The 2021 Report on International Perceptions of Gender Barriers in STEM

Outputs and outcomes of the INWES-KWSE Pilot Survey "Gender perceptions in Science and Engineering" (GISE)

The International Network of Women Engineers and Scientists (INWES) &
The Association of Korean Woman Scientists and Engineers (KWSE)

This report was prepared by Dr. Sarah Peers, project manager of INWES

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Foreword

Human development, in contrast to the concept of economic development, puts human beings at the center. Since 1990, the United Nations has used the human development approach to focus on "expanding the richness of human life" by considering the growth of people's opportunities and choices as a measure of national progress. Yet, the opportunities for women and their choices are still generally more limited than for men, meaning that women in general experience worse human development outcomes. Of the many causes of gender inequality across the world, lack of employment equality and job segregation are two key issues.

One area where there is significant gender-based job segregation is in the science, technology, engineering, and mathematics (STEM) sectors as confirmed in the latest UNESCO Science Report (2021). This UNESCO report also emphasizes the importance of STEM in the achievement of the United Nations Sustainable Development Goals (SDGs). The intersection of gender equality, science and engineering and progress towards better human development outcomes for all is clear.

The Association of Korean Woman Scientists and Engineers (KWSE) began a project in 2014 to assess the perceptions of gender barriers in science and engineering. The international collaborative survey continued for five years with collaboration from the INWES Asia and Pacific Nations Network (APNN), and financial support from the Ministry of Science and Technology (& Ministry of Science and ICT) of the Republic of Korea. Five reports from 2014 to 2018 not only provided results of the responses to the questionnaires on gender barrier perceptions, but also the current status of the APNN member countries expressed in indices including the Human Development Indices and Global Gender Gap Indices. The annual surveys could reveal to a certain degree the gender gap in the perception of barriers in STEM and that despite the rationality expected among scientists and engineers, they have not been "value-free nor people proof." Additionally, the indices outlaid in these reports could provide a rough comparative interpretation of the gender gap in STEM in participating countries.

The aim of KWSE when the 2014 project began was to eventually develop common indices to compare the situation of women in STEM in countries across Asia, as proposed at the first APNN meeting in 2011. The collaborative project agreed by KWSE and INWES in January 2021 was thus timely. KWSE and INWES decided to start with a one-year pilot project based on the previous five-year project with the aim to develop a more specific and quantitative expressions of the status of women in STEM. Moreover, the two organizations decided to include more member countries of INWES in order to expand the participants from Asia to Europe, the Americas, and Africa. The project being funded by the Korean government started with the goal to obtain comparative data on women in STEM between Korea and other countries. Partnering with INWES would upgrade the project to an international level where global cooperation could bring more inclusive and diversified outcomes.

Thus, in 2021, the project with the new name of "Gender barrier perceptions In Science and Engineering (GISE)" commenced with the following objectives:

- To build upon the experiences of the 2014 – 2018 KWSE & APNN surveys
- To test a process and methodology suitable for future international surveys
- To compare data from Asia to data from the rest of the world on gender barriers in STEM
- To explore the development of a gender in STEM index for Asia and for international comparisons

The scope of this pilot project was initially set to share statistical data on gender perceptions in the STEM fields, by country, gender, and age. Moreover, this report proposes a process for future international gender perceptions in STEM surveys, including preliminary results and lessons learnt. A significant result of the 2021 report is in the proposal of a new gender in STEM index which will be further developed and tested in the 2022 project.

GISE acts as a foundation and pilot for developing international indicators on women in STEM and a continued longitudinal study, with the aim of playing a key role in building a policy road map for the balanced development of future human resources worldwide.

The outcomes found in this report have been a strengthening of the process for surveys to deliver a picture of the gender barriers experienced by women in STEM.

We are most grateful to Dr. Sarah Peers for leading the 2021 GISE project and the many participants, advisors, disseminators, and experts from INWES and KWSE that made this report possible. We look forward to the next stage of the study in 2022, which would hopefully lead to the balanced development of human resources in STEM in Korea and worldwide.

Jung Sun Kim, Ph.D.
INWES President 2021-2023

Message from KWSE

The world has been reeling from the devastating impact of COVID-19 for the past two years. This period has been an arduous one, especially for women scientists and engineers who are invigorated through communication and empathy but had to continuously pursue scientific research despite unexpected difficulties. It was even more difficult for young women scientists and engineers who have had to balance between childcare with developing their own careers.

The Association of Korean Woman Scientists and Engineers (KWSE), Korea's first organization of women scientists and engineers founded in 1993, undertook international collaborative research to develop a policy for women in science and engineering in the Asia Pacific region from 2014 to 2018. To understand better the gender-related issues in STEM fields, KWSE conducted a series of international surveys in Asia and the Pacific region with help from the International Network of Women Engineers and Scientists (INWES) and analyzed the survey results and gender-related indices. We have published the results in reports in both Korean and English, and delivered them to INWES members and international organizations such as UNESCO.

This report is the outcome of close cooperation between INWES and KWSE. Previous surveys were limited to INWES member countries in the Asia-Pacific regions but now we have expanded its target nations to Europe, Africa, and the Americas. Both men and women scientists and engineers are included to enhance understanding of gender barriers within the STEM areas of specialism in biological sciences, mechanical/civil engineering, and computer/information technology. This attempt to expand the survey will be a starting point to cooperate with more countries and cover more S&T fields.

In closing, I would like to express my deepest appreciation to INWES President, Prof. Jung Sun Kim, and Dr. Sarah Peers, project manager of INWES, and the Advisory Committee for their work in publishing the 2021 report on International Perceptions of Gender Barriers in STEM. My thanks also to everyone across the world who has taken part in this survey despite their busy schedules. Science and technology is a field where accurate figures are valued above the abstract, and it is my hope this report can deliver a more accurate picture of the current situation to science and technology policymakers. This will lead to the development of gender-balanced policies in the development of human resources in the field and thereby enable more talented women scientists and engineers to contribute significantly to the development of a future that remains a mystery to us all.

Hyo-Suk Lim, Ph.D.
KWSE 13th President

Acknowledgments

Funding and Support

This project is funded by the Ministry of Science and ICT in Korea and directed by KWSE. We are also grateful for administration and secretariat support from Hyon Jung Jang and Yui Jung Min.

The Advisory Group

Meetings have been held with an Advisory Group that includes leads from KWSE (the Association of Korean Woman Scientists & Engineers), INWES, and from INWES Regional Networks. Prof Jung Sun Kim, INWES President and member of KWSE, was Chair of the GISE Advisory Group. Prof Jinah Park (KWSE Vice President, Chair of International Network Committee at KWSE, Professor at KAIST) and Dr Hyun-Ok Kim (KWSE Secretary General, Senior Researcher of Korea Aerospace Research Institute) represented KWSE. Prof Battsengel Baatar, INWES Vice President of Education & Research was the lead INWES representative for this project.

We were also delighted to include in the group: Professor Kong-Ju-Bock Lee, a physics expert and lead expert in past KWSE surveys, of Ewha Womans University, South Korea; Dr Hye Young Park, a gender specialist from Dongseo University who has worked on past KWSE surveys; and Professor Clem Hermann, founder and Editor in Chief of the open access International Journal of Gender Science and Technology, of the Open University, UK. INWES Deputy President, Nadia Ghazzali, Professor of Statistics at the Université du Québec à Trois-Rivières, Canada, provided valuable guidance.

We are very glad of the kind support of everyone taking part in this group who also advised on the methodology for the survey. We were especially grateful to the country leads who supported translation and dissemination of the questionnaire:

- Aguri Nakano (JNWES), for Japan
- Ariunbolor Purvee (WSTEM), for Mongolia
- Belen Garcia de Pablos (INWES-Europe), for the European Union
- Fatoumata Balde and Mrs Rufina Dabo Sarr (AFTStech), for Senegal, Kenya, and Nigeria
- Jung Sun Kim and Hye Yong Park (Dongseo Univ. & KWSE), for South Korea
- Maria Jose Morales, for Mexico
- Najla Triki (ATFI), for Tunisia
- Seema Singh (Wise-India), for India

Participants at the GISE meetings and webinars provided additional feedback and links to materials which were very useful: Josette Rome Chastanet (World Federation of Scientific Workers - WFSW/FMTS, France), Professor Gong Ke (World Federation of Engineering Organizations - WFEO, China), Yetunde Holloway (WFEO, Nigeria), as well as Hye Young Park, Seema Singh, and Belen Garcia.

We also acknowledge the work by David Emond, statistics consultant of Delta Statistique, Quebec, Canada, who provided the detailed analysis and statistical support. Project management was provided by Dr. Sarah Peers at INWES.

In memory of Fatoumata Balde, a victim of Covid.

Summary

INWES member KWSE, the Association of Korean Woman Scientists & Engineers, ran several very successful surveys on gender in STEM, in 2014, 2016, 2017, and 2018, supported by other INWES members and academics. Initially, the surveys targeted certain demographics of scientists and engineers, men, and women, in the Asia and Pacific Nations Network region. In 2018, the African Regional Network also took part in the work funded by the National Research Foundation of Korea and the Ministry of Science and ICT in Korea. These series of surveys have provided much valuable information on the perceptions of the issues for women in STEM, and reports can be found in the INWES Resources page as well as on KWSE's own website.

A new collaboration in 2021 between INWES and KWSE brings this survey to other global regions and extends the analysis. A key goal is to identify a metric that can be compared across different countries and different areas of STEM, to provide a tool to help drive gender equality in STEM.

About the 2021 Project and Survey

The project ran from March to November 2021. This project is intended to be a pilot study and it is expected to run larger projects in the future. The key outputs from this pilot project include

- a survey based on past KWSE questionnaires
- a final detailed technical report on the results of the survey, including gender metrics
- a public report that highlights key results and suggests next steps for the future

The purpose of the survey is

- to gather statistical data on gender perceptions in the STEM fields by country, gender, and age,
- to act as a foundation/pilot for developing international indicators on women in STEM and a continued longitudinal study,
- and to play a key role in building a policy road map for the balanced development of future human resources worldwide.

The questionnaire for the survey asks respondents for their views on gender barriers in STEM education, research and in the work environment. For this pilot, the survey was initially targeted at ten countries: including South Korea and Asia, the European Union, countries in Africa and in the Americas. Both men and women were invited to take part. The initial focus was on three contrasting STEM areas of specialism: biological sciences, mechanical or civil engineering, and finally computer science or information technology.

Future studies will cover many more countries and specialisms and all ages.

An overview of the survey

Individual responses
- 1390
- of which 1215 were included in analyses

Gender
- 638 Women
- 575 Men
- 2 Non-binary

STEM Areas of Focus
- Biological Sciences
- Engineering Mech/Civil
- IT/Computing

Countries & Regions
- 29 reached
- Asia
- Africa
- Europe
- Americas

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Introduction

Purpose of the Gender perceptions In Science and Engineering Project (GISE) is to

- share statistical data on gender perceptions in the STEM fields by country, gender, and age
- provide a foundation/pilot for developing international indicators on women in STEM and a continued longitudinal study.
- play a key role in building a policy road map for the balanced development of future human resources worldwide.

The project had targets of 10 countries from Asia, Africa, Europe, and the Americas and a requirement to reach 1000 responses.

This pilot project builds up on previous surveys carried out by the Association of Korean Woman Scientists and Engineers (KWSE), initially in South Korea and then across several Asian countries:

- The 2014, 2015, 2016 and 2018 Policy Reports on Balanced Development of Human Resources for the Future (summarized in (Kim & Park, 2019))
- Gender Barriers in Science and Engineering in the Asia and Pacific Nations (2017)
- And The Glass Ceiling for Asian Women in STEM (2015)

Human Resource Development, Human Development, and the United Nations

The concept of human development arose from discussions at a global level on the metrics that until recently held sway to describe national progress. GDP, for example, was never intended to be used as an objective measure of improvements in people's lives. The global conversation grew to consider aspects beyond purely economic growth, such as the requirements for the wellbeing of people: employment, fair distribution of wealth, equal opportunities, and the basic needs of food, health, family, and security.

Human resource development considers the processes to increase knowledge, skills, and capacities of all the people in a community or country. It is about human capital and effective development of a country. Equality of opportunities and women's status in the workplace are of relevance to human resource development, and the gender barriers in STEM are indicators of barriers to effective human resource development.

The concept of *human development* considers the human condition and its capability. The dimensions of human development include the economic, as well as education, health, and the political (United Nations Development Programme, n.d.). Previous reports by KWSE on Gender Barriers have offered extensive comparisons of human development across countries, and the reader is encouraged to refer to the past KWSE reports (Lee, et al., 2018).

The United Nations Development reports, e.g., (United Nations Development Programme, 2020), refer to the Human Development Index (HDI): a statistic that combines several indicators related to life expectancy, education, and standard of living. HDI rankings are grouped into very high, high, medium, and low. The UN Development Programme (UNDP) has also developed strategies and road maps towards women's empowerment as a key step towards meeting the UN SDGs.

Although HDI does not explicitly mention the STEM sectors in relation to gender equality, it is clear there is a link between the participation of women in STEM and socioeconomic empowerment.

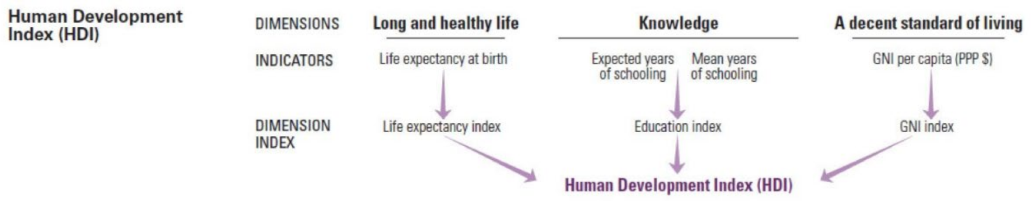

Figure 1 The dimensions of the UN Human Development Index

Gender Equality Indices

A brief review of gender indices related to human development was carried out as part of the GISE project.

The United Nations makes use of several indices related to progress towards gender equality. Just as global and national measures of economic progress can hide inequalities between the richest and the poorest, the usual human development indices can also hide the inequalities between men and women (Gbadamosi, n.d.). The current indices in use at the UN and relevant to gender and STEM, from a human resource development perspective, include:

- Inequality adjusted HDI (IHDI) – where IHDI is equal to the HDI, then there is total equality. IHDI compares inequalities across life expectancy (as a proxy for health and wellbeing), education (as a proxy for equality of opportunity) and income.
- Gender-related Development Index (GDI) – this index is based on the HDI and cannot be used on its own as an indicator of gender gaps.
- Gender Empowerment Measure (GEM) – introduced to measure the equal participation in economic and political life, and decision-making, indicators not included in the GDI.

- Gender Inequality Index (GII)[1] – this was introduced by the UN Development Programme in 2010.
- Gender Parity Index – employed by UNESCO, focusses on access to education.

The UN groups countries by GDI score: from 1 (good gender equality) to 5 (lowest gender equality). GII has a value between 0 for no inequality and 1 for maximum inequality. Of the indices listed above, GII is probably the most general and was developed to overcome some of the shortcomings of the other UN gender indices such as the GDI. It is based on the lost opportunities to human development because of gender inequality in three areas: reproductive health, empowerment, and labor market participation (United Nations Development Programme, n.d.).

A summary of the Gender Statistics or data on indicators that the UN currently collects is provided in the report The United Nations Minimum Set of Gender Indicators (United Nations Statistics Division, 2019). It should be noted that only one indicator refers directly to women in STEM, and that indicator is in the education field, i.e., the indicator "Share of female science, technology, engineering and mathematics graduates at tertiary level".

Other indices to be considered include the GGI (global Gender Gap Index) from the World Economic Forum (World Economic Forum, 2021) (World Economic Forum, 2020), which is a combination of four factors.

The "Gini coefficient", an index for economic inequality also in use by the UN (OECD, 2022), has also been applied to gender income inequality (Costa, 2019) (Joyce & Xu, May 2019).

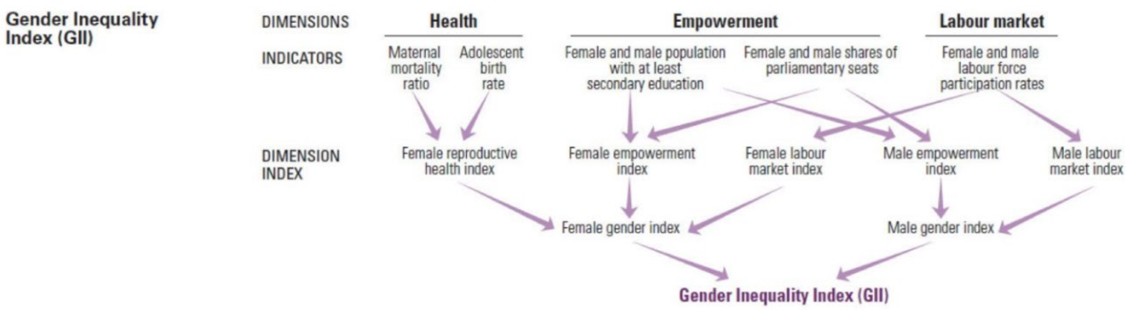

Figure 2 The dimensions of the UN Gender Inequality Index

The 2015 KWSE survey report (The Association of Korean Woman Scientists and Engineers, 2015) also referred to the "glass-ceiling" phenomenon and The Economist's Glass Ceiling

[1] Note that there is potential for confusion: WIPO has defined another GII: Global Innovation Index. Refer to https://www.wipo.int/global_innovation_index/en/ (accessed 06 January 2022).

Index for the OECD countries which refers to women getting access to leadership executive roles (refer for example to (The Economist, 2021)). The OECD does not attempt to summarize gender inequality in one index but reports on a variety of indicators instead.

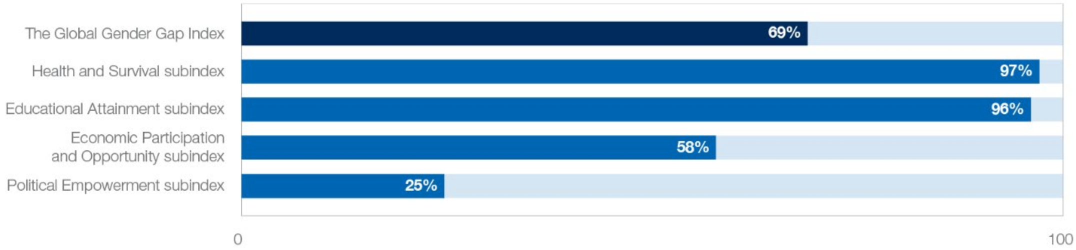

Figure 3 The four factors of the WEF Global Gender Gap Index

Data2X's work on mapping gender data gaps in 2014 and 2019 does not explicitly consider STEM but includes economic and educational opportunities (Grantham, 2020). This work also notes that there is not sufficient data on perceptions and experiences of women in the economic sphere, so indirectly endorsing the approach being taken by KWSE in the past surveys on gender barrier perceptions and re-adopted for the GISE project.

Other metrics exist that focus on agencies and organizational changes: such as the use of gender mainstreaming. Some gender metrics have been modified for local/regional use, such as the African Gender and Development Index (AGDI) which combines the quantitative Gender Status Index (GSI) with a focus on water, sanitation, and hygiene (also known as WASH) and the qualitative African Woman's Progress Scoreboard (AWPS) (Economic Commission for Africa, 2004). The World Bank also publishes gender segregated data, including economic status (The World Bank, 2021).

As noted, none of the indices above include a direct reference to the full participation of women in the science and engineering sectors.

Metrics and actions for STEM progress

In parallel to the general concepts of human development, international communities are also attempting to use metrics and indices to compare progress in STEM and the impact of science and engineering on the economy.

Again, it is in STEM education where most data collection work has been carried out, for example as reported by Freeman, et al (2019). There are in addition many data available from UNESCO on STEM graduates (UNESCO , 2020).

The WEF Global Competitiveness Forum and TCdata 360 (2017) also collate data closely related to science, technology, and engineering, including innovation and economic or industry metrics. One metric mentioned by WEF and in TCdata360 which is very relevant here is the "Availability of Scientists and Engineers". This metric is based on responses by industrialists to the question: *In your country, to what extent are scientists and engineers available?* The replies are on a Likert scale where 1 corresponds to "*not at all*" and 7 means *"widely available"* (The World Bank, 2017). This index is fundamentally an innovation metric. However, diversity (gender and ethnic) and innovation are correlated.

