodology

Taking into consideration the diversity of target audiences by studies' sub groups', geographical area of the study was different for different target audiences. Methodology of survey was face to face interviewing. Total number of the interviews conducted within all sub groups was 918.

The interviews with secondary school teachers, secondary school children and their parents were dispersed through the whole territory of Georgia and covered urban, rural and mountainous settlements.

43 public schools were selected as PSUs from MoES secondary schools database of Georgia. **Sampling universe** was all existing public secondary schools in Georgia that are included in the database mentioned. For drawing out the sample (43 secondary public schools) stratified random selection method was used. The following variables were used for stratification:

- I- Form of ownership – public schools solely
- II- Regions
- III- Settlement types in the regions - urban, rural, mountain

SSU –teachers, secondary level students and their parents were selected in the following manner, IPM research with active participation of MoES contacted schools administrations, provided detailed information regarding the survey objectives and requested to assist in organising the interviews with the target audience.

The respondents' qualification for teachers and students was as follows:

1. Teachers teaching one, or several STEM subjects (math, physics, chemistry, biology, geography and informational sciences);
2. Secondary school students studying in the 9th or 12th grades
3. Parent of the selected secondary school student, who is most involved in

educational issues of her/his child

In spite of small number of interviews the sample captured the whole territory of Georgia except conflict regions.

The **sampling frame** was all State Universities of Georgia where STEM subjects are taught. Stratified sampling method was used for selection of the universities as PSUs.

Stratification variables were

1. Region
2. Number of STEM students within the University

The Universities for the survey were selected in the following cities: Tbilisi, Kutaisi, Batumi and Telavi. The following Universities were selected: Georgian Technical University (Tbilisi); Kutaisi Akaki Tsereteli State University; Batumi Shota Rustaveli State University; Ilia State University (Tbilisi); Ivane Javakhishvili Tbilisi State University; Telavi Iakob Gogebashvili State University; Batumi State Maritime Academy

The number of students and faculty to be surveyed within the selected University was predefined based on proportional distribution of the total number of STEM students within the Universities.

The students and the faculty were selected randomly. The database of contact information off the students and the faculty were provided by the University administration and IPM Research recruitment groups arranged the interviews with them.

The respondents' qualification for the University faculty members and the University students was as follows:

1. 42 female members of STEM faculties for study 1
2. 42 members of STEM faculties (representatives of both gender) for Study 2
3. 42 female University STEM students taking the fourth year at the University (the students of the third year was defined to be acceptable in cases when the fourth year STEM students were not available to conduct the interviews with)
4. 42 socially disadvantaged University STEM students taking the fourth year at the University (the students of the third year was defined to be acceptable in cases when the fourth year STEM students were not available to conduct the interviews with).

The sampling frame for selection of TVETs was all accredited TVETs in Georgia -25 in total. Stratified sampling method was used for selection of the TVET as PSUs. Stratification variables were

1. Region
2. Number of STEM students within the University

The interviews with TVET STEM students and STEM faculty members were conducted in the following settlements: Tbilisi, Kutaisi, Kobuleti, Gori village Khidistavi, Rustavi, Poti, Akhaltsikhe, Chiatura, Ambrolauri, Kobuleti, Ozurgeti, Gurjaani, village Kachreti. Surveyed TVETs were: Community College "Panatsea"; Community College "Spektri"; Community College "Orientiri"; Community College "Georgia"; Vocational college Profiunite; Community

College “Akhali Talga”; Akhaltsikhe Community College; Community College “Aisi”; Vocational College “Erkvani”; Vocational College “Pazisi”; Vocational College “Modusi”; Vocational College “Horizonti”; Vocational College “Gantiadi” Vocational College “Iberia”

The number of students and faculty to be surveyed within the selected TVETs was predefined based on proportional distribution of the total number of STEM students within the TVETs.

The students and the faculty were selected randomly. The database of contact information off the students and the faculty were provided by the TVET administration and IPM Research recruitment groups arranged the interviews with them.

The respondents’ qualification for the TVET STEM faculty members and the TVET STEM students was as follows:

1. 42 female STEM faculties members
2. 42 STEM faculties members (representatives of both gender)
3. 42 female TVET STEM students taking III-V levels at TVETs (it was allowed to conduct interviews with I-II and IV level students in cases when it was not possible to get the sufficient number of III-V level TVET STEM students)
4. 42 socially disadvantaged TVET students taking III-V levels at TVETs (it was allowed to conduct interviews with I-II and IV level students in cases when it was not possible to get the sufficient number of III-V level TVET STEM students)

The interviews with the STEM employers were conducted in all regions of Georgia except the conflict regions (Abkhazia and south Osetia). The STEM employers were surveyed both in urban and rural settlements, although it should be mentioned that majority of the enterprises/firms are located in urban area.

For the enterprise/firm selection the database of active enterprises of Georgia obtained from National Statistics Office of Georgia based on NACE 1. 1. Classification was used.

The firms were selected by the following criteria; the firms were selected proportionally to the universe.

I –size of the enterprise (big, small, medium)

II – Region - Tbilisi/Region

III- Type of activity - 1 digit type of activity (based on NACE 1.1)

Recruitment of the respondents

The respondents for each sub group for all three studies were mostly pre-recruited.

Based on the official letter send to MoES by IPM Research, MoES informed the resource centres about conduction of the study and the resource centres, from their side informed schools’ administrations about objectives of the study, its importance and other details about the types of needed respondents. School administration was rather helpful and by the time the interviewers visited the schools all respondents: teachers, students and parents were already mobilized at the schools.

TVETs and the Universities were contacted beforehand by IPM Research project managers, official letters explaining the objectives of the study and its importance was sent to the majority of TVETs and the Universities. IPM Research needed MoES assistance with several TVETs to confirm that the research was really being conducted and that they had the right to provide the personal information needed for the survey conduction. Most of the TVETs and

the Universities were rather willing to help and timely provided the requested information and assisted in mobilizing the faculty members as well as students.

STEM employers were pre-recruited by IPM recruitment team. 6 people team contacted each firm/enterprise provided in the sample. The firms/enterprises were screened by the size, region and field of activity. The quota for female and socially disadvantaged employees (at least 42 in each case) was also observed. The interviews were appointed with the suitable respondents and interviewers were sent to the destination firm/enterprise for interview conduction.

ANNEX 6 –SURVEY INSTRUMENTS

[Please, see attached folder.](#)

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