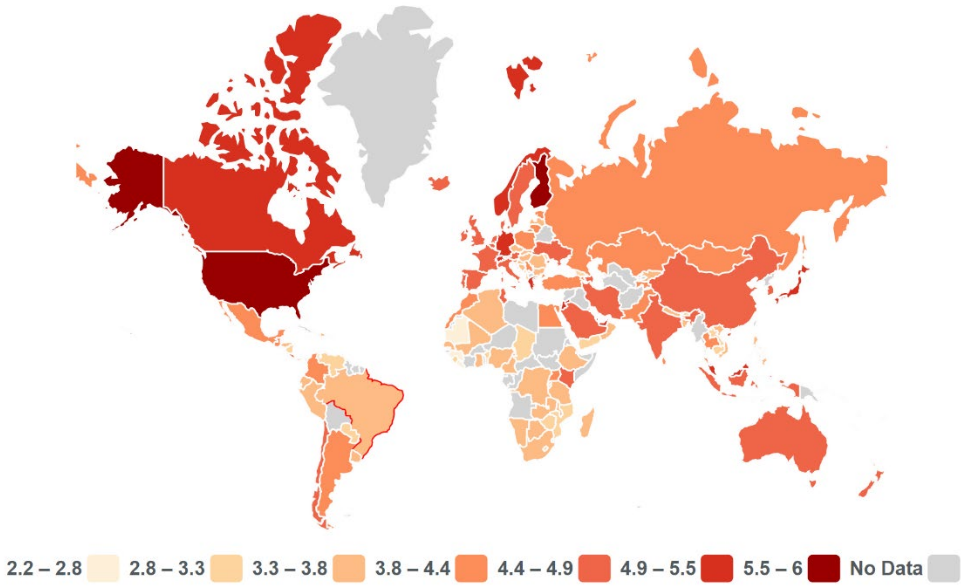

Figure 4 Index of availability of scientists and engineers across the world (World Economic Forum, 2017)

Gender and STEM metrics

A recent development has been the SAGA (STEM and Gender Advancement) Toolkit (SAGA2) (UNESCO, 2017) and the SAGA Indicator Matrix. As the name implies, this does not try to provide a single metric but makes explicit multiple metrics for the areas of interest. The matrix requires detailed data on shares of women in research, senior and decision-making positions, committees, as teachers, and as students. However, the SAGA programme and Toolkit do not appear to have been adopted by the women in STEM networks linked to INWES. It may be that this is due to the very large data gaps on gender and STEM in many regions of the world, as explained later in this report (refer to the section in this report: **Sample sizing**), making the SAGA Toolkit not easy to implement. This data gap is confirmed by the UNESCO report "Cracking the Code" which also calls for more data gathering on the participation of women and girls in STEM across the world (UNESCO, 2017).

Another recent piece of work is the "30 by 30" campaign by Engineers Canada (Engineers Canada, n.d.) which includes the proposal to facilitate data collection and dissemination on gender as multiple metrics. The campaign's accompanying guide to employers "Changing the culture for engineering employers" exhorts employers to "do the numbers", i.e., create a measurement program to track progress in gender equality. This work has influenced the World Federation of Engineering Organizations' (WFEO) Women in Engineering committee to develop a Gender Scorecard for engineering as a strategic theme (WFEO , n.d.). Such a scorecard would provide a process to enable professional engineering institutions and other policy-making organizations to identify gender gaps.

The International Science Council have also carried out a three-year survey and data collection project to measure the gender gap in science (International Science Council, 2020). The final output of this work focuses on the experiences of women in science, and this leads to the underlying issues.

Fundamental questions about gender diversity and STEM

The work to consider how to measure gender inequality in STEM is one side of the equation: on the other side, there is the fundamental question as to whether or the STEM sectors need to change to include all.

For example, it seems that women in science research wishing to publish their work are subject to higher expectations from reviewers, and this in addition to the structural barriers they may face that "[push them off] the career ladder" (The Economist, 2020 (a)). Recommendations by UNESCO on the adoption of open science and promoting open peer review practices (UNESCO, 2021) are partly about addressing some of these structural barriers.

In addition, much of the current work to progress gender equality in STEM focuses on changing women: often explained as "empowerment" of individual women. Examples of this range from the many and varied mentorship programs run by member organizations of INWES and coaching schemes specific to women run by corporates, to the short-term projects providing individual women with a chance to network and build new skills, such as the ILO Women in STEM project (International Labor Organization, 11 February 2021). The recommendations of the International Science Council 2020 report focus to a large extent on support for women in science and developing women's skills. In contrast, a report produced for WiSET - the Korea Foundation for Women in Science, Engineering, and Technology (Park, 2021), and based on the outputs of the past KWSE gender perceptions surveys in Asia, provides many solid recommendations to support women in STEM networks. The recommended strategies include providing those networks with the power to become "gatekeepers against gender barriers/discriminations" and to lead the dialogue in gender and STEM. It sets the issues of gender barriers in STEM into a wider context of social gender issues.

Other sectors with similar gender diversity issues, however, are now starting to examine the philosophical and theoretical structures on which they are based. For example, in economics, there are some questioning the intellectual frameworks and hierarchies in their areas (The Economist, 2020 (b)). Just as in many STEM disciplines, in economics there have been moves in the West since the 1970s and 1980s to change recruitment practices to increase gender and wider diversity: but these have not led to continuous change. Economists are now wondering if the biggest issue is that of the perceptions of what is important to study or of value, and that diversity should mean “new ways of seeing the world”.

The 2021 KWSE-INWES Survey on Perceptions of Gender Barriers

The purpose of this survey is to evaluate how scientists and engineers across several regions in the world perceive "gender barriers" experienced by women in STEM. The term "gender barriers" is used in this study to describe hurdles and obstacles women in STEM experience in their educational and professional lives because of their biological and social identity as women. This forms part of the KWSE-INWES Gender perceptions In Science and Engineering project.

This survey was targeted at respondents who are

- of any gender (male or female or other)
- currently residing/working in India, Japan, Kenya, Mexico, Mongolia, Nigeria, Senegal, South Korea, Tunisia, or the European Union
- in the STEM specialisms of the biological sciences, or civil or mechanical engineering, or the computing/digital sciences (studied or currently)
- and of working age (including currently studying for a postgraduate degree, or not currently working).

From September 2021 we welcomed responses from other countries and other STEM areas. Reporting focuses on the three STEM focus areas and the above regions, but other data is included in general analysis. Responses from young people, however, without a first or undergraduate level university degree or equivalent were not included in any data analysis.

More explanations of the STEM specialisms and other terms were provided in an online appendix **Glossary and Detailed Explanations**.

Where respondents were not sure about their STEM specialism, they were encouraged to submit a response with an explanation of their specialism.

The process and timelines

The initial proposal outlined the basic steps for the project:

1. Prepare and develop questionnaire with input through discussion from international and domestic women in STEM expert group on gender barrier perception.
2. Conduct survey among 7 groups of INWES members: Americas (US, Canada), Europe (UK, Germany, France, Spain, Netherlands), Africa (Nigeria, Kenya, Senegal), ASEAN (Myanmar, Malaysia), North Asian (Mongolia), Southeast Asia (India, Nepal, Sri Lanka), Fareast Asia (Japan, Korea)
3. Coding of data
4. Statistical analyses comparing by country and/ or by continent

5. Write up report
6. Publish and Disseminate report

The final printed report will include an international publication number (ISBN) and be posted on the homepage of KWSE and INWES. Reports will also be distributed to members and related organizations including UNESCO, and UN ECOSOC.

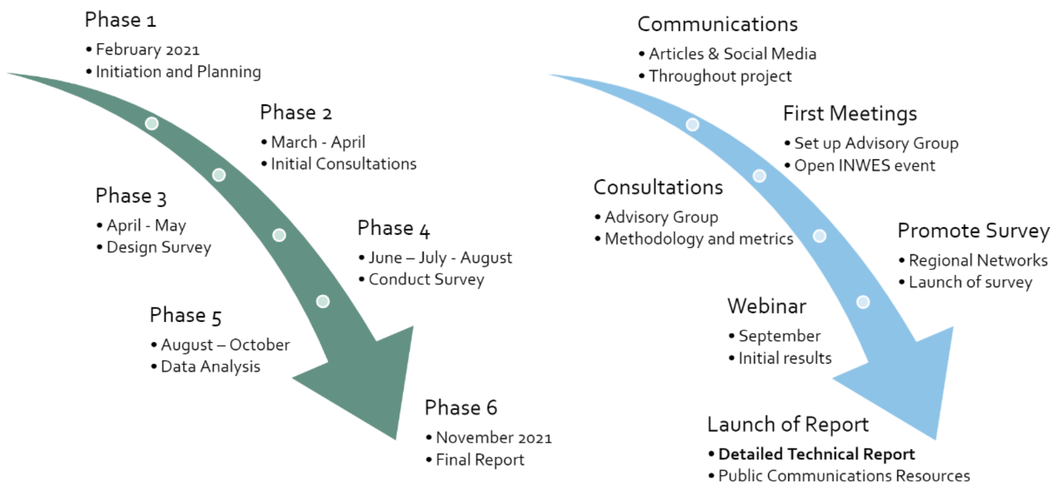

Figure 5 Project GISE Timelines - Phases and Communications

Meetings and consultations

Meetings were held:

- 30 March – Meeting #1 initial consultation
- 7 April – Meeting #2 Advisory Group: confirming membership
- 11 May – Meeting #3 Advisory Group: methodology
- 17 July – Meeting #4 Advisory Group: dissemination
- 17 December – Meeting #5 Open Meeting: presentation of results from statistical analysis and plans for next steps

Multiple separate meetings were held with individuals to support dissemination, and with experts to explore some of the detailed issues of statistical analysis.

Ethics and data

International requirements for data protection and confidentiality of personal information were considered.

Regulations considered included:

- Canadian data and privacy laws: Personal Information Protection and Electronic Documents Act (PIPEDA) is the federal privacy law for private-sector organizations. PIPEDA outlines some principles including: an organization must appoint someone to be accountable, purpose for collecting the personal information should be identified at the point of collection, consent is required, collection of data must be limited to the purpose given, etc. (Office of the Privacy Commissioner of Canada, May 2019).
- In the EU, GDPR (general data protection regulation) applies (European Union, n.d.) and "personal data" is defined as "information that relates to an identified or identifiable individual."

Guides to Canadian data protection regulations, for example Kardash & Kosseim (2018), give the definition of "personal data" as being of an identifiable individual: "Generally, information will be deemed to be about an "identifiable individual" where it is reasonably possible for an individual to be identified using that information, alone or in combination with other available information." The European Commission guidelines also refer to IP (internet protocol) addresses as being part of personal data (European Commission, 2018).

The GISE survey did not identify any individual respondents, for example respondents were asked for Year of Birth only and not their date of birth. Online tools were chosen to keep responses anonymous. There was no collection of "personal data" as defined in Canada and the EU. All responses were used only for analytical purposes. All data gathered is published in combined form with no identification data. This survey was anonymous and individual records are kept strictly confidential.

A Data Protection and Confidentiality statement was provided to all respondents and published on the INWES GISE webpage (http://inwes.org/gise_DP_Confidentality) in all the languages of the questionnaire.

Designing the questionnaire

The questionnaire was based on the 2018 KWSE APNN questionnaire. The key questions on perceptions of gender barriers (Sections B-G) remained largely unchanged from 2018. The last question (see below for Section G) was amended to include work environments as well as study and research environments. In addition, a new Section H was introduced.

The key questions were on:

- Section B: Perception of Gender Barriers in STEM
- Sections C/D: Direct/Indirect Experience of Gender Barriers in STEM (C was aimed at women and those who consider their experience to be like that of women in general; D for men and those who consider their experience to be like that of men in general).

- Section E: Career outlook for women in STEM and need for Support Policies to combat Gender barriers in STEM
- Section F: Perception of Gender Equity and Gender Roles
- Section G: Perception of Gender Barriers in the work, study, and research environments in STEM
- Section H: Perception of the respondent's own STEM Career.

Responses were on the Likert Scale (1-5) to assess the degree to which the respondent agreed or disagreed/ confirmed the experience or did not have that experience as in the statement.

The opening of the questionnaire, i.e., Section A, in which personal information and circumstances (the confounding variables) was modified to allow more information on family circumstances (including identifying where caring responsibilities lay), aspects of socioeconomic backgrounds (e.g., rural versus urban backgrounds), identification of career stages and language which was primarily intended to identify where there may have been misunderstandings in responses.

Sampling variables

The Advisory Group were very much involved in the discussion of the variables and categories of interest to be considered for the sampling for the GISE survey, and the groups of values to consider in comparisons. One of the aims was to ensure that this survey would be applicable to most regions of the world and to be able to compare the data across past and future surveys.

The questions set in the survey will be investigating the relationship between an independent variable such as "country and/or region" and perceptions or attitudes towards gender and STEM (the dependent variable). The relationship between each pair of values (e.g., country and belief in women's natural ability in STEM) can be distorted by the other variables. These *confounding* variables can impact on results if not considered.

The following summarizes the variables that were considered for inclusion in the survey:

- Gender - Male, female, and non-binary
- Age - Year of birth
- Family situation and caring responsibilities
- Career stage – years in STEM, years out of STEM and reasons
- Workplace: corporate, small enterprises, public service, etc.
- STEM specialism - during study/training and current (including the option to indicate if they were not always in STEM)
- Language, country of origin, current country of work and residence

- By country – variables to be of local/regional relevance could be included in local surveys. For example, the following regions/countries had additional questions added to the surveys distributed locally:
  - India – caste & religion
  - Mongolia – rural/nomadic or urban, also request for additional data gathering on perceptions of gender in Mongolia, entry to STEM pre- or post-Soviet influence
  - Senegal – extended households, caring for extended family
  - Europe – further detail on countries, disabilities, immigration
  - Not all volunteers suggested extra questions for their region

Advisors suggested that the survey include questions to identify populations that are part of the diaspora and immigration across the world. A simple question added asked about the origins of the respondent but in no detail.

Respondents were also asked about their marital status, number of children, whether in a single- or double-income family, and who was responsible for the greater part of caring duties. This was to allow continuity of comparisons with past KWSE surveys and of course will allow assessment of the impact of traditional family setups on perceptions.

Other variables included in the questions for respondents in Africa : multi-generation/caring for elders/extended family, or polygamy/multi-families in the household which come about because if the rural exodus in Africa.

Selection of countries

The requirement was for ten countries including South Korea and across more than one global region. The regions and spread of countries were initially considered by their ranking by HDI (human development index) and GDI (gender development index).

As the target minimum number of responses per country was 100, it was initially proposed to consider countries that have responded well to past surveys, such as: Mongolia, Bangladesh, Taiwan, Malaysia, Japan, and Nigeria. In addition, and for practical reasons, the pilot project focused on countries represented on the INWES Board. Naturally, South Korea was to be included. Thus the initially proposed countries (with some comments on reasons for including and key socioeconomic characteristics), by INWES regional network, were:

APNN (Asia and Pacific Nations Network):

- South Korea - Very high HDI, group 3 for GDI, high to mid-ranking GII, and a very low percentage of female researchers. Total population of 52 million.
- Mongolia - Medium HDI, group 2 for GDI, and very near parity percentage of female researchers. Total population of 3 million.

- Japan – Very high HDI, group 2 for GDI. Total population 126 million.
- India - Medium HDI, group 5 for GDI, also extremely low percentage of female researchers. Total population of 1.366 billion.

ARN (SubSaharan Africa Regional Network):

- Senegal – Selected for an expected good response rate and also to test language translation methodology. Low HDI, group 5 for GDI. Total population of 16 million.
- Kenya - Medium HDI, group 4 for GDI, Total population of 53 million.
- Nigeria - Low HDI, group 5 for GDI, Total population of 205 million.

Other regions:

The following were also proposed to allow testing of translations and the possibility of dual languages:

- Tunisia - High HDI, group 5 for GDI. Total population of 12 million. Representing the MENA (Middle-East and Northern Africa regional network of INWES)
- Canada - Very high HDI, group 1 for GDI. Total population of 38 million.
- Mexico – Testing dissemination through extended INWES membership. High HDI, group 2 for GDI. Total population of 129 million.

Europe:

In addition, the pilot would include the European Union countries represented in INWES. These will be from Western Europe as INWES currently has no representation in Eastern Europe. The SHE Figures for Europe (European Commission, 2021) provide very robust background data if needed for analysis in the future.

Other considerations:

It is also proposed to request origins of the respondents. This will allow checks on outliers: for example, a respondent in Canada who originally studied in Kenya may have very different experiences and expectations to a respondent who has studied and worked primarily in Canada.

Sample sizing

During initial consultations with the Advisory Group, concerns were raised about using the same sample size (100) when comparing countries or regions with very different populations of STEM professionals. The advice was to assess the various population sizes of STEM professionals, particularly, if possible, for women, and make use of relative ratios.

A brief study of sources of data on numbers of scientists and engineers indicated:

- Data does exist in various forms in the European and Asia & Pacific Nations regions
- But not much data exists for the Sub-Saharan Africa and Middle East & Northern Africa regions

- Gender-segregated data on researchers/scientists at universities can be found
- Engineers/IT professional in industry or business are rarely counted and hence statistics on gender and even total numbers are not so easily found
- Some regions only have data on university student populations.

UN Human Development Reports webpages refer to the share of female graduates among all graduates of tertiary (i.e., university level) programs in science, technology, engineering and mathematics (UNESCO , 2020). UIS (UNESCO Institute for Statistics) data only includes one very high-level overview of the participation of women in engineering and nothing on women in the science and technology workforce in industry; on the other hand, UIS Factsheets do include data on women in research and development (UIS - UNESCO Institute for Statistics, 2020). Other sources of data explored included the OECD, the EU She Figures and UN Women. These all were able to provide data on women in STEM education or as researchers, but not in the workforce more generally.

Using the WEF Global Competitiveness Forum metric on innovation: TCdata360 Index on Availability of scientists & engineers (TCdata360 ASE), and making use of the assumption of a minimum sample size for South Korea of 100, an estimate for a sample size for a survey could be calculated by:

$$\frac{\text{Population size} \times \text{TCdata360 ASE} \times 100}{\text{Population size of South Korea} \times \text{TCdata360 ASE in South Korea}}$$

Using this expression, ideal sample sizes were calculated (Table 1). This exercise made obvious that this process did not provide figures that could easily be employed. It is however an aspect to consider in future studies.

Table 1 Calculated sample sizes based on population sizes and TCdata360 indices, normalized using figures for South Korea

Country	Population Size (millions)	TCdata360 Index - (Perceived) Availability of scientists & engineers	Sample Size for GISE?
South Korea	52	4.51	100
India	1380	4.63	2724
Japan	126	5.32	286
Kenya	54	4.45	102
Mexico	128	4.18	228
Mongolia	3	4.01	5
Nigeria	206	3.80	334
Senegal	18	3.69	28
Tunisia	12	4.40	23
EU	448	3.40-6.03 (Spain:4.47, Germany:5.15)	
WORLD	**8000**	**~3.90**	

Promotion and information

A webpage was set up on the INWES website to provide information on the project: www.inwes.org/project_gise. This webpage provided the central point for distribution of the questionnaire and provided links to translations of the Glossary and the statement on Data Protection & Confidentiality.

The questionnaire was distributed online using Google Forms. This method was chosen for the following reasons:

- Google Forms guarantees anonymity of respondents (no collection of internet addresses, etc.) which was important to meet the requirements for data privacy
- Free and easy to use
- Google services are generally available across the world
- Data gathering method was clear
- Sharing of access was possible

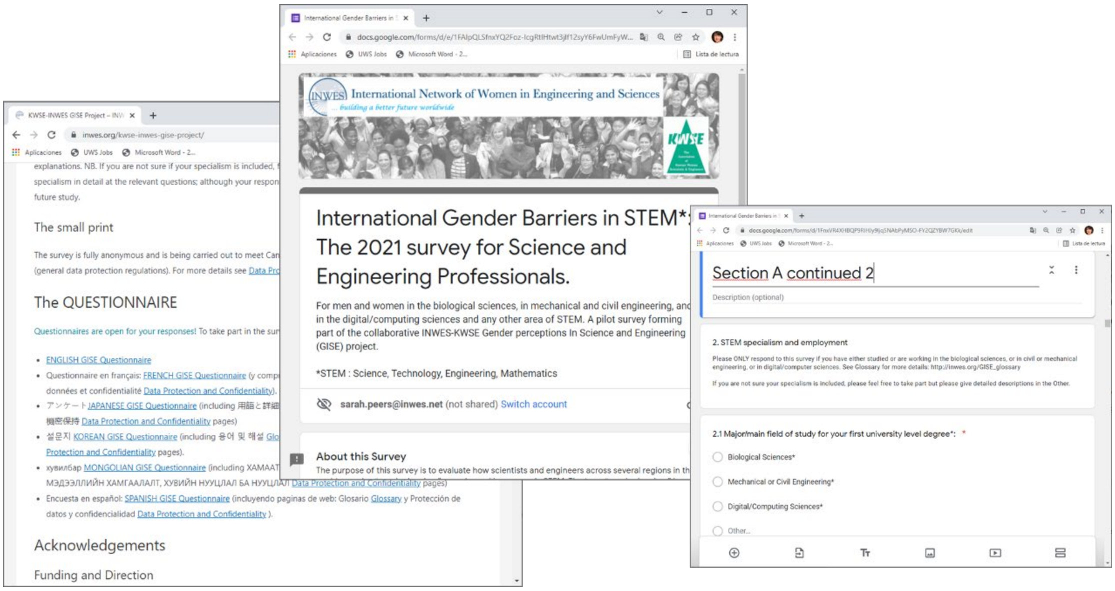

Figure 6 Snapshots of webpages for the GISE project, including online Questionnaire

Dissemination

The questionnaire was distributed by the INWES GISE volunteers in several languages as required for the local region and based on expectations, to INWES membership in the INWES Regional Networks and to their extended local contacts. Contacts were strongly encouraged to extend the invitation to take part to their own networks outside INWES.

Any regional variations were implemented as additional questions or sections. All questionnaires had the same core questions on sampling variables (which appeared as part of Section A) and the questions on the gender barrier perceptions were developed in English, and then translated into several languages. There was some variation in the content of the different language versions, based upon the regional requirements (refer to the section in this report: **Designing the questionnaire**).

Table 2 GISE Questionnaire Versions: Languages

Language	Principally disseminated in	Comments on variations
English	All countries	Complete questionnaire with all variations. For India, additional questions include caste and religion, as is usual in Indian surveys.
Korean	South Korea	Additional questions requested information on where in Korea the respondent was based.
French	Tunisia, Senegal, Europe	Included extended questions on family circumstances for African Regional Network respondent.
Mongolian	Mongolia	Additional questions on STEM teaching and motivation to enter STEM, and an extended section M on further gender barriers perceptions.
Japanese	Japan	No additional questions.
Spanish	Mexico, Europe	For Europe: additional questions on disabilities and ethnicity as is usual in European surveys.

Further dissemination occurred through the INWES communications channels, i.e., news items on the website, social media, and newsletter.

Through the efforts of our volunteers, other national and international external organizations also shared the survey: e.g., in Spain, the Spanish Engineering Institute (Instituto de la Ingeniería de España) also shared the survey to their members by email.

Results of the 2021 Survey

The following reports some of the key results of the pilot survey.

Actual country and regions

The actual reach of the survey was not as expected. Many more countries (29) were reached, but few reached the target sample size of 100. In carrying out the analyses, the following regions and countries did reach approximately 100 responses: South Korea, Europe (as a region), India, Japan, and Mongolia.

In addition, responses from other APNN countries, the Americas, the Sub-Saharan African region, and the Middle East and Northern Africa region were grouped and included in comparative analyses where relevant.

Summary tables of data

The following tables provide an overview of the outputs from the 2021 survey.

Table 3 Targets and Achieved Numbers

	Target	**Achieved**
Responses	1000	1200+
Countries	10	29
Female : Male	50:50	53:47
Biological Sciences : Mech or Civil Engineering : IT & Computer Sciences (:Other STEM)	33:33:33	25:31:35:9

The above figures appear promising given the restricted time and issues in dissemination. However, these hide imbalances in countries or regions. In the tables below, the most obvious imbalances are highlighted as red text.

Table 4 Breakdown of responses by Gender x Region or Country

	Korea	Americas	APNN	ARN	Europe	MENA	India	Japan	Mongolia	Total
Female	109	20	3	38	81	33	217	69	68	638
Male	23	18	2	11	33	5	430	23	30	575
Total	**132**	**38**	**5**	**49**	**114**	**38**	**647**	**92**	**98**	**1213**

In addition to the above, there were 2 responses from individuals who identified as non-binary. They subsequently selected to respond to Section C (Direct Experience of Gender Barriers in STEM, aimed at women) and their responses were later grouped with those of women. They have not been included in the tables below to avoid the potential for identification.

Table 5 Breakdown of responses by Gender x STEM Area

	Biosciences	Civ/Mech Eng	IT/Computer	Other Sci	Other Eng	Other IT	Total
Female	224	137	138	43	21	10	638
Male	59	243	243	11	15	4	575
Total	**303**	**380**	**426**	**54**	**36**	**14**	**1213**

Table 6 Breakdown of responses by Gender x STEM Area x Region/Country

		Korea	Americas	APNN	ARN	Europe	MENA	India	Japan	Mongolia	Total
Female	Bio	56	4	1	19	27	11	69	41	16	224
	Eng	16	3	1	7	42	9	44	6	9	137
	IT	28	11	1	4	9	9	98	7	16	183
	OE	2			1	1	2	1	3	11	21
	OI		1		2			3	1	3	10
	OS	7	1		5	2	2	2	11	13	43
Female Total		109	20	3	38	81	33	217	69	68	638
Male	Bio	3	1	1	1	9		34	10		59
	Eng	10	5		5	19	2	186	4	12	243
	IT	9	12	1	2	4	3	188	9	15	243
	OE				1			13		1	15
	OI							3		1	4
	OS	1			2	1		6		1	11
Male Total		23	18	2	11	33	5	430	23	30	575
Grand Total		**132**	**38**	**5**	**43**	**114**	**38**	**647**	**92**	**98**	**1213**

Analyses carried out

Priorities for the comparative analyses:

1. All global: men vs. women
2. All global: a 3-way comparison of biology vs. civil/mech engineering vs. digital technologies
3. South Korea vs. all other regions/countries
4. For South Korea and other countries/regions with ~100 responses
   - men vs. women

- a 3-way comparison of biology vs. civil/mech engineering vs. digital technologies

Other analyses considered:

1. A comparison of all countries with low economic development vs. countries with high economic development
2. A 3-way comparison for all countries, young women vs. midcareer women vs. senior women
3. Comparison of people working in STEM now vs. people who have left STEM

The statistical tests employed were:

(a) T-test for two-way comparisons
(b) ANOVA for three-way comparisons
(c) Spearman correlation for ordinal type variables
(d) Extended techniques were applied when data conditions were not validated, but conclusions remained the same

In interpreting the results, the actual mean values and variances for the group were taken into consideration.

The responses for Sections B-H were coded as follows:

Table 7 Questionnaire response coding

Responses			Code
Sections B, E, F, G, H	**Section C**	**Section D**	
Strongly agree	Never experienced, seen nor heard from others	Never seen nor heard from others	1
Somewhat agree	Neither seen nor heard but recognize the possibility	Neither seen nor heard but recognize the possibility	2
Neutral	Heard from others	Heard from others about an unknown person's case	3
Somewhat disagree	I have seen others experience this	Heard from my colleague of known person's experience	4
Strongly disagree	Experienced for myself	I have seen someone experience this	5

Interesting results and interpretations

The following outlines the most interesting of the comparisons, that is where the test results identified clear differences in the populations.

“The global war of the sexes”

It was clear from this pilot that globally there are significant differences in the perceptions of men and women towards barriers in STEM.

	A	B	C	D	E	F	G
1	Variable	FemaleAverage	MaleAverage	FemaleStandardDeviation	MaleStandardDeviation	t	p
2	H3	2.82	1.92	1.293	1.016	13.299	0.000
3	G5	2.83	1.98	1.274	1.095	12.421	0.000
4	G2	2.59	1.85	1.233	1.004	11.367	0.000
5	G6	3.51	2.71	1.442	1.353	9.989	0.000
6	B3	2.70	2.03	1.287	1.127	9.664	0.000
7	G1	2.45	1.85	1.182	1.028	9.423	0.000
8	G3	2.43	1.85	1.237	0.980	8.964	0.000
9	E1	2.10	1.63	1.021	0.882	8.552	0.000
10	G4	2.53	2.00	1.184	1.051	8.332	0.000
11	F2	4.05	3.43	1.269	1.387	8.176	0.000
12	B1	2.42	1.86	1.309	1.067	8.096	0.000
13	B6	2.67	2.10	1.322	1.177	7.943	0.000
14	F4	4.17	3.61	1.219	1.374	7.598	0.000
15	B2	2.39	1.88	1.261	1.053	7.586	0.000
16	F1	3.45	2.87	1.458	1.376	7.132	0.000
17	F3	3.59	3.10	1.417	1.399	6.057	0.000
18	H5	2.10	1.76	1.060	0.917	5.949	0.000
19	H1	2.22	1.96	1.038	0.954	4.597	0.000
20	B5	2.56	2.33	1.287	1.262	3.215	0.001
21	H2	2.34	2.20	1.042	0.981	2.432	0.015
22	B4	2.61	2.50	1.296	1.325	1.487	0.137
23	H4	1.76	1.68	0.959	0.880	1.358	0.175
24	G7	3.02	2.99	1.267	1.360	0.473	0.636
25	F5	1.78	1.91	1.120	1.105	-2.117	0.034
26	E2	1.55	1.82	0.804	1.032	-5.055	0.000
27	E3	2.01	2.53	1.140	1.334	-7.377	0.000
28							

Figure 7 Snapshot of test data results comparing perceptions of men against women.

The greatest differences between men and women respondents are in responses to the following questions:

- **H3** I have not been personally affected by gender barriers in STEM.
- **G5** Women receive the same social evaluation and respect as men in their roles as scientists and engineers.
- **G2** Women equally receive appraisal or award for the outcome of their project or research or work.

In the above, women were more likely to disagree than men to the above statements.

At the opposite end of the scale, we note that men were more likely to disagree with the following statement:

- **E3** It is appropriate to introduce a quota system or affirmative actions to solve gender inequality in the STEM field.

Bioscientists versus mechanical and civil engineers & digital technologists

It is often claimed by women in the engineering and technology sectors that their situation is not comparable to the situation of women in the biosciences, since there is a high representation of women in the biosciences compared to the former sectors. So it may seem a little surprising to note that bioscientists, in general, disagree more with the following statements than engineers and digital technologists.

G6 Marriage, pregnancy or childcare have the same effect on scientist/engineer regardless of their gender/sex on their study, research, or work performance.

G5 Women receive the same social evaluation and respect as men in their roles as scientists or engineers (by their colleagues, professor, managers, funding donors, academic association, scientific society, professional institution, etc.)

H3 I have not been personally affected by gender barriers in STEM.

This would indicate that equal representation alone is not enough to resolve gender barriers. It may be that since there are more women than men in the biosciences, those men in leadership positions may be more likely to seek to support junior men into more senior posts. This will be related to perceptions of "leadership material", a phenomenon related to "cultural fit" (Epstein, 2021) . Male leaders tend to be biased towards male "followers" (Rink, et al., 2019) and so seek to promote the few men in the group. Where there are very few women, such as in digital technologies and engineering, the competition for leadership still allows a few women through and so disguising any gender barriers in mid-career.

Other notable results

The table below summarizes a few more remarkable results:

Table 8 Distinct differences between countries/regions

Country: variable	Statements where there were significant differences	Comments on the difference
Japan: gender	**E1** I believe things will turn out fine in the future career for women in STEM. **G1** Women are equally granted or entrusted equal roles for their research or project or work performance at the laboratory and at work. **G2** Women equally receive the appraisal or award for the outcome of their project or research or work.	Women tend to disagree with these statements. But men tend to agree strongly. The biggest difference of opinion was for H3 and G5.

Country: variable	Statements where there were significant differences	Comments on the difference
	G4 Dealing with funders (those providing funding for research projects or those providing the budget for a work project), in terms of administrative or budget process, is equally fair regardless of the gender/sex of applicant or project leader. **G5** Women receive the same social evaluation and respect as men in their roles as scientists or engineers (by their colleagues, professor, managers, funding donors, academic association, scientific society, professional institution, etc.) **H3** I have not been personally affected by gender barriers in STEM.	
Europe: gender	**H3** I have not been personally affected by gender barriers in STEM. **B3** Women in STEM receive equal work distribution and work appraisals compared to men of the same qualifications and level. **G3** The strictness, objectiveness and importance of the research or task outcome are equally respected regardless of the sex/gender of the person in charge.	Women were much more likely to disagree with these statements. It is notable that men and women in Europe appear to respond very differently to many of the statements.
Mongolia: gender	**B5** Being promoted or becoming a tenured professor or a principal investigator is equally difficult for women in STEM as for men in STEM. **B4** It is equally difficult for a woman as for a man to get a job in the STEM field with the same qualifications.	In a rare show of male support, men are more likely to disagree with these statements than women. NB. This was also noted in past KWSE surveys.
Korea vs. all other regions	**Responses to section F:** Perception of Gender Roles	Korean scientists and engineers are notably gender equalitarian (section F) in their views, compared to the rest of the world.

Country: variable	Statements where there were significant differences	Comments on the difference
Europe: STEM areas of focus	**F3:** Women are born to be, or naturally able to care for children in a way that men are just not as capable.	It seems IT professionals are slightly less likely to disagree with this.
Korea: STEM areas of focus	**D4:** Women in STEM being sexually harassed (linguistical or physical) or treated unfairly by their senior classmate or labmate or professor (in university laboratory, project group, etc) or senior colleagues or managers at work.	In the Biosciences, many men reported having seen this happen. In responses from Civil/ Mechanical Engineering and IT and Computing, this was not so prevalent.
World, India, Europe, Japan (note: not Korean male bioscientists)	**Comparing mean values for Section C:** Direct experiences of women **and Section D:** Indirect experiences of men	In these regions, women report negative experiences more often than men report seeing/hearing of them.

Countries grouped by human development & gender equity indices (HDI/GII)

A final analysis tested the concept of making comparisons between groups of countries with same values of the HDI (Human Development Index) and of the GII (Gender Inequality Index). For this analysis, a Spearmen correlation test was carried out instead of a t-test as the economic and gender indices, HDI and GII, are ordinal variables, i.e. only take whole number values representing ordered categories, in this case from 1 to 5.

The comparisons were made in relation to the total sample from each country/region, irrespective of gender or STEM area of focus.

In general, although for many of the questions for Section B to H there at first appeared to be significance in the correlations between HDI or GII and the responses, on inspection, there were only a handful of questions for which the correlations were meaningful where the absolute values of the coefficients indicated a low to moderate correlation. These were mainly in the statements relating to gender roles (Section F).

It may be that future analyses should consider more segregated groupings, such as HDI and gender. We also note that there were very similar results for HDI and GII.

Table 9 Correlations between HDI /GII and responses

Statements where there was correlation	Form of correlation	Comments
C1 Women in STEM being disadvantaged in receiving promotions, grade appraisal, research funds or scholarships because she is female.	Negative correlation with a coefficient of -0.3 (approx.)	This means that the higher values of HDI/GII (i.e. higher development or greater gender equality) corresponds to lower levels of agreement with this statement, i.e. less likely to have experienced this.
F1 In a relative sense, men are rational while women are emotional, and thus they ought to complement each other by carrying out roles that are appropriate for their gender.	Negative for both HDI and GII, with a coefficient close to -0.3 to -0.4 (approx.)	This means that the higher values of HDI/GII (i.e. higher development or greater gender equality) corresponds to lower levels of agreement with this statement, i.e. less likely to agree that there are "natural" gender roles.
F2 Primary breadwinners (who take care of financial obligations) of households should be men.	As above.	As above.
F4 In order to maintain the order and peace of a family, the husband should have greater power and authority than the wife.	Negative correlation with a coefficient of -0.3 (approx.)	As above.
G6 Marriage, pregnancy or childcare have the same effect on scientist/engineer regardless of their gender/sex on their study, research or work performance.	Negative correlation with a coefficient of -0.3 (approx.)	This means that the higher values of HDI/GII (i.e. higher development or greater gender equality) corresponds to lower levels of agreement with this statement, i.e. less likely to agree with this statement, so more likely to perceive marriage, etc, having more of an effect on careers.

The Public Report

In parallel to this project report, a report is being prepared for public communication. This report will focus on the key messages:

- There are gaps between the perceptions of men and women in STEM of gender barriers. In some countries they are significant but sometimes counterintuitive.
- The gaps in gender barrier perceptions do not always correspond to the areas where there is better representation of women in STEM. This is particularly relevant when trying to address ways and means of removing gender barriers: just increasing the number of women, as found in the biosciences, does not necessarily mean that gender barriers and issues disappear.
- Gender equity is not a “zero-sum game” (Roy, et al., 2020): in regions there is high gender equity, there is also high innovation and high societal gains.
- We need to distinguish between the role of individuals and the role of organizations, particularly the role of women in STEM networks to drive change at a policy and societal level (Park, 2021).
- Empowering with knowledge, by raising awareness of the gender barriers and (mis)perceptions in both men and women is a first and very important step. (Roy, et al., 2020) (Park, 2021).
- Lastly, “Fix the system, not the women” (Tasted & Bass, 2020): we note that it is still often the case that women are given the burden of proving their worth in the lab and the workplace. It is the STEM sectors that need to change, not individuals.

Proposal for a Gender barriers perceptions In Science and Engineering (GISE) Index

One of the hoped-for outcomes of this pilot project was an index to measure the progress of women in STEM at national levels. We here propose an approach to deliver a gender in STEM Index, with illustrations based on the data from this pilot project.

The approach here suggested takes a similar tactic to that of the World Economic Forum's "Availability of scientists and engineers" metric, which is part of the WEF Global Competitiveness Index employed by The World Bank TCdata360 (World Economic Forum, 2018) (The World Bank, 2017). This metric is based on perceptions, or in other words the opinions of the respondents. The GISE survey and the previous KWSE surveys are comparing perceptions of gender barriers across multiple areas, and it is here proposed that these perceptions can provide a good indicator of the situation of women in STEM in a country. We also note the commentary by Data2X on the lack of data on perceptions for women in economic areas.

The proposal suggested is to compare, on a country-wide basis, male versus female perceptions of gender barriers: the wider the variance between men and women, the more likely gender barriers exist and the less likely there will be change.

The process to transform the results of a survey would take the following steps:

1. For all statistically significant differences between the perceptions of men and women to each gender barrier identified in the survey, find the mean difference in values of the scores.
2. NB. The raw score values are recoded so that 5 represents strong agreement with the perception of a gender barrier and 1 represents strong disagreement.
3. Factor the mean by the median score of each gender barrier indicator or by making use of the t-value, since this includes a measure of the spread of the sample. It may be appropriate to weigh the factor such that the lower the representation of either gender, the higher the influence of that gender's average score on the overall average.
4. To achieve an index with a value lying between 0 and 1, we can normalize the output of steps 1 to 4 by a maximum possible differences value.

The above process should be compared to and assessed against good practice in creating indices such as the guidance provided by the OECD to construct reliable indicators (OECD, 2008).

The result of this would be a **GISE Index** where 0 represents potential for progress due to raised awareness of gender barriers and 1 least potential progress. The indices could be calculated not just for each country but also for each STEM sector of interest in the country.

To illustrate the concept, consider the following extreme and artificial cases:

Case 1 for a region where men and women in STEM report very different perceptions in all 32 of the gender barriers questions (sections B-H):

- For women, the average response value for all 32 questions is 5, where 5 represents strong agreement of a gender barrier
- The average response value for men is 1, representing strong disagreement of any gender barrier in STEM
  - Thus the mean difference between women's and men's responses will be (5 - 1) = 4 and this is a maximum value.
- The median score value across both men and women will be 3 for all questions.

The calculation for the index would be carried out as follows:

Output value from steps 1 to 4, is given by (mean difference x median score value) = 4 x 3 = 12. This is the maximum score value, and hence we divide by 12 to obtain a GISE Index of 1.

Case 2 for a region where men and women in STEM report statistically different perceptions in 10 of the gender barriers questions (sections B-H) but the gender barrier perceptions are not extreme (i.e. many respond with a 3 to these questions).

- For women, the average response value for these questions is 3.5.
- The average response value for men is 2.5
  - Thus the difference between women's and men's responses will be 1.
- The median score value across both men and women is 3 for these 10 questions.

The GISE Index for this case will be given by: 1 x 3 / 12 = 0.25.

Case 3 for a region where men and women in STEM report statistically different perceptions in 10 of the gender barriers questions (sections B-H):

- For women, the average response value for these questions is 4.5.
- The average response value for men is 3.5
  - Thus the difference between women's and men's responses will be 1.
- The median score value across both men and women is 4 for these 10 questions.

The GISE Index for this case will be given by: 1 x 4 / 12 = 0.33 (to 2 decimal places).

Finally, it should be noted that in theory, the value of a GISE Index could lie anywhere between -1 and 1. A value of less than 0 would indicate that men are seeing gender barriers that women are not experiencing; this is a very unlikely although possible situation.

From the cases and examples above, the more men and women disagree over the gender barriers they have seen or experienced combined with the extent to which those gender barriers appear to exist, the higher the value of this proposed GISE Index, as is desired.

This proposal is very much a draft proposal. It is suggested that future work includes a full factor analysis, such as described in (Knekta, et al., 2019), to compare this simple calculation process with more robust processes based on statistical theory. The hopes are that this index will provide a tool for change.

Conclusions and Suggestions

The key aims and objectives of the pilot survey were achieved:

- The targets were met; with over 1200 valid responses and a reach of 29 countries.
- The focus on STEM Areas was largely useful and so successful.
- Ten countries were targeted, but of these the countries in the INWES African Regional Network had lower than expected responses; as noted elsewhere, this was partly related to issues outside our control.
- The translation of questionnaire was a useful exercise, and prepares for a more extensive international survey with improved promotional material.
- The consultation events supported the initial thinking and definition of process. These supported smaller meetings and conversations with experts.
- The pilot project allowed for some exploration of issues, including sample sizes, and an understanding of relevant confounding variables that should inform future work.
- The most valuable output for future projects is the “Lessons Learned”, particularly in relation to the inclusion of all areas of STEM to widen reach.
- Closer linking between United Nations/World Economic Forum/other gender metrics and results of these surveys: a foundation for a GISE Index has been proposed that is influenced by UN and WEF approaches.
- The key messages for public communications form the basis for the public (easy-to-read) report, together with some suggestions of what can be done to support progress towards gender equality in STEM.

The most important outcomes of the project include:

- A robust process for international surveys of gender barriers in the STEM areas, including consideration of ethics, the link to UN and other gender indices, ways to promote and disseminate the survey and a structure for a public report.
- A library of data to build up on in the future. The raw data can be made available on request and on agreement to the terms and conditions.
- A proposed gender index for STEM based on perceived gender barriers.

These will provide the basis for future survey work.

We also note the counterintuitive results regarding the greater perceptions of gender barriers in the biosciences as compared to the two areas of engineering and in computing, which as noted earlier in this report may be a result of the phenomenon of “cultural fit”. These results may surprise those of us who have until now believed that the high representation of women in a sector might be sufficient to progress gender equality.

Suggestions and recommendations

The following are the general suggestions and recommendations for future planned surveys:

- Consider similar sized (in terms of expected numbers of STEM professionals) regions with similar cultural/socioeconomic issues instead of countries.
- Include all areas of STEM, including medicine, economics, and the social sciences.
- Add questions on the experiences of respondents regarding empowerment programs such as development of soft skills & leadership, mentoring and coaching.
- Consider the impact of wider notions of "cultural fit" and how this affects leadership in STEM.
- Find alternative ways of obtaining input from experts and advisors: smaller meetings provided more feedback and robust discussions.
- Link to other international work on gender data to share INWES-KWSE reports and data: e.g., World Bank Group Gender Data Portal, Data2X and the International Labor Organisation. As noted earlier in this report, Data2X note the lack of data on women's reported experiences and perceptions in the workplace. More generally, we should aim to offer the data from these surveys as "open data" to encourage other researchers to carry out further analyses on the data.
- As noted earlier, the SAGA Toolkit does not appear to feature highly in consciousness of women in STEM networks. We should explore how to incorporate the lessons and existing resources from the SAGA programme.
- Carry out a formal process of constructing indices based on OECD guidance including a full statistical factor analysis to underpin a Gender barrier perceptions In Science and Engineering (GISE) Index.
- Enlist other networks and allies across extended network and influencers in STEM as champions for INWES and the GISE work.

There are longer term questions/issues to consider:

- The impact of Covid-19 – will this lead to longer structural changes to gender and STEM? Should future surveys on gender barriers in STEM include pre-and post-pandemic comparisons?
- For this pilot we avoided including job roles in addition to STEM specialisms, since we did not plan to carry out any analysis based on roles. Should future surveys allow for some way to compare across job roles: e.g., to compare the gender barriers in a sector for women who are in the technical or so called "hard" roles versus the facilitating roles?
- In these surveys so far, it is assumed that the surveys are intended for STEM professionals only. However, the issues gender in technician level roles are even

more pressing and has a direct relevance and effect on gender barriers in the professional spheres. This is an area to note for future more extended work.

- We noted above that although we allowed for non-binary genders, the survey did not break this down any further. It may be that in future, as gender fluid identity becomes more acceptable in many regions, this work may need to consider more than two or three genders.
- It was noted in the section in this report **Sampling variables** that the question of diasporas, migrants and refugees has only just been touched upon until now. For some regions, e.g., some African countries, the diaspora of scientists to other regions is important to consider.
- Finally, we also note that INWES, as an NGO with links to the United Nations, should seek to influence UN metrics. We should consider ways to affect how countries report on STEM and gender for example through the Voluntary National Reports (United Nations Committee for Development Policy, 2021).

Next steps and Scope of the 2022 Project

There are proposals to run a further project in 2022, with a focus on more data collection in African countries as a comparison with South Korea. This next survey will add data to the data collected in this 2021 survey and all past KWSE-led surveys. We will work to study the robustness of the proposed index through factor analysis. We will aim to widen the dissemination of the survey and outputs through the extended network of INWES supports.

We encourage readers of this report to contact INWES to express an interest in supporting future GISE surveys. INWES and KWSE seek to extend the reach of the survey and welcome individuals and organizations who are willing to support dissemination and sharing of data.

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APPENDICES

The following may include documents reproduced as images. They are available in PDF format upon request. In addition, some are also available in the languages of the questionnaires.

GISE Advisory Group Terms of Reference

This document is available only in English.

GISE Advisory Group
Terms of Reference

Purpose of the Advisory Group

The Advisory Group is to provide expert advice and guidance to the project team at KWSE and INWES on:

- Survey aims
- Data collection gathering and analysis
- Methodology
- Reaching the target audiences

This Group may include subject matter experts who are not part of INWES.

Term

The project runs from 1 February 2021 to 30 November 2021. The Terms of Reference is effective from 25 April 2021 and continues until the end of the project or until terminated by agreement between the parties.

Membership and Roles

The Advisory Group will include:

- The Chair – Professor Jung Sun Kim, INWES President
- KWSE leads and representatives
- INWES leads
- Subject Matter Experts/Expert Advisers
- INWES Regional Network representatives
- Administrative Support – Hyon Jung Jang
- Project Manager – Dr Sarah Peers

The current list is appended to this document.

Responsibilities

The role of this Advisory Group is not to make decisions, but instead to provide current knowledge and critical thinking to support the project management of the GISE project. NB There is also a separate GISE Steering Committee to ensure effective decision-making.

Responsibilities of the GISE Advisory Group members include:

- To respond in a timely manner to requests for advice and guidance
- To attend meetings of the Advisory Group where possible
- To respond to requests from the Chair as necessary

The additional responsibilities for each role include:

- The Chair – to chair meetings and ensure the group is effective in its task of advising the direction of the project.
- KWSE leads and representatives – to provide guidance on the requirements and needs of the funders of the project and of KWSE.
- INWES leads – to provide guidance on requirements of INWES.
- Subject Matter Experts/Expert Advisers – to provide advice and guidance on the issues of gender, statistics, survey techniques, analysis and reporting, past experiences of the KWSE gender in STEM surveys.

- INWES Regional Network representatives – to provide guidance on the practicalities of ensuring a good reach for the survey, including method of dissemination, ensuring a reasonable sample, translating as necessary to other languages.
- Administrative Support – to provide administrative support for the project as requested by the Chair, such as supporting organisation of meetings and communications between members of the GISE Advisory Group.
- Project Manager – to manage the project including ensuring meeting requirements of KWSE and INWES, managing communications and events, carrying out design and delivery of the survey, reporting on progress, promoting the project, writing the final reports.

Meetings, Reporting and Events
It is expected the Advisory Group will meet once per month (apart from August). Meetings will be held online. Where possible, members will be given one week's notice including papers for the meeting. These meetings will include a report on the project and requests for comments.

In addition, individual members may be requested to provide ad hoc advice and guidance addressing a particular question by email and, where convenient, in small online discussion meetings.

The project plan includes open meetings for a wider audience and a launch event for the final reports. Members of the Advisory Group will be invited to attend these meetings as VIPs.

NB. Expenses and Honoraria
There is a small budget available for project out-of-pocket expenses and for honoraria to recognise the time and services supplied by members of the GISE Advisory Group or others involved in the delivery of the survey. Members are requested to confer with the Chair before carrying out any activity for the project that incurs out-of-pocket expenses. Any payments must be agreed beforehand with the Chair on an individual basis according to the requested services/time spent on delivery/ and expected expenses incurred.

APPENDICES

The Questionnaire

The English version is reproduced in full in this report. The questionnaires in Korean, French, Japanese, Spanish, and Mongolian can be made available upon request. he questionnaire is translated into French, Japanese, Korean, Mongolian, and Spanish.

English Version

International Gender Barriers in STEM*: The 2021 survey for Science and Engineering Professionals.

For men and women in the biological sciences, in mechanical and civil engineering, and in the digital/computing sciences and any other area of STEM. A pilot survey forming part of the collaborative INWES-KWSE Gender perceptions In Science and Engineering (GISE) project.

*STEM : Science, Technology, Engineering, Mathematics

* Required

About this Survey

The purpose of this survey is to evaluate how scientists and engineers across several regions in the world perceive "gender barriers" experienced by women in STEM. The term "gender barriers" is used in this study to describe hurdles and obstacles women in STEM experience in their educational and professional lives because of their biological and social identity as women. This forms part of the KWSE-INWES Gender perceptions In Science and Engineering project.

Please take time to answer each and every question as truthfully as possible. There are no right or wrong answers. Please respond based on your experiences and thoughts. Your response and those of approximately 1,200 other scientists and engineers from over 10 countries in Africa, Asia, the Americas and Europe will be used to draw out policy agendas to expand women's participation in STEM, as well as to promote regional and national development in STEM. We estimate the questionnaire takes a maximum of 30-40 minutes to complete.

Your answers will be used only for analytical purposes. All data gathered will be published in combined form. This survey is anonymous and any personal information will be kept strictly confidential. Please see: Data Protection and Confidentiality (http://inwes.org/gise_DP_Confidentality)

This survey is for respondents who are
➤ of any gender* (male or female or other);
➤ currently residing/working in India, Japan, Kenya, Mexico, Mongolia, Nigeria, Senegal, South Korea, Tunisia, or the European Union;
➤ in the STEM specialisms of the biological sciences, or civil or mechanical engineering, or the computing/digital sciences (studied or currently);
➤ and of working age (including currently studying for a postgraduate degree, or not currently working).
➤ UPDATE: From September 2021 we welcome responses from other countries and other STEM areas. Reporting will focus on the 3 areas and the above regions, but all data will be included in general analysis.
Please do NOT participate if you have yet to start a first university level degree, are an undergraduate student, or are retired. More explanations of the STEM specialisms and other terms (indicated with a black*) can be found in Glossary and Detailed Explanations (http://inwes.org/gise_glossary). NB. If you are not sure if your specialism is included, feel free to submit a response but please explain your specialism in detail in the comments section 'Any other comments on Section A?'; although your response might not be used for this pilot, it may be used in a future study.

All respondents, will be required to answer sections A, B, E, F, G, H. Those who identify as women or more closely female will be asked to reply to Section C. Those who identify as men will be asked to reply to Section D. Those who have defined themselves as "other" gender will be asked to attempt to identify whether they need to respond to either C or D according to the best approximation to their personal circumstances or lived experiences.

This survey is part of the 2021 INWES-KWSE Gender perceptions In Science and Engineering (GISE) project; for more information on the project, please refer to www.inwes.org/project_gise. In case of questions and queries on this questionnaire, email the Project Manager Dr Sarah Peers sarah.peers@inwes.org. In case of complaints or more general questions about the project, email info@inwes.org.

We deeply appreciate your cooperation!

1. Are you working or studying or have you worked or studied in the STEM sectors? *

Mark only one oval.

- Yes
- No
- Maybe

2. Are you a graduate of a first (or higher) university level degree* (or equivalent)? *

Mark only one oval.

- Yes
- No
- Other: ____________________

3. Are you over the age of 18 AND not yet retired? *

Mark only one oval.

- Yes
- No
- Other: ____________________

4. Are you working or living in India, Japan, Kenya, Mexico, Mongolia, Nigeria, Senegal, South Korea, Tunisia, or the European Union? *

Mark only one oval.

- Yes
- No
- Other: ____________________

Section A. About you

1. Sociodemographic information

5. 1.1 Your year of birth *

____

6. 1.2 Please indicate your marital status:

Mark only one oval.

- ◯ Single/ long-term separated/ divorced *Skip to question 8*
- ◯ Married or in a long-term relationship *Skip to question 7*
- ◯ Other: ______________________

Skip to question 8

If married or in a long-term relationship or otherwise appropriate:

7. 1.2 (contd) Please indicate your situation:

Mark only one oval.

- ◯ My spouse/partner and I earn a professional level income
- ◯ Only my spouse/partner earns a professional level income
- ◯ I am the main breadwinner (i.e. take care of financial obligations) in our relationship
- ◯ Neither of us are earning a professional level income
- ◯ Other: ______________________

Section A continued 1

8. 1.3 Please indicate the number of children and other dependents needing care (e.g. elderly and the infirm) in your household:

Mark only one oval.

- ◯ None at all
- ◯ One to 3
- ◯ More than 3 but less than 7
- ◯ Other: ______________________

9. 1.4 Please indicate the time you personally spend on family/domestic/caring responsibilities*:

See Glossary http://inwes.org/GISE_glossary

Mark only one oval.

- Less than 8 hours a week because there is little need (e.g. no children residing at home, no care of the elderly, or caring of dependents)
- More than 8 hours but less than 20 hours
- More than 20 hours a week
- In our household, family/domestic/caring responsibilities are mainly carried out by my husband/wife/partner.
- In our household, family/domestic/caring responsibilities are mainly carried out by staff or by extended family members (e.g. nanny, maid, or grandparents, etc.)
- Other: ______________________

Section A continued 2

2. STEM specialism and employment

Please ONLY respond to this survey if you have either studied or are working in the biological sciences, or in civil or mechanical engineering, or in digital/computer sciences. See Glossary for more details: http://inwes.org/GISE_glossary

If you are not sure your specialism is included, please feel free to take part but please give detailed descriptions in the Other.

10. 2.1 Major/main field of study for your first university level degree*: *

Mark only one oval.

- Biological Sciences*
- Mechanical or Civil Engineering*
- Digital/Computing Sciences*
- Other: ______________________

11. 2.2 Your current specialism: *

Mark only one oval.

- ◯ Biological Sciences*
- ◯ Mechanical or Civil Engineering*
- ◯ Digital/Computing Sciences*
- ◯ Other: ____________________

12. 2.3 Please provide the number of years you have of experience in STEM: (add the number of years of STEM work experience and of postgraduate STEM study).

____

13. 2.4 Please also estimate the number of years since your first university level degree when you have NOT been working in, or studying STEM:

____

14. 2.4 (contd) If relevant, indicate the main reasons for this time out of STEM (you can select more than one):

Check all that apply.

- ☐ Not STEM qualified
- ☐ Childcare/caring for family
- ☐ Unemployment
- ☐ Health reasons
- ☐ Working in a non-STEM role and sector
- ☐ Never out of STEM!

Other: ☐ ____________________

15. 2.5 Your current employment status: *

Mark only one oval.

- Employed (including self-employed) *Skip to question 17*
- Part-time STEM employment and part-time study at postgraduate level (e.g., masters, PhD, etc.) *Skip to question 17*
- Full-time study at postgraduate level
- Not employed nor studying
- Working in a temporary job while studying or while job hunting
- Other: ____________________

IF NOT employed

16. 2.5 (contd) If not employed, what is your situation:

Mark only one oval.

- I am seeking the right job, opportunity, etc.
- Work/further study is incompatible with my family/domestic/caring responsibilities
- I have chosen not to work/study for the moment
- Temporarily unable to work for health reasons
- Other: ____________________

Skip to question 18

IF employed

17. 2.5 (contd) If employed, are you employed by

Mark only one oval.

- Corporate or industry
- University or research institute
- Public services (e.g. education, local government, etc. including NGOs/charities
- Microcompany (start-up or your own small company)
- Other: ____________________

Skip to question 18

Country and Regional

3 Country and Regional Information:

18. 3.1 Your main language when working in STEM

Mark only one oval.

- English
- French
- Japanese
- Korean
- Mongolian
- Spanish
- Other: ____________

19. 3.2 Your nationality/country of origin: *

Mark only one oval.

- India
- Japan
- Kenya
- Mexico
- Mongolia
- Nigeria
- Senegal
- South Korea
- Tunisia
- One of the European Union countries
- Other: ____________

20. 3.3 Country where you are currently employed/living: *

Mark only one oval.

- India *Skip to question 21*
- Japan *Skip to question 23*
- Kenya *Skip to question 36*
- Mexico *Skip to question 36*
- Mongolia *Skip to question 27*
- Nigeria *Skip to question 36*
- Senegal *Skip to question 31*
- South Korea *Skip to question 26*
- Tunisia *Skip to question 36*
- One of the European Union countries *Skip to question 32*
- Other: ____________________

Skip to question 36

India

Other circumstances related to local or regional issues that may affect your gender and STEM experiences. All questions are strictly for research purposes and as for the rest of the questionnaire, completely anonymous.

21. 3.4 a) Please indicate your caste:

Mark only one oval.

- General
- OBC
- SC
- ST
- Other: ____________________

22. 3.4 b) Please indicate your religion:

Mark only one oval.

- Hinduism
- Islam
- Christianity
- Jainism
- Buddhism
- Sikhism
- None
- Other: ______

Skip to question 36

Japan

Other circumstances related to local or regional issues that may affect your gender and STEM experiences.

23. 3.4 (a) Please indicate your final or highest level of academic study:

Mark only one oval.

- ① High school/Secondary school
- ② Undergraduate
- ③ Masters Course
- ④ Doctoral course
- Other: ______

24. 3.4 (b) Please indicate when you decided to get into STEM

Mark only one oval.

- ① Primary school
- ② Junior high school/Secondary school
- ③ High school/Sixth Form College
- ④ Technical College/University
- Other: ______

25. 3.4 (c) Please indicate your reason for deciding to get into STEM

Mark only one oval.

- ① Interest
- ② Strongest subject
- ③ Desired career or employment
- ④ Work experience program
- Other: ____________________

Skip to question 36

Korea

Other circumstances related to local or regional issues that may affect your gender and STEM experiences.

26. 3.4 In which region of Korea are you working?

Mark only one oval.

- ① Capital (Seoul, Kyoung-gi, Incheon)
- ② Youngnam region (including Gangwon)
- ③ Honam region (including Jeju)
- ④ Choongchung region

Skip to question 36

Mongolia

Other circumstances related to local or regional issues that may affect your gender and STEM experiences. All questions are strictly for research purposes and as for the rest of the questionnaire, completely anonymous.

27. 3.4 a) Please indicate your background:

Mark only one oval.

- 1. Urban (Ulaanbaatar, Darkhan, Erdenet)
- 2. Regional (center of provinces)
- 3. Rural and nomadic (soum, bag)
- Other: ____________________

28. 3.4 b) Please indicate if you had a school teacher who positively influenced you the most in STEM

Mark only one oval.

- ⬭ Yes, they were a female teacher who was new to teaching or under 30 years old
- ⬭ Yes, they were a female teacher who was an experienced teacher or more than 30 years old
- ⬭ Yes, they were a male teacher who was new to teaching or under 30 years old
- ⬭ Yes, they were a male teacher who was an experienced teacher or more than 30 years old
- ⬭ No teacher influenced me positively in STEM
- ⬭ Other: ____________________

29. GENDER BARRIERS IN WORKPLACES IN MONGOLIA *

Mark only one oval per row.

	① Strongly agree	② Somewhat agree	③ Neutral	④ Somewhat disagree	⑤ Strongly disagree
1 Sexual harassment is more likely under male leadership	⬭	⬭	⬭	⬭	⬭
2 Sexual harassment is more likely under female leadership	⬭	⬭	⬭	⬭	⬭
3 There is usually a need for some kind of a bribe under male leadership	⬭	⬭	⬭	⬭	⬭
4 There is usually a need for some kind of a bribe under female leadership	⬭	⬭	⬭	⬭	⬭
5 It is more difficult to lead, collaborate and/or mentor men compared to women	⬭	⬭	⬭	⬭	⬭
6 It is more difficult to lead, collaborate and/or mentor women compared to men	⬭	⬭	⬭	⬭	⬭
7 Newly hired young people are typically required to work overtime, with little to no extra payment	⬭	⬭	⬭	⬭	⬭

30. GENDER BARRIERS TO WORKING IN PROFESSIONAL FIELDS IN MONGOLIA *

Mark only one oval per row.

	① Strongly agree	② Somewhat agree	③ Neutral	④ Somewhat disagree	⑤ Strongly disagree
1 Women engineers do not work in their main professions or in their professional field	⬭	⬭	⬭	⬭	⬭
2 Women engineers are not employed in their profession due to the unfunded mandates imposed in order to meet international standards/requirements in their fields and in their professions	⬭	⬭	⬭	⬭	⬭
3 There is no private or public family support for working and/orpromoting advanced studies and careers in STEM fields	⬭	⬭	⬭	⬭	⬭
4 Decisions to have a family and/or children greatly influence my career and professional choices	⬭	⬭	⬭	⬭	⬭

Skip to question 36

Senegal

Other circumstances related to local or regional issues that may affect your gender and STEM experiences. All questions are strictly for research purposes and as for the rest of the questionnaire, completely anonymous.

31. 3.4 Please indicate further family circumstances

Check all that apply.

☐ I live in a polygamous family
☐ I live in with a large extended family (uncles, aunts, nephews, nieces, grandparents) in one household
Other: ☐ ____________________

Skip to question 36

European Union

Other circumstances related to local or regional issues that may affect your gender and STEM experiences. All questions are strictly for research purposes and as for the rest of the questionnaire, completely anonymous.

32. 3.3 (contd.) Please give your current country of work/residence

Mark only one oval.

- Austria
- Belgium
- Bulgaria
- Croatia
- Cyprus
- Czechia
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- Lithuania
- Luxembourg
- Malta
- Netherlands
- Poland
- Portugal
- Romania
- Slovakia
- Slovenia
- Spain
- Sweden
- Other

33. 3.4 Please indicate any other characteristics that may affect your experiences at work or study:

Check all that apply.

- [ ] I am a person of color
- [ ] I am an immigrant from outside the EU
- [ ] I am LGBTQI

Other: [ ] ______________________

34. 3.4 (contd) Do you have a disability?

Mark only one oval.

( ) Yes *Skip to question 35*
( ) No *Skip to question 36*
( ) Maybe *Skip to question 35*

If with a disability

35. 3.4 (contd) If you have a disability or not sure, please explain here briefly:

____

Skip to question 36

Any other comments on Section A?

This is free text entry question to allow you to make comments as required.

36. 4. If there are any other issues you wish to add, please explain below. For example, you may wish to describe your STEM specialism. Please do NOT include ANY information that may identify you.

____
____
____
____
____

Section B.

For all respondents.

37. Perception of 'gender barriers' in STEM *

Mark only one oval per row.

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree
Girls and boys are equally encouraged to choose any major/field of study in STEM during their education period.	⬭	⬭	⬭	⬭	⬭
Female students in STEM receive equally fair assessments and appraisals for their work, task, or project results, compared to their male counterparts in the same programs and levels.	⬭	⬭	⬭	⬭	⬭
Women in STEM receive equal work distribution and work appraisals compared to men of the same qualifications and level.	⬭	⬭	⬭	⬭	⬭
It is equally difficult for a woman as for a man to get a job in the STEM field with the same qualifications.	⬭	⬭	⬭	⬭	⬭
Being promoted or becoming a tenured professor or a principal investigator is equally difficult for women in STEM as for men in STEM.	⬭	⬭	⬭	⬭	⬭
Women in STEM generally receive equal pay for equal work, compared with their equally-qualified male colleagues.	⬭	⬭	⬭	⬭	⬭

Your gender

38. 1.1 Your gender* *

Mark only one oval.

- Female *Skip to question 40*
- Male *Skip to question 41*
- Other: ____________________

"Other" gender

The option for "other" is to allow non-binary genders to identify themselves and be included in this survey at a basic level. We realise this option covers many genders. Our focus, for the purpose of this survey only, is to identify the barriers of people who identify more with the female gender or whose experiences reflect those of women generally.
For this reason, the next question aims to best match you to either Section C (intended primarily for women or those who are perceived to be more feminine) or Section D (intended for men).

39. On balance, to which gender do your experiences of STEM, work and study match closest?

Mark only one oval.

- Male (for Section D.) *Skip to question 41*
- Female or strictly non-binary (for Section C.)

Section C.

These questions are intended for women or those who identify more with women than with men or those who are strictly non-binary.

40. Direct/Indirect experience of 'gender barriers' *

Mark only one oval per row.

	Never experienced, seen nor heard from others	Neither seen nor heard but recognize the possibility	Heard from others	I have seen others experience this	Experienced for myself
Women in STEM being disadvantaged in receiving promotions, grade appraisal, research funds or scholarships because she is female.	⬭	⬭	⬭	⬭	⬭
Women in STEM being disadvantaged in participating or leading a research/work project or team because she is female.	⬭	⬭	⬭	⬭	⬭
Women in STEM being sexually harassed (linguistical or physical) or treated unfairly by their colleagues/peers (in class, laboratory, team, at work, etc).	⬭	⬭	⬭	⬭	⬭
Women in STEM being sexually harassed (linguistical or physical) or treated unfairly by their senior classmate, lab-mate or professor (in university laboratory or project group, etc), or senior colleagues or managers at work.	⬭	⬭	⬭	⬭	⬭
Women in STEM being disadvantaged in accessing	⬭	⬭	⬭	⬭	⬭

research/work equipment or information because she is female.					
Women in STEM being in trouble or leaving study/work/research project due to her marriage, pregnancy or childcare.	◯	◯	◯	◯	◯

Skip to question 42

Section D.

These questions are for men or those who identify more closely with men.

41. (Indirect) Experience of 'gender barriers' in STEM *

Mark only one oval per row.

	Never seen nor heard from others	Neither seen nor hear but recognize the possibility	Heard from others about unknown person's case	Heard from my colleague or known person's experience	I have seen someone experience this
Women in STEM being disadvantaged in receiving promotions, grade appraisal, research funds or scholarships because she is female.	◯	◯	◯	◯	◯
Women in STEM being disadvantaged in participating or leading a research/work project or team because she is female.	◯	◯	◯	◯	◯
Women in STEM being sexually harassed (linguistical or physical) or treated unfairly by their colleagues/peers (in class, laboratory, team, at work, etc).	◯	◯	◯	◯	◯
Women in STEM being sexually harassed (linguistical or physical) or treated unfairly by their senior classmate or labmate or professor (in university laboratory, project group, etc) or senior colleagues or managers at work.	◯	◯	◯	◯	◯
Women in STEM being disadvantaged in accessing	◯	◯	◯	◯	◯

research/work equipment or information because she is female.					
Women in STEM being in trouble or leaving study/work/research project due to her marriage, pregnancy or child care.	⬭	⬭	⬭	⬭	⬭

Skip to question 42

Section E.

For all respondents.

42. Perception of policy to overcome 'gender barriers' *

Mark only one oval per row.

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree
I believe things will turn out fine in the future career for women in STEM.	⬭	⬭	⬭	⬭	⬭
It is crucial to have strong policy support to solve gender inequality in the STEM field.	⬭	⬭	⬭	⬭	⬭
It is appropriate to introduce a quota system* or affirmative actions* to solve gender inequality in the STEM field	⬭	⬭	⬭	⬭	⬭

Section F.

For all respondents.

43. Perception of gender roles *

Mark only one oval per row.

	Strongly agree	Some- what agree	Neutral	Somewhat disagree	Strongly disagree
In a relative sense, men are rational while women are emotional, and thus they ought to complement each other by carrying out roles that are appropriate for their gender.	⬭	⬭	⬭	⬭	⬭
Primary breadwinners (who take care of financial obligations) of households should be men.	⬭	⬭	⬭	⬭	⬭
Women are born to be, or naturally able to care for children in a way that men are just not as capable.	⬭	⬭	⬭	⬭	⬭
In order to maintain the order and peace of a family, the husband should have greater power and authority than the wife.	⬭	⬭	⬭	⬭	⬭
I believe gender equality will be fully achieved only if women are given equal opportunities as men.	⬭	⬭	⬭	⬭	⬭

Section G.

For all respondents.

44. Perception of gender equality in study, research and work environments *

Mark only one oval per row.

	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree
Women are equally granted or entrusted equal roles for their research or project or work performance at the laboratory and at work.	◯	◯	◯	◯	◯
Women equally receive the appraisal or award for the outcome of their project or research or work.	◯	◯	◯	◯	◯
The strictness, objectiveness and importance of the research or task outcome are equally respected regardless of the sex/gender of the person in charge.	◯	◯	◯	◯	◯
Dealing with funders (those providing funding for research projects or those providing the budget for a work project), in terms of administrative or budget process, is equally fair regardless of the gender/sex of applicant or project leader.	◯	◯	◯	◯	◯
Women receive the same social evaluation and respect as men in their roles as scientists or engineers (by their colleagues, professor, managers, funding donors, academic association, scientific society, professional institution, etc.)	◯	◯	◯	◯	◯
Marriage, pregnancy or childcare have the same effect on scientist/engineer regardless of their gender/sex on their study, research or work performance.	◯	◯	◯	◯	◯
Female students in STEM are intimidated in the laboratory or in classes or in the workplace because they are female.	◯	◯	◯	◯	◯

Section H.

For all respondents.

45. Perception of your STEM career *

Mark only one oval per row.

	Strongly agree	Some- what agree	Neutral	Somewhat disagree	Strongly disagree
On balance, my STEM career has progressed well so far.	⬭	⬭	⬭	⬭	⬭
I am considered by colleagues to be either a leader in STEM, or on track for leadership.	⬭	⬭	⬭	⬭	⬭
I have not been personally affected by gender barriers in STEM.	⬭	⬭	⬭	⬭	⬭
My family /partner /friends are, on the whole, supportive of my STEM career.	⬭	⬭	⬭	⬭	⬭
My current colleagues, managers, professors, are as supportive of me and my STEM career as of others in the same environment.	⬭	⬭	⬭	⬭	⬭

End of Questionnaire

✿ We have come to the end of the survey. Thank you for your time and participation!!✿

This survey is part of the 2021 INWES-KWSE Gender perceptions In Science and Engineering (GISE) project; for more information on the project, please refer to www.inwes.org/project_gise. In case of questions and queries on this questionnaire, email the Project Manager Dr Sarah Peers sarah.peers@inwes.org. In case of complaints or more general questions about project, email info@inwes.org.

46. If you have any final comments to make about the Survey or the Questions, please feel free to add them here. Please do NOT add any information that may identify you.

Glossary

Glossary and Detailed Descriptions

- **STEM Specialisms:**
  - **Biological sciences** may include biology, anatomy, biochemistry, biophysics, cell and molecular biology, computational biology, ecology and evolution, environmental biology, forensic biology, genetics, marine biology, microbiology, molecular biosciences, natural science, neurobiology, physiology, zoology.
  - We are NOT including medicine, veterinary medicine, healthcare, or pure chemistry in this pilot survey.
  - **Civil and/or mechanical engineering** includes coastal engineering, transportation, construction, structural engineering, environmental engineering, geotechnical engineering, water resources engineering, automotive engineering, manufacturing, transportation systems, combustion, marine engineering, naval architecture, ocean engineering, production engineering.
  - We are NOT including architecture, surveying, bioengineering, computer hardware engineering, robotics/mechatronics, or any other form of chemical engineering, electrical or electronic engineering in this pilot survey.
  - **Computing/digital sciences** includes computer programming, software development, computer sciences, web development, programming design & analysis, digital communications, application development, computer games design.
  - We are NOT including hardware development, networks, telecommunications, or computer engineering in this pilot survey.
- **Gender**
  - is used in this questionnaire to mean the gender/sex you identify as.
  - The option for “other” is to allow non-binary genders to identify themselves and be included in this survey at a basic level. We realise this option covers many genders. Our focus, for the purpose of this survey only, is to identify the barriers of people who identify more with the female gender or whose experiences reflect those of women generally. In future, larger surveys, we may be able to consider all aspects of gender more widely.
- **Working age**
  - is a descriptor intended, in the context of this survey, to apply to someone who could be employed as a STEM professional, assuming they have achieved the basic qualification.
- **First university level degree**
  - is used to mean a bachelor’s level degree (BA, BSc, BEng/MEng) or other officially agreed (e.g., by your scientific society or professional institution) equivalent to ISCED 2011 Level 6 achieved through training or relevant work experience.

- **Family/domestic/caring responsibilities**
  - means the tasks related to caring for children, meal preparation and shopping, laundry and cleaning.
- **Affirmative Action**
  - is the social policy to protect and support members of minority groups intended to end and correct the effects of a specific form of discrimination.
- **Quota System**
  - is the social policy which gives preference to protected group members (historically unfairly treated due to their sex, class or race) to correct the inequality in hiring, studying or social participation.

Data Protection and Confidentiality Statement

Data Protection, Privacy and Confidentiality

The purpose of this section is to help you understand exactly what your participation in this survey entails so that you can make an informed decision about it.

The data collected by this survey is fully anonymous. There will be no collection of names nor of any other data, such as IP addresses or dates of birth, that may lead to your identification. No response to the questionnaire will ever be published in its entirety nor in any detail that may lead to speculation over the identity of any one respondent. The data collected by this survey will only be published in combined forms and for the purpose of research into gender perceptions of STEM and comparisons across regions and groups.

Purpose of the Survey

The purpose of the survey is to compile basic data to inform policy development to reduce gender barriers in STEM and ultimately support better human development across the world. This pilot survey is part of a preliminary study that will eventually lead to development of gender indices related to women in STEM for Asia and for other global regions.

The output from this survey will be a report comparing gender perceptions across countries, by gender, by STEM specialisation, number of years of experience, etc. The intention is to carry out future similar surveys as part of a major longitudinal study.

Ownership and Accountability

This is a collaboration between the Korean Association of Women in Science and Engineering (KWSE) and the International Network of Women in Engineering and Science (INWES). INWES is accountable in Canadian to good practice in data protection and privacy.

The report from the GISE project 2021 survey, and any future reports based on this data, will be freely and openly shared by INWES and KWSE with policy-makers and anyone interested in these issues. The reports will be made available through their websites and/or on request.

Your task

Your participation in this research project consists of completing a questionnaire concerning your perceptions of gender in STEM. It is estimated that the questionnaire may take you from 30 to 40 minutes.

Your collaboration will contribute to the better understanding of the perceived gender barriers for women in STEM, and may lead to the advancement of evidence-based policy development.

Confidentiality

The data collected by this study is completely confidential and can in no case lead to your identification. Your privacy will be ensured by the absence of personal identifiers in the forms collected and in the use of online systems that do not collect IP addresses. Data collected will be kept electronically on systems accessible only to a limited number of permitted project members. All such project members will have signed a commitment to keeping this data private and secure, as required by INWES policies on conduct, ethics and confidentiality of information, and in accordance with Canadian regulations and EU GDPR regulations.

All data held will be strictly anonymous. Raw response data may be held for several years to be able to carry out comparisons over time. However, at no point will the data from a single response be published, nor will responses be shared with any third party. All reports shall include only data for clusters of samples.

Voluntary participation

Your participation in this survey is on a voluntary basis. You are entirely free to participate or not, to refuse to answer some questions or withdraw at any time without prejudice and without having to provide explanations. We may use the responses you provide to us even if there are incomplete sections.

Contact

For more information or for any questions regarding this research project, you can communicate by email with the Project Manager, Dr Sarah Peers sarah.peers@inwes.net

For more on the KWSE-INWES "Gender perceptions in Science and Engineering" project, please visit www.inwes.org/project_gise

For complaints about the survey or the project, please contact the INWES President, Prof Jung Sun Kim, by email: president@www.inwes.org or by post:

INWES c/o Carleton University,
1125 Colonel By Drive, 4456 Mackenzie Building,
Ottawa, ON,
K1S 5B6
Canada.
Telephone: + 1 (631) 644 1065
Fax: + 1 (631) 344 5584
E-mail: info@www.inwes.org

Your agreement

By submitting responses to the GISE Project questionnaire you indicate you have:
- read this information
- agreed to participate.

Summary of Survey Data

Questionnaire version	TOTAL INCLUDED	All Responses	Age range (year of birth)	Biological Sciences	Mechanical & Civil Engineering	IT/ Computer Science	ALL Sciences (inc. healthcare)	ALL Engineering	ALL Technology (inc. mathematics)	Female	Male
English	773	885	1948-2001	133	274	321	149	294	330	306	467
French	47	49	1958-1997	19	9	13	24	10	13	43	4
Japanese	90	90	1948-1996	52	9	13	64	12	14	70	20
Korean	110	117	1962-1996	55	24	25	61	24	25	93	17
Mongolian	87	107	1960-2000	14	21	26	28	29	30	62	25
Spanish	86	92	1950-1998	28	38	19	29	38	19	53	33
Paper test (English)	20	20		2	5	9	2	9	9	11	9
TOTALS	**1213**	**1360**		**303**	**380**	**426**	**357**	**416**	**440**	**638**	**575**

Questionnaire version	South Korea	India	Japan	Mon-golia	Kenya	Senegal	Tunisia	Mexico	Germany	Spain	ALL APNN	ALL ARN	ALL MENA	ALL Europe	ALL Americas
English	22	634	2	8	22	0	3	5	16	8	671	36	8	44	17
French	0	0	0	0	0	15	30	0	0	0	0	46	30	1	0
Japanese	0	1	88	0	0	0	0	0	0	0	89	0	0	1	0
Korean	110	0	0	0	0	0	0	0	0	0	110	0	0	0	0
Mongolian	0	0	2	83	0	0	0	0	0	0	85	0	0	1	1
Spanish	0	0	0	0	0	0	0	20	0	64	0	0	0	66	20
Paper test (English)	0	12	0	7	0	0	0	0	0	0	19	0	0	1	0
TOTALS	**132**	**647**	**92**	**98**	**22**	**15**	**33**	**25**	**16**	**72**	**974**	**82**	**38**	**114**	**38**
TOTAL Number of Countries reached				**26**	**And these were in the following regions of INWES**						**8**	**8**	**4**	**7**	**4**

Statistical Results

By gender

The tables below are the results of gender comparisons across the whole set of responses using t-tests.

The use of t-tests assumes both the normality of the distribution of the variable to be compared, and the homogeneity of the variance of that variable. For some of the twenty-six variables to be compared, one of these two conditions or even both conditions are not validated. There are alternative tests when these situations arise: such as a t-test with heterogeneous variance, a Wilcoxon test, or a Fligner-Policello test. Analyses were carried out using alternative tests as appropriate. The conclusions obtained from the alternative and most appropriate tests were always the same as the conclusions obtained with a t-test. So, to ensure a certain consistency between the different variables, the conclusions of the t-tests are shown below, because, even though the conditions underlying these tests are not always validated, the conclusion of the rejection/not-rejection of the hypothesis of equality of means is the same as the alternative test better suited to the distribution of variables.

Note that as men responded to Section D and women to Section C, these sections are not included in this comparison.

In the table below, any row in GREEN, RED or BLUE indicates where the p-value (the probability that the results occurred by chance) is very low, hence indicating the averages and standard deviations are not by chance. GREEN and RED are reserved for where the differences between the men and women are notable.

Data in GREEN are for statements where women are more likely to disagree than men. Data in RED are for statements where men are more likely to disagree with women.

Question		Female AVG	Male AVG	Female Std Deviation(SD)	Male Std Deviation(SD)	t	p
B	**Perception of 'gender barriers' in STEM**						
B1	Girls and boys are equally encouraged to choose any major/field of study in STEM during their education period.	2.42	1.86	1.309	1.067	8.096	0.000

Question		Female AVG	Male AVG	Female Std Deviation(SD)	Male Std Deviation(SD)	t	p
B2	Female students in STEM receive equally fair assessments and appraisals for their work, task, or project results, compared to their male counterparts in the same programs and levels.	2.39	1.88	1.261	1.053	7.586	0.000
B3	Women in STEM receive equal work distribution and work appraisals compared to men of the same qualifications and level.	2.70	2.03	1.287	1.127	9.664	0.000
B4	It is equally difficult for a woman as for a man to get a job in the STEM field with the same qualifications.	2.61	2.50	1.296	1.325	1.487	0.137
B5	Being promoted or becoming a tenured professor or a principal investigator is equally difficult for women in STEM as for men in STEM.	2.56	2.33	1.287	1.262	3.215	0.001
B6	Women in STEM generally receive equal pay for equal work, compared with their equally-qualified male colleagues.	2.67	2.10	1.322	1.177	7.943	0.000
E	**Perception of policy to overcome 'gender barriers'**						
E1	I believe things will turn out fine in the future career for women in STEM.	2.10	1.63	1.021	0.882	8.552	0.000
E2	It is crucial to have strong policy support to solve gender inequality in the STEM field.	1.55	1.82	0.804	1.032	-5.055	0.000

Question		Female AVG	Male AVG	Female Std Deviation(SD)	Male Std Deviation(SD)	t	p
E3	It is appropriate to introduce a quota system* or affirmative actions* to solve gender inequality in the STEM field	2.01	2.53	1.140	1.334	-7.377	0.000
F	**Perception of gender roles**						
F1	In a relative sense, men are rational while women are emotional, and thus they ought to complement each other by carrying out roles that are appropriate for their gender.	3.45	2.87	1.458	1.376	7.132	0.000
F2	Primary breadwinners (who take care of financial obligations) of households should be men.	4.05	3.43	1.269	1.387	8.176	0.000
F3	Women are born to be, or naturally able to care for children in a way that men are just not as capable.	3.59	3.10	1.417	1.399	6.057	0.000
F4	In order to maintain the order and peace of a family, the husband should have greater power and authority than the wife.	4.17	3.61	1.219	1.374	7.598	0.000
F5	I believe gender equality will be fully achieved only if women are given equal opportunities as men.	1.78	1.91	1.120	1.105	-2.117	0.034
G	**Perception of gender equality in study, research and work environments**						
G1	Women are equally granted or entrusted equal roles for their research or project or work performance at the laboratory and at work.	2.45	1.85	1.182	1.028	9.423	0.000

Question		Female AVG	Male AVG	Female Std Deviation(SD)	Male Std Deviation(SD)	t	p
G2	Women equally receive the appraisal or award for the outcome of their project or research or work.	2.59	1.85	1.233	1.004	11.367	0.000
G3	The strictness, objectiveness and importance of the research or task outcome are equally respected regardless of the sex/gender of the person in charge.	2.43	1.85	1.237	0.980	8.964	0.000
G4	Dealing with funders (those providing funding for research projects or those providing the budget for a work project), in terms of administrative or budget process, is equally fair regardless of the gender/sex of applicant or project leader.	2.53	2.00	1.184	1.051	8.332	0.000
G5	Women receive the same social evaluation and respect as men in their roles as scientists or engineers (by their colleagues, professor, managers, funding donors, academic association, scientific society, professional institution, etc.)	2.83	1.98	1.274	1.095	12.421	0.000
G6	Marriage, pregnancy or childcare have the same effect on scientist/engineer regardless of their gender/sex on their study, research or work performance.	3.51	2.71	1.442	1.353	9.989	0.000
G7	Female students in STEM are intimidated in the laboratory or in classes or in the workplace because they are female.	3.02	2.99	1.267	1.360	0.473	0.636

Question		Female AVG	Male AVG	Female Std Deviation(SD)	Male Std Deviation(SD)	t	p
H	**Perception of your STEM career**						
H1	On balance, my STEM career has progressed well so far.	2.22	1.96	1.038	0.954	4.597	0.000
H2	I am considered by colleagues to be either a leader in STEM, or on track for leadership.	2.34	2.20	1.042	0.981	2.432	0.015
H3	I have not been personally affected by gender barriers in STEM.	2.82	1.92	1.293	1.016	13.299	0.000
H4	My family /partner /friends are, on the whole, supportive of my STEM career.	1.76	1.68	0.959	0.880	1.358	0.175
H5	My current colleagues, managers, professors, are as supportive of me and my STEM career as of others in the same environment.	2.10	1.76	1.060	0.917	5.949	0.000

By areas of STEM focus

Comparisons using Analysis of Variance (ANOVA) of responses by area of STEM focus are shown below. As is the case with t-tests, ANOVA assumes normality of the distribution of the variable to be compared together with homogeneity of the variance of this variable for each group. These two conditions were not valid for some of the thirty-eight variables. Alternative tests were applied as needed and these confirmed the general conclusions based on the ANOVA results. The results therefore shown below are reliable, even where the conditions might not be met.

In the table below, any row in BLUE indicates where the p-value (the probability that the results occurred by chance) is very low, hence indicating the averages and standard deviations are not by chance and hence there are possible differences between the STEM areas.

When the p-value was low, further analyses were carried out and shown below. If two STEM areas share the same letter, they are not significantly different. If two areas do not share the same letter, they are significantly different. For example, for responses to B1, there is a difference between "Civil or Mechanical Engineering" (Eng) and

"Computing/Digital Technology" (IT), but there is no difference between "Civil or Mechanical Engineering" and "Biological Sciences"(Bio) and there is also no difference between "Biological Sciences" and "Computing/Digital Technology " .

Questions		Bio AVG	Eng AVG	IT AVG	Bio SD	Eng SD	IT SD	F	p	Analysis
B	**Perception of 'gender barriers' in STEM**									
B1	Girls and boys are equally encouraged to choose any major/field of study in STEM during their education period.	2.14	2.26	2.03	1.206	1.320	1.163	3.482	0.031	ANOVA with heterogeneous variance term for each area
B2	Female students in STEM receive equally fair assessments and appraisals for their work, task, or project results, compared to their male counterparts in the same programs and levels.	2.24	2.10	2.05	1.233	1.186	1.173	2.415	0.090	ANOVA
B3	Women in STEM receive equal work distribution and work appraisals compared to men of the same qualifications and level.	2.48	2.41	2.25	1.279	1.281	1.232	3.154	0.043	ANOVA
B4	It is equally difficult for a woman as for a man to get a job in the STEM field with the same qualifications.	2.47	2.57	2.59	1.265	1.335	1.331	0.796	0.451	ANOVA
B5	Being promoted or becoming a tenured professor or a principal investigator is equally difficult for women in STEM as for men in STEM.	2.39	2.54	2.42	1.297	1.310	1.268	1.345	0.261	ANOVA
B6	Women in STEM generally receive equal pay for equal work, compared with their equally-qualified male colleagues.	2.46	2.43	2.30	1.334	1.293	1.261	1.621	0.198	ANOVA
C	**Direct/Indirect experience of 'gender barriers'**									

Questions		Bio AVG	Eng AVG	IT AVG	Bio SD	Eng SD	IT SD	F	p	Analysis
C1	Women in STEM being disadvantaged in receiving promotions, grade appraisal, research funds or scholarships because she is female.	2.70	3.05	2.57	1.329	1.330	1.299	5.463	0.004	ANOVA
C2	Women in STEM being disadvantaged in participating or leading a research/work project or team because she is female.	2.73	2.98	2.59	1.295	1.352	1.200	3.603	0.028	ANOVA
C3	Women in STEM being sexually harassed (linguistical or physical) or treated unfairly by their colleagues/peers (in class, laboratory, team, at work, etc).	2.75	2.93	2.63	1.314	1.391	1.233	1.972	0.140	ANOVA
C4	Women in STEM being sexually harassed (linguistical or physical) or treated unfairly by their senior classmate, lab-mate or professor (in university laboratory or project group, etc), or senior colleagues or managers at work.	2.93	2.85	2.56	1.362	1.427	1.202	4.244	0.015	ANOVA
C5	Women in STEM being disadvantaged in accessing research/work equipment or information because she is female.	2.22	2.48	2.18	1.241	1.301	1.087	2.595	0.076	ANOVA with heterogeneous variance term for each area
C6	Women in STEM being in trouble or leaving study/work/research project due to her marriage, pregnancy or childcare.	3.32	3.24	2.90	1.218	1.228	1.263	6.230	0.002	ANOVA
D	**(Indirect) Experience of 'gender barriers' in STEM**									

Questions		Bio AVG	Eng AVG	IT AVG	Bio SD	Eng SD	IT SD	F	p	Analysis
D1	Women in STEM being disadvantaged in receiving promotions, grade appraisal, research funds or scholarships because she is female.	1.91	1.92	1.91	1.128	1.145	1.094	0.009	0.991	ANOVA
D2	Women in STEM being disadvantaged in participating or leading a research/work project or team because she is female.	1.90	1.92	1.88	1.150	1.165	1.097	0.070	0.933	ANOVA
D3	Women in STEM being sexually harassed (linguistical or physical) or treated unfairly by their colleagues/peers (in class, laboratory, team, at work, etc).	2.05	1.99	2.20	1.234	1.102	1.180	1.998	0.137	ANOVA
D4	Women in STEM being sexually harassed (linguistical or physical) or treated unfairly by their senior classmate or labmate or professor (in university laboratory, project group, etc) or senior colleagues or managers at work.	2.05	1.96	2.14	1.206	1.059	1.219	1.543	0.217	ANOVA with heterogeneous variance term for each area
D5	Women in STEM being disadvantaged in accessing research/work equipment or information because she is female.	1.60	1.80	1.80	1.042	1.092	1.110	0.845	0.430	ANOVA
D6	Women in STEM being in trouble or leaving study/work/research project due to her marriage, pregnancy or childcare.	2.40	2.35	2.39	1.401	1.332	1.325	0.045	0.956	ANOVA
E	**Perception of policy to overcome ‘gender barriers’**									

Questions		Bio AVG	Eng AVG	IT AVG	Bio SD	Eng SD	IT SD	F	p	Analysis
E1	I believe things will turn out fine in the future career for women in STEM.	2.04	1.87	1.76	1.032	0.999	0.922	7.199	0.001	ANOVA
E2	It is crucial to have strong policy support to solve gender inequality in the STEM field.	1.54	1.76	1.70	0.812	1.047	0.911	5.304	0.005	ANOVA with heterogeneous variance term for each area
E3	It is appropriate to introduce a quota system* or affirmative actions* to solve gender inequality in the STEM field	2.17	2.32	2.28	1.243	1.302	1.264	1.259	0.284	ANOVA
F	**Perception of gender roles**									
F1	In a relative sense, men are rational while women are emotional, and thus they ought to complement each other by carrying out roles that are appropriate for their gender.	3.39	3.08	3.09	1.481	1.414	1.461	4.943	0.007	ANOVA
F2	Primary breadwinners (who take care of financial obligations) of households should be men.	3.99	3.66	3.73	1.317	1.379	1.372	5.254	0.005	ANOVA
F3	Women are born to be, or naturally able to care for children in a way that men are just not as capable.	3.40	3.33	3.38	1.454	1.433	1.424	0.203	0.816	ANOVA
F4	In order to maintain the order and peace of a family, the husband should have greater power and authority than the wife.	4.08	3.83	3.88	1.319	1.325	1.343	3.198	0.041	ANOVA
F5	I believe gender equality will be fully achieved only if women are given equal opportunities as men.	1.79	1.82	1.85	1.113	1.083	1.161	0.284	0.753	ANOVA

Questions		Bio AVG	Eng AVG	IT AVG	Bio SD	Eng SD	IT SD	F	p	Analysis
G	**Perception of gender equality in study, research and work environments**									
G1	Women are equally granted or entrusted equal roles for their research or project or work performance at the laboratory and at work.	2.36	2.12	2.08	1.198	1.165	1.101	5.502	0.004	ANOVA
G2	Women equally receive the appraisal or award for the outcome of their project or research or work.	2.47	2.19	2.09	1.244	1.198	1.117	8.877	0.000	ANOVA with heterogeneous variance term for each area
G3	The strictness, objectiveness and importance of the research or task outcome are equally respected regardless of the sex/gender of the person in charge.	2.28	2.14	2.06	1.246	1.170	1.085	3.190	0.042	ANOVA with heterogeneous variance term for each area
G4	Dealing with funders (those providing funding for research projects or those providing the budget for a work project), in terms of administrative or budget process, is equally fair regardless of the gender/sex of applicant or project leader.	2.41	2.22	2.22	1.217	1.160	1.113	3.029	0.049	ANOVA
G5	Women receive the same social evaluation and respect as men in their roles as scientists or engineers (by their colleagues, professor, managers, funding donors, academic association, scientific society, professional institution, etc.)	2.67	2.41	2.25	1.288	1.273	1.234	10.132	0.000	ANOVA

Questions		Bio AVG	Eng AVG	IT AVG	Bio SD	Eng SD	IT SD	F	p	Analysis
G6	Marriage, pregnancy or childcare have the same effect on scientist/engineer regardless of their gender/sex on their study, research or work performance.	3.51	3.03	2.99	1.455	1.421	1.460	13.776	0.000	ANOVA
G7	Female students in STEM are intimidated in the laboratory or in classes or in the workplace because they are female.	3.08	2.87	3.03	1.370	1.284	1.303	2.483	0.084	ANOVA
H	**Perception of your STEM career**									
H1	On balance, my STEM career has progressed well so far.	2.16	2.09	2.03	1.013	1.032	0.985	1.473	0.230	ANOVA
H2	I am considered by colleagues to be either a leader in STEM, or on track for leadership.	2.33	2.24	2.25	1.053	1.021	0.992	0.752	0.472	ANOVA
H3	I have not been personally affected by gender barriers in STEM.	2.62	2.28	2.26	1.309	1.235	1.194	8.908	0.000	ANOVA
H4	My family /partner /friends are, on the whole, supportive of my STEM career.	1.69	1.71	1.70	0.903	0.923	0.934	0.022	0.978	ANOVA
H5	My current colleagues, managers, professors, are as supportive of me and my STEM career as of others in the same environment.	1.98	1.92	1.87	1.036	1.003	0.977	1.146	0.318	ANOVA

Bonferroni Grouping for STEM Specialism Least Squares Means (Alpha=0.05)			
Within a question: LS-means with the same letter are not significantly different.			
STEM_Specialism	**Estimate**		
Question B1			
Bio	2.1353	B	A
Eng	2.2579		A

Bonferroni Grouping for STEM Specialism Least Squares Means (Alpha=0.05)			
Within a question: LS-means with the same letter are not significantly different.			
STEM_Specialism	**Estimate**		
IT	2.0258	B	
Question B3			
Bio	2.4818		A
Eng	2.4053	B	A
IT	2.2535	B	
Question C1			
Bio	2.7008	B	
Eng	3.0511		A
IT	2.5683	B	
Question C2			
Bio	2.7336	B	A
Eng	2.9779		A
IT	2.5902	B	
Question C4			
Bio	2.9262		A
Eng	2.8540	B	A
IT	2.5574	B	
Question C6			
Bio	3.3156		A
Eng	3.2409		A
IT	2.9016	B	
Question E1			
Bio	2.0396		A
Eng	1.8658	B	A
IT	1.7606	B	
Question E2			
Bio	1.5446	B	
Eng	1.7605		A
IT	1.7042		A
Question F1			
Bio	3.3927		A
Eng	3.0789	B	
IT	3.0915	B	
Question F2			
Bio	3.9868		A
Eng	3.6605	B	
IT	3.7300	B	
Question F4			

Bonferroni Grouping for STEM Specialism Least Squares Means (Alpha=0.05)			
Within a question: LS-means with the same letter are not significantly different.			
STEM_Specialism	**Estimate**		
Bio	4.0759		A
Eng	3.8289	B	
IT	3.8756	B	A
Question G1			
Bio	2.3564		A
Eng	2.1211	B	
IT	2.0845	B	
Question G2			
Bio	2.4686		A
Eng	2.1895	B	
IT	2.0939	B	
Question G3			
Bio	2.2805		A
Eng	2.1447	B	A
IT	2.0563	B	
Question G4			
Bio	2.4092		A
Eng	2.2158		A
IT	2.2183		A
Question G5			
Bio	2.6733		A
Eng	2.4132	B	
IT	2.2465	B	
Question G6			
Bio	3.5149		A
Eng	3.0263	B	
IT	2.9859	B	
Question H3			
Bio	2.6205		A
Eng	2.2763	B	
IT	2.2606	B	

Comparison of South Korea vs all other regions/countries

The results below are comparisons between South Korea and the rest of the world (ROW) applying t-tests.

In the table below, any row in GREEN indicates where the p-value (the probability that the results occurred by chance) is very low, hence indicating the averages and standard deviations are not by chance.

Question	ROW Average	South Korea Average	ROW Std Deviation(SD)	South Korea Std Deviation(SD)	t	p
B1	2.16	2.13	1.246	1.115	0.291	0.771
B2	2.16	2.02	1.206	1.084	1.317	0.188
B3	2.35	2.63	1.268	1.162	-2.401	0.017
B4	2.54	2.72	1.320	1.219	-1.486	0.137
B5	2.42	2.73	1.278	1.267	-2.633	0.009
B6	2.36	2.70	1.283	1.290	-2.810	0.005
C1	2.65	3.15	1.314	1.283	-3.606	0.000
C2	2.62	3.18	1.298	1.218	-4.165	0.000
C3	2.72	3.02	1.322	1.262	-2.178	0.030
C4	2.70	3.24	1.343	1.276	-3.825	0.000
C5	2.21	2.54	1.202	1.221	-2.610	0.009
C6	3.11	3.56	1.279	1.013	-3.484	0.001
D1	1.90	2.18	1.103	1.220	-1.156	0.248
D2	1.89	1.86	1.114	1.207	0.104	0.917
D3	2.10	2.17	1.158	1.267	-0.297	0.766
D4	2.05	2.32	1.153	1.171	-1.051	0.294
D5	1.78	1.77	1.100	1.020	0.014	0.989
D6	2.35	2.96	1.327	1.224	-2.139	0.033
E1	1.84	2.21	0.974	1.019	-4.165	0.000
E2	1.67	1.75	0.923	0.976	-0.959	0.338
E3	2.27	2.15	1.263	1.257	0.995	0.320
F1	3.09	3.83	1.441	1.345	-5.558	0.000
F2	3.68	4.41	1.392	0.847	-5.887	0.000
F3	3.33	3.51	1.431	1.411	-1.311	0.190
F4	3.84	4.45	1.353	0.894	-5.051	0.000
F5	1.82	1.99	1.112	1.129	-1.665	0.096
G1	2.12	2.55	1.143	1.148	-4.086	0.000
G2	2.20	2.55	1.186	1.175	-3.148	0.002
G3	2.12	2.48	1.144	1.232	-3.364	0.001
G4	2.25	2.54	1.151	1.155	-2.732	0.006
G5	2.41	2.61	1.272	1.196	-1.723	0.085
G6	3.02	4.06	1.446	1.190	-7.949	0.000
G7	3.01	3.01	1.323	1.220	-0.009	0.993

Question	ROW Average	South Korea Average	ROW Std Deviation(SD)	South Korea Std Deviation(SD)	t	p
H1	2.08	2.29	1.010	0.969	-2.287	0.022
H2	2.26	2.38	1.022	0.953	-1.250	0.212
H3	2.35	2.80	1.245	1.240	-3.925	0.000
H4	1.73	1.64	0.927	0.885	1.121	0.262
H5	1.93	2.01	1.008	1.015	-0.827	0.408

Statistical Results by Country/Region

For each of the following countries/regions

1. men vs women
2. a 3-way comparison of biology vs civil/mech engineering vs digital technologies

As before, any row in GREEN or BLUE indicates where the p-value (the probability that the results occurred by chance) is very low, hence indicating the averages and standard deviations are not by chance.

As for the global comparisons of STEM Focus, when the p-value was low for the STEM areas, further analyses were carried out and shown below. If two STEM areas share the same letter, they are not significantly different. If two areas do not share the same letter, they are significantly different.

South Korea (Men vs Women)

Question	Female AVG	Male AVG	Female Std Deviation(SD)	Male Std Deviation(SD)	t	p
B1	2.17	1.96	1.151	0.928	0.814	0.417
B2	2.08	1.70	1.131	0.765	1.564	0.120
B3	2.71	2.26	1.157	1.137	1.683	0.095
B4	2.66	3.00	1.188	1.348	-1.216	0.226
B5	2.66	3.04	1.249	1.331	-1.321	0.189
B6	2.75	2.43	1.292	1.273	1.074	0.285
E1	2.28	1.91	1.008	1.041	1.557	0.122
E2	1.60	2.48	0.806	1.344	-4.179	0.000
E3	1.91	3.30	1.135	1.185	-5.321	0.000
F1	3.87	3.61	1.355	1.305	0.851	0.396
F2	4.44	4.26	0.865	0.752	0.923	0.358
F3	3.57	3.22	1.443	1.242	1.086	0.280
F4	4.50	4.22	0.899	0.850	1.360	0.176
F5	2.01	1.91	1.182	0.848	0.370	0.712
G1	2.65	2.09	1.150	1.041	2.173	0.032

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Question	Female AVG	Male AVG	Female Std Deviation(SD)	Male Std Deviation(SD)	t	p
G2	2.70	1.83	1.167	0.937	3.357	0.001
G3	2.62	1.78	1.238	0.951	3.069	0.003
G4	2.65	2.00	1.142	1.087	2.506	0.013
G5	2.77	1.83	1.183	0.937	3.594	0.000
G6	4.23	3.26	1.119	1.214	3.716	0.000
G7	2.94	3.30	1.201	1.295	-1.287	0.200
H1	2.34	2.04	0.964	0.976	1.335	0.184
H2	2.42	2.17	0.926	1.072	1.135	0.258
H3	3.03	1.70	1.182	0.876	5.109	0.000
H4	1.68	1.43	0.932	0.590	1.205	0.231
H5	2.09	1.61	1.041	0.783	2.101	0.038

South Korea (Bio vs Eng vs IT)

Question	Bio AVG	Eng AVG	IT AVG	Bio AVG	Eng AVG	IT AVG	F	p	Analysis
B1	1.95	2.19	2.30	1.105	0.981	1.222	1.201	0.305	ANOVA
B2	1.93	1.81	2.16	0.998	0.981	1.259	0.914	0.404	ANOVA
B3	2.44	2.38	3.03	1.087	1.061	1.280	3.610	0.030	ANOVA
B4	2.69	2.81	2.78	1.290	1.234	1.158	0.100	0.905	ANOVA
B5	2.63	2.65	3.00	1.325	1.325	1.202	1.036	0.358	ANOVA
B6	2.63	2.54	2.97	1.401	1.104	1.301	1.081	0.343	ANOVA
C1	3.00	3.94	3.04	1.250	1.063	1.319	3.733	0.027	ANOVA
C2	2.91	3.63	3.39	1.195	1.204	1.166	2.995	0.055	ANOVA
C3	2.89	3.19	3.18	1.260	1.276	1.307	0.632	0.534	ANOVA
C4	3.27	3.50	3.14	1.286	1.366	1.297	0.383	0.683	ANOVA
C5	2.32	3.38	2.46	1.146	1.310	1.232	4.881	0.010	ANOVA
C6	3.73	3.44	3.32	0.774	0.964	1.307	1.550	0.227	ANOVA with heterogeneous variance term for each area
D1	1.67	2.40	2.13	0.577	1.578	0.991	0.390	0.683	ANOVA
D2	1.33	1.70	2.38	0.577	1.337	1.188	1.070	0.364	ANOVA
D3	3.33	1.80	2.22	1.528	1.229	1.202	1.736	0.203	ANOVA
D4	3.67	1.60	2.75	0.577	0.966	1.035	6.573	0.007	ANOVA
D5	1.67	1.60	2.13	1.155	0.843	1.246	0.585	0.567	ANOVA
D6	2.33	2.90	3.22	0.577	1.524	1.093	0.559	0.581	ANOVA
E1	2.17	1.96	2.43	0.985	1.038	1.094	1.662	0.194	ANOVA
E2	1.58	2.19	1.59	0.770	1.201	0.865	2.962	0.060	ANOVA with heterogeneous variance term for each area
E3	1.97	2.54	2.11	1.259	1.240	1.173	1.964	0.145	ANOVA
F1	3.98	3.81	3.73	1.252	1.266	1.521	0.439	0.645	ANOVA

Question	Bio AVG	Eng AVG	IT AVG	Bio AVG	Eng AVG	IT AVG	F	p	Analysis
F2	4.46	4.54	4.38	0.816	0.647	0.893	0.303	0.739	ANOVA
F3	3.41	3.65	3.68	1.452	1.413	1.355	0.516	0.598	ANOVA
F4	4.54	4.46	4.41	0.837	0.905	0.927	0.286	0.752	ANOVA
F5	1.88	2.12	2.08	1.100	1.211	1.187	0.533	0.588	ANOVA
G1	2.53	2.42	2.76	1.120	1.238	1.164	0.732	0.483	ANOVA
G2	2.56	2.42	2.73	1.118	1.301	1.239	0.523	0.594	ANOVA
G3	2.41	2.46	2.70	1.233	1.334	1.199	0.694	0.504	ANOVA with heterogeneous variance term for each area
G4	2.47	2.35	2.89	1.150	1.198	1.100	2.161	0.120	ANOVA
G5	2.58	2.54	2.81	1.192	1.303	1.175	0.541	0.584	ANOVA
G6	4.31	3.77	4.00	0.969	1.210	1.354	2.157	0.120	ANOVA
G7	3.24	2.92	2.68	1.250	1.262	1.107	2.510	0.086	ANOVA
H1	2.10	2.08	2.62	0.736	0.845	1.187	3.052	0.055	ANOVA with heterogeneous variance term for each area
H2	2.25	2.12	2.68	0.883	0.766	1.180	2.673	0.077	ANOVA with heterogeneous variance term for each area
H3	2.86	2.38	2.92	1.137	1.235	1.320	1.759	0.177	ANOVA
H4	1.51	1.58	1.70	0.796	0.758	0.878	0.648	0.525	ANOVA
H5	1.88	1.96	2.14	0.930	0.958	1.084	0.758	0.471	ANOVA

Bonferroni Grouping for STEM Specialism Least Squares Means (Alpha=0.05)			
Within a question: LS-means with the same letter are not significantly different.			
STEM_Specialism	Estimate		
Question B3 (NB LINES display does not reflect all significant comparisons. This pair is significantly different (IT,Bio))			
Bio	2.4407		A
Eng	2.3846		A
IT	3.0270		A
Question C1			
Bio	3.0000	B	
Eng	3.9375		A
IT	3.0357	B	A
Question C5			
Bio	2.3214	B	
Eng	3.3750		A
IT	2.4643	B	
Question D4			

Bonferroni Grouping for STEM Specialism Least Squares Means (Alpha=0.05)			
Within a question: LS-means with the same letter are not significantly different.			
STEM_Specialism	Estimate		
Bio	3.6667		A
Eng	1.6000	B	
IT	2.7500	B	A

India (Men vs Women)

Question	Female AVG	Male AVG	Female Std Deviation(SD)	Male Std Deviation(SD)	t	p
B1	2.32	1.81	1.264	1.013	5.536	0.000
B2	2.36	1.86	1.178	1.030	5.590	0.000
B3	2.45	2.04	1.236	1.122	4.261	0.000
B4	2.23	2.43	1.171	1.302	-1.971	0.049
B5	2.16	2.22	1.115	1.193	-0.613	0.540
B6	2.46	2.05	1.236	1.129	4.220	0.000
E1	1.89	1.61	0.880	0.859	3.916	0.000
E2	1.65	1.72	0.859	0.948	-0.869	0.385
E3	2.26	2.49	1.213	1.315	-2.093	0.037
F1	2.94	2.65	1.450	1.331	2.529	0.012
F2	3.81	3.27	1.401	1.386	4.674	0.000
F3	3.47	3.09	1.408	1.402	3.323	0.001
F4	3.91	3.47	1.398	1.400	3.759	0.000
F5	1.69	1.88	1.103	1.068	-2.167	0.031
G1	2.24	1.83	1.049	1.003	4.856	0.000
G2	2.31	1.87	1.077	1.017	5.162	0.000
G3	2.18	1.86	1.021	0.950	3.935	0.000
G4	2.39	1.99	1.079	1.026	4.612	0.000
G5	2.57	1.94	1.189	1.050	6.882	0.000
G6	3.18	2.60	1.433	1.334	5.030	0.000
G7	2.79	2.84	1.220	1.304	-0.441	0.659
H1	2.12	1.93	0.977	0.908	2.384	0.017
H2	2.25	2.14	0.931	0.945	1.396	0.163
H3	2.41	1.96	1.187	1.009	5.039	0.000
H4	1.85	1.74	1.008	0.915	1.462	0.144
H5	1.92	1.78	0.924	0.913	1.777	0.076

India (Bio vs Eng vs IT)

Question	Bio AVG	Eng AVG	IT AVG	Bio SD	Eng SD	IT SD	F	p	Analysis
B1	1.95	2.03	1.94	1.051	1.200	1.116	0.359	0.698	ANOVA
B2	2.12	2.02	1.98	1.096	1.113	1.125	0.546	0.580	ANOVA
B3	2.26	2.26	2.08	1.163	1.222	1.155	1.676	0.188	ANOVA
B4	2.17	2.32	2.44	1.076	1.295	1.296	2.178	0.115	ANOVA with heterogeneous variance term for each area
B5	2.05	2.27	2.19	1.079	1.211	1.169	1.339	0.263	ANOVA
B6	2.28	2.20	2.12	1.208	1.196	1.181	0.840	0.432	ANOVA
C1	2.17	2.41	2.22	1.175	1.148	1.126	0.598	0.551	ANOVA
C2	2.38	2.52	2.28	1.126	1.406	1.033	0.595	0.553	ANOVA with heterogeneous variance term for each area
C3	2.42	2.64	2.37	1.193	1.313	1.078	0.821	0.441	ANOVA
C4	2.51	2.34	2.34	1.232	1.311	1.035	0.468	0.628	ANOVA with heterogeneous variance term for each area
C5	2.19	2.39	2.13	1.240	1.316	1.022	0.640	0.530	ANOVA with heterogeneous variance term for each area
C6	2.86	2.84	2.63	1.375	1.311	1.187	0.759	0.470	ANOVA
D1	1.70	1.85	1.85	1.132	1.090	1.048	0.317	0.728	ANOVA
D2	1.88	1.86	1.83	1.166	1.106	1.072	0.056	0.946	ANOVA
D3	1.85	1.99	2.17	1.202	1.048	1.171	1.753	0.175	ANOVA
D4	1.82	1.92	2.08	1.074	0.989	1.206	1.224	0.299	ANOVA with heterogeneous variance term for each area
D5	1.61	1.83	1.75	1.144	1.116	1.087	0.637	0.529	ANOVA
D6	2.06	2.28	2.32	1.298	1.339	1.361	0.531	0.588	ANOVA
E1	1.75	1.73	1.66	0.801	0.913	0.863	0.678	0.508	ANOVA
E2	1.61	1.71	1.70	0.831	0.974	0.922	0.453	0.636	ANOVA
E3	2.49	2.38	2.39	1.290	1.275	1.306	0.249	0.779	ANOVA
F1	2.68	2.62	2.90	1.429	1.279	1.447	2.756	0.064	ANOVA
F2	3.41	3.31	3.60	1.445	1.407	1.420	2.727	0.066	ANOVA
F3	3.15	3.14	3.31	1.389	1.404	1.452	1.053	0.350	ANOVA
F4	3.52	3.53	3.74	1.533	1.379	1.408	1.673	0.188	ANOVA
F5	1.73	1.79	1.84	1.050	0.998	1.163	0.387	0.679	ANOVA
G1	2.13	1.90	1.94	1.063	1.024	1.036	1.706	0.182	ANOVA
G2	2.30	1.96	1.94	1.170	1.040	1.028	4.752	0.009	ANOVA
G3	2.08	1.93	1.92	1.026	0.984	0.973	1.096	0.335	ANOVA
G4	2.26	2.07	2.09	1.111	1.085	1.044	1.233	0.292	ANOVA
G5	2.50	2.13	2.05	1.195	1.116	1.130	6.122	0.002	ANOVA

Question	Bio AVG	Eng AVG	IT AVG	Bio SD	Eng SD	IT SD	F	p	Analysis
G6	3.01	2.69	2.84	1.438	1.357	1.415	2.005	0.135	ANOVA
G7	2.64	2.67	2.98	1.187	1.227	1.334	4.865	0.008	ANOVA
H1	2.18	1.97	1.93	0.947	0.984	0.901	2.883	0.057	ANOVA
H2	2.42	2.10	2.15	0.965	0.952	0.931	4.101	0.017	ANOVA
H3	2.29	2.00	2.12	1.143	1.057	1.104	2.565	0.078	ANOVA
H4	1.94	1.78	1.70	0.978	0.943	0.945	2.562	0.078	ANOVA
H5	1.95	1.80	1.77	0.933	0.900	0.914	1.506	0.223	ANOVA

Bonferroni Grouping for STEM Specialism Least Squares Means (Alpha=0.05)			
Within a question: LS-means with the same letter are not significantly different.			
STEM Specialism	**Estimate**		
Question G2			
Bio	2.3010		A
Eng	1.9565	B	
IT	1.9441	B	
Question G5			
Bio	2.5049		A
Eng	2.1261	B	
IT	2.0524	B	
Question G7 (NB LINES display does not reflect all significant comparisons.This pair is significantly different (IT,Eng))			
Bio	2.6408		A
Eng	2.6739		A
IT	2.9825		A
Question H2			
Bio	2.4175		A
Eng	2.1043	B	
IT	2.1538	B	

Mongolia (Men vs Women)

Question	Female AVG	Male AVG	Female Std Deviation(SD)	Male Std Deviation(SD)	t	p
B1	2.46	1.90	1.202	1.185	2.119	0.037
B2	2.50	2.07	1.178	1.285	1.632	0.106
B3	2.68	2.00	1.165	1.017	2.750	0.007
B4	2.41	2.97	1.109	1.159	-2.251	0.027
B5	2.43	3.13	1.027	1.279	-2.908	0.005
B6	2.72	2.13	1.157	1.074	2.366	0.020
E1	1.66	1.57	0.725	0.858	0.565	0.573

Question	Female AVG	Male AVG	Female Std Deviation(SD)	Male Std Deviation(SD)	t	p
E2	1.53	2.10	0.680	0.845	-3.549	0.001
E3	1.87	2.10	0.896	0.960	-1.158	0.250
F1	2.81	2.80	1.069	0.887	0.040	0.969
F2	3.10	2.83	1.135	1.053	1.107	0.271
F3	2.74	2.20	1.180	0.961	2.184	0.031
F4	3.57	3.30	1.137	1.055	1.121	0.265
F5	2.00	2.47	0.881	0.730	-2.540	0.013
G1	1.94	1.87	0.844	0.860	0.400	0.690
G2	2.26	1.73	0.940	0.907	2.606	0.011
G3	2.21	1.93	0.923	0.944	1.337	0.184
G4	2.32	2.07	0.905	0.944	1.278	0.204
G5	2.43	2.00	1.012	0.947	1.960	0.053
G6	2.90	2.43	1.148	1.104	1.864	0.065
G7	3.10	3.37	1.039	1.326	-1.062	0.291
H1	2.38	2.07	1.008	1.015	1.426	0.157
H2	2.46	2.53	0.937	0.860	-0.386	0.700
H3	2.79	2.83	1.140	1.206	-0.154	0.878
H4	2.10	1.80	0.979	0.714	1.523	0.131
H5	2.22	1.90	0.960	0.845	1.579	0.118

Mongolia (Bio vs Eng vs IT)

NB Blank cells indicate where there were no/too few responses.

Question	Bio AVG	Eng AVG	IT AVG	Bio SD	Eng SD	IT SD	F	p	Analysis
B1	2.25	2.33	2.03	1.291	1.278	1.197	0.403	0.670	ANOVA
B2	2.31	2.24	2.19	1.250	1.300	1.250	0.047	0.954	ANOVA
B3	2.44	2.43	2.45	1.031	1.399	1.121	0.002	0.998	ANOVA
B4	2.50	2.62	2.58	1.211	1.071	1.285	0.045	0.956	ANOVA
B5	2.56	2.57	2.84	1.263	1.121	1.319	0.398	0.673	ANOVA
B6	2.19	2.57	2.52	1.223	1.248	1.122	0.550	0.580	ANOVA
C1	2.44	2.44	2.44	0.964	1.236	1.031	0.000	1.000	ANOVA
C2	1.88	2.13	2.13	1.088	0.991	0.806	0.323	0.726	ANOVA
C3	2.19	2.44	2.13	1.276	1.590	1.088	0.187	0.830	ANOVA
C4	1.94	2.11	1.94	1.237	1.364	0.929	0.079	0.924	ANOVA
C5	1.94	2.22	2.00	1.124	1.302	0.894	0.206	0.815	ANOVA
C6	2.75	3.78	3.44	1.291	1.093	1.413	2.082	0.139	ANOVA
D1	.	2.33	1.93	.	0.888	1.223	0.968	0.335	ANOVA with heterogeneous variance term for each area

Question	Bio AVG	Eng AVG	IT AVG	Bio SD	Eng SD	IT SD	F	p	Analysis
D2	.	2.17	1.93	.	0.835	1.335	0.308	0.584	ANOVA with heterogeneous variance term for each area
D3	.	1.92	1.93	.	0.996	1.163	0.002	0.969	ANOVA
D4	.	2.08	2.13	.	1.084	1.356	0.011	0.918	ANOVA
D5	.	1.92	1.93	.	0.793	1.163	0.002	0.965	ANOVA with heterogeneous variance term for each area
D6	.	3.00	2.80	.	0.953	1.014	0.273	0.606	ANOVA
E1	1.50	1.71	1.48	0.730	0.902	0.626	0.525	0.596	ANOVA with heterogeneous variance term for each area
E2	1.50	1.57	2.00	0.730	0.676	0.856	2.995	0.057	ANOVA
E3	1.88	1.67	2.06	1.088	0.796	0.892	1.192	0.310	ANOVA
F1	2.50	2.81	2.77	1.211	0.814	0.884	0.573	0.567	ANOVA
F2	2.69	3.05	3.10	1.138	0.865	1.274	0.738	0.482	ANOVA
F3	2.50	2.33	2.68	1.211	1.017	1.137	0.599	0.553	ANOVA
F4	3.25	3.62	3.55	1.125	1.071	1.150	0.546	0.582	ANOVA
F5	1.94	2.29	2.19	0.929	0.784	0.833	0.726	0.491	ANOVA with heterogeneous variance term for each area
G1	2.00	1.90	2.03	1.211	0.831	0.706	0.163	0.850	ANOVA with heterogeneous variance term for each area
G2	2.19	1.95	2.06	1.047	0.973	0.892	0.276	0.759	ANOVA
G3	2.13	1.90	2.10	1.088	0.700	0.978	0.346	0.709	ANOVA
G4	2.06	2.19	2.32	0.998	0.814	0.979	0.423	0.657	ANOVA
G5	2.00	2.14	2.45	1.033	0.793	1.179	1.157	0.321	ANOVA
G6	2.75	2.38	2.77	1.291	0.805	1.230	1.140	0.331	ANOVA with heterogeneous variance term for each area
G7	2.81	3.00	3.29	1.471	1.183	1.006	0.947	0.393	ANOVA
H1	2.31	2.24	2.32	1.138	1.091	1.107	0.039	0.962	ANOVA
H2	2.25	2.48	2.61	1.125	0.928	0.803	0.814	0.448	ANOVA
H3	3.00	2.90	2.81	1.211	1.221	1.078	0.154	0.858	ANOVA
H4	2.19	1.81	2.19	1.167	0.680	0.980	1.604	0.216	ANOVA with heterogeneous variance term for each area
H5	2.31	1.86	2.32	1.078	0.793	1.045	1.604	0.209	ANOVA

Europe (Men vs. Women)

Question	Female AVG	Male AVG	Female Std Deviation(SD)	Male Std Deviation(SD)	t	p
B1	3.15	2.15	1.467	1.372	3.350	0.001
B2	2.83	1.73	1.395	1.069	4.066	0.000
B3	3.30	1.64	1.391	1.084	6.131	0.000
B4	3.49	2.03	1.266	1.237	5.634	0.000
B5	3.58	1.97	1.322	1.334	5.885	0.000
B6	3.51	2.30	1.286	1.510	4.304	0.000
E1	2.40	1.55	1.126	0.905	3.855	0.000
E2	1.62	2.45	0.995	1.523	-3.465	0.001
E3	2.32	3.09	1.273	1.588	-2.720	0.008
F1	4.41	4.12	1.104	1.083	1.262	0.210
F2	4.85	4.58	0.503	1.032	1.920	0.057
F3	4.51	3.91	0.924	1.444	2.634	0.010
F4	4.84	4.58	0.580	1.091	1.677	0.096
F5	1.36	1.52	0.913	1.202	-0.758	0.450
G1	2.96	1.88	1.336	1.193	4.048	0.000
G2	3.32	1.85	1.368	1.149	5.447	0.000
G3	3.19	1.64	1.324	0.994	6.054	0.000
G4	2.90	1.97	1.338	1.159	3.499	0.001
G5	3.54	2.27	1.304	1.353	4.667	0.000
G6	4.16	3.45	1.229	1.325	2.718	0.008
G7	3.19	3.70	1.236	1.447	-1.907	0.059
H1	2.15	2.15	1.205	1.228	-0.013	0.989
H2	2.31	2.58	1.158	1.251	-1.091	0.277
H3	3.17	1.33	1.447	0.645	7.008	0.000
H4	1.44	1.39	0.837	0.747	0.301	0.764
H5	2.30	1.55	1.289	0.971	3.013	0.003

Europe (Bio vs. Eng vs. IT)

Question	Bio AVG	Eng AVG	IT AVG	Bio SD	Eng SD	IT SD	F	p	Analysis
B1	2.42	3.10	2.62	1.402	1.546	1.325	2.552	0.083	ANOVA
B2	2.33	2.54	2.69	1.352	1.385	1.548	0.405	0.668	ANOVA
B3	2.58	2.90	2.92	1.628	1.457	1.441	0.549	0.579	ANOVA
B4	2.81	3.13	3.31	1.348	1.408	1.548	0.864	0.424	ANOVA
B5	3.00	3.13	3.23	1.512	1.511	1.589	0.139	0.871	ANOVA
B6	2.89	3.33	3.23	1.526	1.411	1.423	1.048	0.354	ANOVA
C1	3.00	3.50	3.44	1.330	1.174	1.667	1.248	0.309	ANOVA with heterogeneous variance term for each area
C2	3.37	3.24	3.33	1.305	1.206	1.000	0.101	0.904	ANOVA

Question	Bio AVG	Eng AVG	IT AVG	Bio SD	Eng SD	IT SD	F	p	Analysis
C3	2.59	3.19	3.67	1.279	1.550	0.866	2.523	0.087	ANOVA
C4	2.70	3.17	3.33	1.409	1.497	1.225	1.082	0.344	ANOVA
C5	2.37	2.50	2.67	1.363	1.215	1.118	0.206	0.814	ANOVA
C6	3.26	3.50	3.11	1.095	1.194	1.269	0.601	0.551	ANOVA
D1	2.22	2.11	1.75	1.202	1.243	0.957	0.215	0.808	ANOVA
D2	1.56	2.21	1.75	0.726	1.398	0.500	1.269	0.316	ANOVA with heterogeneous variance term for each area
D3	2.33	2.00	3.00	1.323	1.414	1.826	0.838	0.443	ANOVA
D4	1.89	2.11	2.00	1.054	1.243	1.414	0.099	0.906	ANOVA
D5	1.56	1.68	1.50	0.882	0.946	0.577	0.137	0.874	ANOVA with heterogeneous variance term for each area
D6	2.67	2.37	1.25	1.323	1.212	0.500	2.009	0.152	ANOVA
E1	1.89	2.30	1.85	0.950	1.202	0.899	1.988	0.142	ANOVA
E2	1.69	2.02	1.77	1.142	1.372	0.725	0.822	0.442	ANOVA
E3	2.81	2.49	2.38	1.305	1.501	1.261	0.701	0.499	ANOVA
F1	4.44	4.49	3.38	0.969	0.906	1.660	6.344	0.002	ANOVA
F2	4.89	4.82	4.23	0.398	0.563	1.481	1.364	0.272	ANOVA with heterogeneous variance term for each area
F3	4.67	4.36	3.38	0.894	1.065	1.446	6.947	0.001	ANOVA
F4	4.94	4.74	4.31	0.232	0.794	1.377	3.000	0.066	ANOVA with heterogeneous variance term for each area
F5	1.22	1.48	1.38	0.832	1.043	0.870	0.788	0.457	ANOVA
G1	2.47	2.74	2.69	1.383	1.401	1.377	0.420	0.658	ANOVA
G2	2.72	3.02	2.69	1.466	1.432	1.548	0.587	0.558	ANOVA
G3	2.61	2.82	2.77	1.440	1.455	1.235	0.244	0.784	ANOVA
G4	2.64	2.54	2.77	1.334	1.361	1.423	0.173	0.841	ANOVA
G5	3.11	3.30	2.69	1.430	1.406	1.548	0.987	0.376	ANOVA
G6	3.67	4.15	3.92	1.474	1.138	1.382	1.593	0.208	ANOVA
G7	3.56	3.23	3.31	1.252	1.296	1.494	0.712	0.493	ANOVA
H1	2.00	2.26	2.08	1.373	1.168	1.115	0.541	0.584	ANOVA
H2	2.36	2.49	2.15	1.268	1.164	1.214	0.464	0.630	ANOVA
H3	2.11	2.87	2.85	1.450	1.544	1.345	3.128	0.057	ANOVA with heterogeneous variance term for each area
H4	1.39	1.33	1.54	0.838	0.651	0.776	0.457	0.634	ANOVA
H5	2.08	2.15	1.69	1.461	1.195	0.855	1.310	0.282	ANOVA with heterogeneous variance term for each area

Bonferroni Grouping for STEM Specialism Least Squares Means (Alpha=0.05)			
Within a question: LS-means with the same letter are not significantly different.			
STEM_Specialism	**Estimate**		
Question F1			
Bio	4.4444		A
Eng	4.4918		A
IT	3.3846	B	
Question F3			
Bio	4.6667		A
Eng	4.3607		A
IT	3.3846	B	

Japan (Men vs. Women)

Question	Female AVG	Male AVG	Female Std Deviation(SD)	Male Std Deviation(SD)	t	p
B1	2.62	2.09	1.296	0.900	1.839	0.069
B2	**2.68**	**1.91**	**1.334**	**1.041**	**2.515**	**0.014**
B3	**2.97**	**2.04**	**1.283**	**1.261**	**3.015**	**0.003**
B4	2.49	3.04	1.279	1.522	-1.704	0.092
B5	2.35	2.70	1.258	1.428	-1.110	0.270
B6	2.78	2.13	1.327	1.359	2.029	0.045
E1	**2.84**	**1.96**	**1.093**	**0.928**	**3.480**	**0.001**
E2	1.67	2.00	0.741	1.087	-1.650	0.102
E3	**1.97**	**2.70**	**1.057**	**1.428**	**-2.598**	**0.011**
F1	4.04	3.83	1.181	1.114	0.775	0.440
F2	4.75	4.48	0.579	0.790	1.795	0.076
F3	**3.80**	**2.74**	**1.290**	**1.054**	**3.554**	**0.001**
F4	4.64	4.39	0.707	0.891	1.354	0.179
F5	2.52	2.83	1.302	1.497	-0.935	0.352
G1	**2.77**	**1.87**	**1.202**	**1.217**	**3.095**	**0.003**
G2	**2.97**	**1.74**	**1.294**	**0.915**	**4.219**	**0.000**
G3	**2.36**	**1.70**	**1.435**	**1.105**	**2.034**	**0.045**
G4	**2.78**	**1.70**	**1.338**	**1.063**	**3.537**	**0.001**
G5	**3.20**	**1.61**	**1.208**	**0.941**	**5.767**	**0.000**
G6	**3.93**	**3.13**	**1.287**	**1.456**	**2.489**	**0.015**
G7	3.84	4.09	1.302	1.443	-0.765	0.446
H1	2.62	2.13	1.214	1.014	1.752	0.083
H2	2.72	2.57	1.371	1.121	0.504	0.616
H3	**3.52**	**1.52**	**1.158**	**0.665**	**7.843**	**0.000**
H4	1.88	1.48	0.916	0.790	1.900	0.061
H5	**2.41**	**1.70**	**1.155**	**0.822**	**2.724**	**0.008**

Japan (Bio vs. Eng vs. IT)

Question	Bio AVG	Eng AVG	IT AVG	Bio SD	Eng SD	IT SD	F	p	Analysis
B1	2.49	2.40	2.25	1.332	0.699	1.238	0.220	0.804	ANOVA with heterogeneous variance term for each area
B2	2.63	2.10	2.00	1.385	1.197	0.966	1.818	0.169	ANOVA
B3	3.00	2.10	2.19	1.342	1.197	1.167	3.713	0.029	ANOVA
B4	2.43	3.40	3.19	1.315	1.174	1.515	3.431	0.038	ANOVA
B5	2.20	3.50	2.75	1.342	0.972	1.342	4.622	0.013	ANOVA
B6	2.73	2.10	2.38	1.372	1.101	1.455	1.095	0.340	ANOVA
C1	3.24	2.17	3.14	1.463	0.983	1.464	1.502	0.232	ANOVA
C2	3.00	2.00	2.86	1.432	0.632	1.773	1.298	0.282	ANOVA
C3	3.27	2.00	3.14	1.550	0.632	1.464	1.938	0.154	ANOVA
C4	3.61	2.83	3.29	1.394	1.329	1.890	0.818	0.447	ANOVA
C5	2.00	1.33	1.86	1.360	0.516	1.464	0.679	0.512	ANOVA
C6	3.85	3.00	3.43	1.108	1.414	1.397	1.592	0.213	ANOVA
D1	2.20	1.00	2.00	1.135	0.000	1.414	1.531	0.241	ANOVA
D2	2.10	1.00	1.44	1.287	0.000	0.726	2.142	0.144	ANOVA
D3	1.90	1.00	1.67	1.101	0.000	1.000	1.226	0.315	ANOVA
D4	2.30	1.00	1.67	1.567	0.000	1.000	1.729	0.203	ANOVA
D5	1.40	1.00	1.22	0.966	0.000	0.667	0.401	0.675	ANOVA
D6	3.60	1.25	2.44	1.506	0.500	1.236	5.113	0.016	ANOVA
E1	2.88	2.10	2.19	1.125	0.876	1.047	3.924	0.024	ANOVA
E2	1.57	2.50	1.69	0.728	0.972	0.946	3.995	0.037	ANOVA with heterogeneous variance term for each area
E3	1.96	3.00	2.06	0.999	1.633	1.289	1.821	0.191	ANOVA with heterogeneous variance term for each area
F1	4.02	4.00	3.63	1.140	1.155	1.258	0.714	0.493	ANOVA
F2	4.76	4.30	4.56	0.551	1.059	0.629	2.379	0.100	ANOVA
F3	3.67	2.80	3.19	1.322	1.135	1.276	2.315	0.106	ANOVA
F4	4.71	4.10	4.56	0.672	0.994	0.727	2.903	0.061	ANOVA
F5	2.37	3.60	2.88	1.296	1.174	1.544	3.851	0.026	ANOVA
G1	2.75	2.40	2.00	1.339	1.075	1.033	2.233	0.114	ANOVA
G2	2.86	2.00	2.06	1.281	0.943	1.289	3.773	0.028	ANOVA
G3	2.41	1.50	1.81	1.458	0.707	1.276	4.559	0.019	ANOVA with heterogeneous variance term for each area
G4	2.67	2.10	1.94	1.381	0.994	1.289	2.239	0.114	ANOVA
G5	3.04	2.00	2.13	1.311	1.054	1.360	4.800	0.011	ANOVA
G6	3.96	3.40	3.44	1.341	1.075	1.504	1.375	0.259	ANOVA
G7	3.84	4.00	4.06	1.488	1.333	1.124	0.173	0.842	ANOVA

Question	Bio AVG	Eng AVG	IT AVG	Bio SD	Eng SD	IT SD	F	p	Analysis
H1	2.49	2.90	2.00	1.138	0.876	1.033	2.255	0.112	ANOVA
H2	2.63	3.30	2.56	1.280	1.418	1.153	1.286	0.282	ANOVA
H3	3.16	2.80	2.19	1.391	1.033	1.377	3.179	0.047	ANOVA
H4	1.61	2.50	1.63	0.802	1.354	0.806	1.974	0.168	ANOVA with heterogeneous variance term for each area
H5	2.14	2.10	2.06	1.096	0.876	1.124	0.031	0.970	ANOVA

Bonferroni Grouping for STEM Specialism Least Squares Means (Alpha=0.05)			
Within a question: LS-means with the same letter are not significantly different.			
STEM_Specialism	**Estimate**		
Question B3			
Bio	3.0000		A
Eng	2.1875		A
IT	2.1000		A
Question B4			
Bio	3.1875		A
Eng	3.4000		A
IT	2.4314		A
Question B5			
Bio	2.1061	B	
Eng	3.5000		A
IT	2.7500	B	A
Question D6			
Bio	3.6000		A
Eng	1.2500	B	
IT	2.4444	B	A
Question E1			
Bio	2.8824		A
Eng	2.1000		A
IT	2.1875		A
Question E2			
Bio	1.5686	B	
Eng	2.5000		A
IT	1.6875	B	A
Question F5			
Bio	2.3725		A
Eng	3.6000		A
IT	2.4314		A

Bonferroni Grouping for STEM Specialism Least Squares Means (Alpha=0.05)			
Within a question: LS-means with the same letter are not significantly different.			
STEM_Specialism	**Estimate**		
Question G2			
Bio	2.8627	B	A
Eng	2.0000		A
IT	2.0625	B	A
Question G3			
Bio	2.4118		A
Eng	1.5000	B	A
IT	1.8125	B	
Question G5 (NB LINES display does not reflect all significant comparisons. This pair is significantly different (Bio,IT))			
Bio	3.0392		A
Eng	2.0000		A
IT	2.1250		A
Question H3			
Bio	3.1569		A
Eng	2.8000	B	A
IT	2.1875	B	

Statistical results by global indices (HDI and GII)

The table below provides the results of a Spearman correlation calculation to indicate if there is a relation between the Human Development Index (HDI) of a country and responses of individuals, or between the Gender Inequality Index (GII) and responses.

The three values in each cell correspond to:

- SCC: Spearman Correlation Coefficient (Rho) ($-1 \leq Rho \leq 1$)
- Significance: a measure or level of significance of the result (given by Prob > |r| under H0: Rho=0)
- #Obs: Number of Observations or responses included in the calculation.

Where the Significance value is greater than 0.05, there is no correlation between the responses to the question and HDI or GDI value. These cells have been coloured in GREY.

If the Significance value is less than 0.05, there is a correlation, and we proceed to consider the Spearman Correlation Coefficient (SCC). If the SCC value is negative, the correlation between the question and the economic index is negative and the closer to SCC=-1, the stronger the negative correlation. If the SCC value is positive, then higher values of the index are linked to higher values of the responses to the questions and vice versa. The strongest positive correlation is given by SCC=+1.

NB. We note that where the Significance value is close to 0.05 and/or the absolute value of the Spearman Correlation Coefficient is much less than 0.3, we have for the purposes of this analysis opted to assume there is no meaningful correlation. These cells have been left uncoloured.

Thus, those cells highlighted in LIGHT RED indicate where there is some negative correlation: i.e. the higher the index value the lower the value of the responses to the question, and vice versa. We note there no cells with significant positive correlation, i.e., where higher values of the index are linked to higher values of the responses to the questions.

Question			HDI	GII
B	**Perception of 'gender barriers' in STEM**			
B1	Girls and boys are equally encouraged to choose any major/field of study in STEM during their education period.	**SCC** **Significance** **#Obs**	-0.14948 <.0001 1213	-0.12443 <.0001 1205
B2	Female students in STEM receive equally fair assessments and appraisals for their work, task, or project results, compared to their male counterparts in the same programs and levels.	**SCC** **Significance** **#Obs**	-0.10199 0.0004 1213	-0.06708 0.0199 1205
B3	Women in STEM receive equal work distribution and work appraisals compared to men of the same qualifications and level.	**SCC** **Significance** **#Obs**	-0.17585 <.0001 1213	-0.15017 <.0001 1205
B4	It is equally difficult for a woman as for a man to get a job in the STEM field with the same qualifications.	**SCC** **Significance** **#Obs**	-0.13324 <.0001 1213	-0.10179 0.0004 1205
B5	Being promoted or becoming a tenured professor or a principal investigator is equally difficult for women in STEM as for men in STEM.	**SCC** **Significance** **#Obs**	-0.18487 <.0001 1213	-0.14207 <.0001 1205
B6	Women in STEM generally receive equal pay for equal work, compared with their equally-qualified male colleagues.	**SCC** **Significance** **#Obs**	-0.21745 <.0001 1213	-0.19209 <.0001 1205
C	**Direct/Indirect experience of 'gender barriers'**			
C1	Women in STEM being disadvantaged in receiving promotions, grade appraisal, research funds or scholarships because she is female.	**SCC** **Significance** **#Obs**	-0.30028 <.0001 638	-0.29566 <.0001 633
C2	Women in STEM being disadvantaged in participating or leading a research/work project or team because she is female.	**SCC** **Significance** **#Obs**	-0.25447 <.0001 636	-0.29136 <.0001 631
C3	Women in STEM being sexually harassed (linguistical or physical) or treated unfairly by their colleagues/peers (in class, laboratory, team, at work, etc).	**SCC** **Significance** **#Obs**	-0.17183 <.0001 637	-0.16127 <.0001 632
C4	Women in STEM being sexually harassed (linguistical or physical) or treated unfairly by their senior classmate, lab-mate or professor (in university laboratory or project group, etc), or senior colleagues or managers at work.	**SCC** **Significance** **#Obs**	-0.22719 <.0001 637	-0.22041 <.0001 632

Question			HDI	GII
C5	Women in STEM being disadvantaged in accessing research/work equipment or information because she is female.	**SCC** **Significance** **#Obs**	-0.04338 0.2743 637	-0.04963 0.2127 632
C6	Women in STEM being in trouble or leaving study/work/research project due to her marriage, pregnancy or childcare.	**SCC** **Significance** **#Obs**	-0.25731 <.0001 638	-0.21653 <.0001 633
D	**(Indirect) Experience of 'gender barriers' in STEM**			
D1	Women in STEM being disadvantaged in receiving promotions, grade appraisal, research funds or scholarships because she is female.	**SCC** **Significance** **#Obs**	-0.10438 0.0127 570	-0.04678 0.2662 567
D2	Women in STEM being disadvantaged in participating or leading a research/work project or team because she is female.	**SCC** **Significance** **#Obs**	-0.04516 0.2813 571	0.00007 0.9987 568
D3	Women in STEM being sexually harassed (linguistical or physical) or treated unfairly by their colleagues/peers (in class, laboratory, team, at work, etc).	**SCC** **Significance** **#Obs**	-0.02567 0.5405 571	0.02008 0.6330 568
D4	Women in STEM being sexually harassed (linguistical or physical) or treated unfairly by their senior classmate or labmate or professor (in university laboratory, project group, etc) or senior colleagues or managers at work.	**SCC** **Significance** **#Obs**	-0.06747 0.1073 571	0.00320 0.9393 568
D5	Women in STEM being disadvantaged in accessing research/work equipment or information because she is female.	**SCC** **Significance** **#Obs**	0.00699 0.8676 571	0.06890 0.1009 568
D6	Women in STEM being in trouble or leaving study/work/research project due to her marriage, pregnancy or child care.	**SCC** **Significance** **#Obs**	-0.13535 0.0012 571	-0.07647 0.0686 568
E	**Perception of policy to overcome 'gender barriers'**			
E1	I believe things will turn out fine in the future career for women in STEM.	**SCC** **Significance** **#Obs**	-0.23429 <.0001 1213	-0.24954 <.0001 1205
E2	It is crucial to have strong policy support to solve gender inequality in the STEM field.	**SCC** **Significance** **#Obs**	-0.05714 0.0466 1213	-0.05728 0.0468 1205
E3	It is appropriate to introduce a quota system* or affirmative actions* to solve gender inequality in the STEM field	**SCC** **Significance** **#Obs**	0.04086 0.1549 1213	0.00171 0.9526 1205
F	**Perception of gender roles**			
F1	In a relative sense, men are rational while women are emotional, and thus they ought to complement each other by carrying out roles that are appropriate for their gender.	**SCC** **Significance** **#Obs**	-0.37573 <.0001 1213	-0.36938 <.0001 1205
F2	Primary breadwinners (who take care of financial obligations) of households should be men.	**SCC** **Significance** **#Obs**	-0.34254 <.0001 1213	-0.37939 <.0001 1205
F3	Women are born to be, or naturally able to care for children in a way that men are just not as capable.	**SCC** **Significance** **#Obs**	-0.17029 <.0001 1213	-0.20312 <.0001 1205
F4	In order to maintain the order and peace of a family, the husband should have greater power and authority than the wife.	**SCC** **Significance** **#Obs**	-0.31167 <.0001 1213	-0.33793 <.0001 1205

Question			HDI	GII
F5	I believe gender equality will be fully achieved only if women are given equal opportunities as men.	**SCC** **Significance** **#Obs**	-0.05180 0.0713 1213	-0.02198 0.4458 1205
G	**Perception of gender equality in study, research and work environments**			
G1	Women are equally granted or entrusted equal roles for their research or project or work performance at the laboratory and at work.	**SCC** **Significance** **#Obs**	-0.20633 <.0001 1213	-0.19576 <.0001 1205
G2	Women equally receive the appraisal or award for the outcome of their project or research or work.	**SCC** **Significance** **#Obs**	-0.23051 <.0001 1213	-0.21667 <.0001 1205
G3	The strictness, objectiveness and importance of the research or task outcome are equally respected regardless of the sex/gender of the person in charge.	**SCC** **Significance** **#Obs**	-0.16115 <.0001 1213	-0.13598 <.0001 1205
G4	Dealing with funders (those providing funding for research projects or those providing the budget for a work project), in terms of administrative or budget process, is equally fair regardless of the gender/sex of applicant or project leader.	**SCC** **Significance** **#Obs**	-0.16596 <.0001 1213	-0.14318 <.0001 1205
G5	Women receive the same social evaluation and respect as men in their roles as scientists or engineers (by their colleagues, professor, managers, funding donors, academic association, scientific society, professional institution, etc.)	**SCC** **Significance** **#Obs**	-0.22972 <.0001 1213	-0.19355 <.0001 1205
G6	Marriage, pregnancy or childcare have the same effect on scientist/engineer regardless of their gender/sex on their study, research or work performance.	**SCC** **Significance** **#Obs**	-0.31607 <.0001 1213	-0.32239 <.0001 1205
G7	Female students in STEM are intimidated in the laboratory or in classes or in the workplace because they are female.	**SCC** **Significance** **#Obs**	-0.17459 <.0001 1213	-0.15811 <.0001 1205
H	**Perception of your STEM career**			
H1	On balance, my STEM career has progressed well so far.	**SCC** **Significance** **#Obs**	-0.11668 <.0001 1213	-0.10293 0.0003 1205
H2	I am considered by colleagues to be either a leader in STEM, or on track for leadership.	**SCC** **Significance** **#Obs**	-0.12596 <.0001 1213	-0.10469 0.0003 1205
H3	I have not been personally affected by gender barriers in STEM.	**SCC** **Significance** **#Obs**	-0.22056 <.0001 1213	-0.17838 <.0001 1205
H4	My family /partner /friends are, on the whole, supportive of my STEM career.	**SCC** **Significance** **#Obs**	0.05070 0.0775 1213	0.07137 0.0132 1205
H5	My current colleagues, managers, professors, are as supportive of me and my STEM career as of others in the same environment.	**SCC** **Significance** **#Obs**	-0.09889 0.0006 1213	-0.07806 0.0067 1205

2021 MAPWiST

Web Poster

Keynote Speech

BIEN 2021, The 5th International Conference of Women Scientists and Engineers
August 18 - 20, 2021, Daejeon, Korea

Ten years of research into gender and STEM: learning from the past and looking to the future

Clem HERMAN*

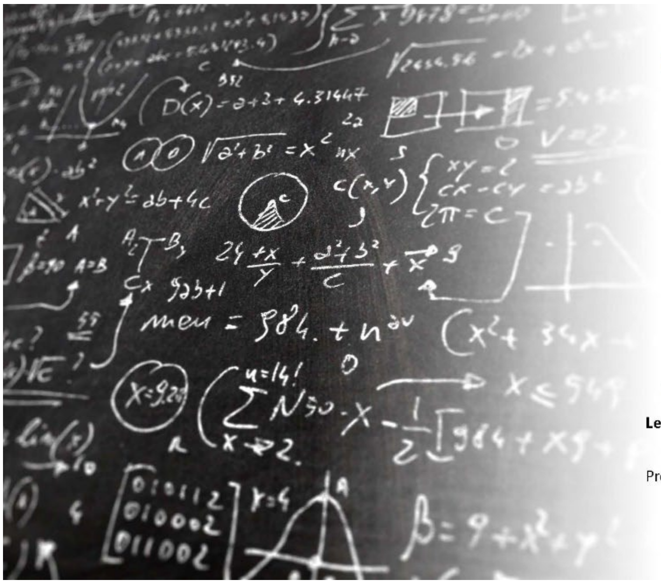
School of Computing and Communications, The Open University, Milton Keynes, UK

**Presenting Author: Clem Herman (clem.herman@open.ac.uk)*

In 2009 a group of international scholars and practitioners working on gender issues in STEM decided to create a new online journal. At that time most of the journals that published work about gender and STEM were not being read by people outside of universities as the charges for accessing articles was very high, and the current practice of open access was not yet in place. We were given a start-up grant from the UK Resource Centre for Women in SET (UKRC), an independent organisation funded by the UK government. The Open University agreed to provide the website infrastructure and support for the journal and to resource the editorial team that would run the journal. We were intentionally an interdisciplinary group with a mixture of STEM, social science, education and humanities backgrounds.

Since then we have published more than 350 articles reporting on research from many countries and regions of the world. When we began, we were committed to inclusivity – namely to ensure that we could support new researchers and those from countries where access to publishing was difficult. We also wanted to publish authors whose first language was not English, so offered support with editing and proofreading articles. Our Editorial Board also reflected this wide range of disciplines and countries but shared a commitment to bring insights from research to new audiences and bridging the gap between research and practice.

In this talk I will present an overview of trends in the topics/themes covered in the journal, as well as other published work on Gender and STEM and reflect on the field has been developing over the past decade. Have our concerns and questions changed? What insights have translated from research into practice? Where are the gaps that are still needing to be explored? I will consider some of the challenges and difficulties faced by the growing community of scholars and researchers going forward including methodological questions. How useful is our interdisciplinary approach? What are the limitations of taking a comparative approach?



10 years of research into Gender and STEM

Learning from the past and looking to the future

Professor Clem Herman | The Open University, UK

The Open University

About this talk

- In this talk I will present an overview of trends in the topics/themes covered in the journal and reflect on the field has been developing over the past decade.
  - Have our concerns and questions changed?
  - What insights have translated from research into practice?
  - Where are the gaps that are still needing to be explored?
- I will consider some of the challenges and difficulties going forward including methodological questions.
  - How useful is our interdisciplinary focus in reaching the right audiences?
  - What are the implications of taking a comparative approach?

About my research

- Practical projects to give women access to technology and skills
  - The Women's Electronic Village Hall 1990s
- STEM returners – impact of career breaks/ success strategies
- Academic careers/ gender equality in universities
- Women in computing education – motivation and choice
- Cross cultural comparisons
  - East/West Europe engineering careers
  - EU engineering and technology companies
  - India/UK women IT companies

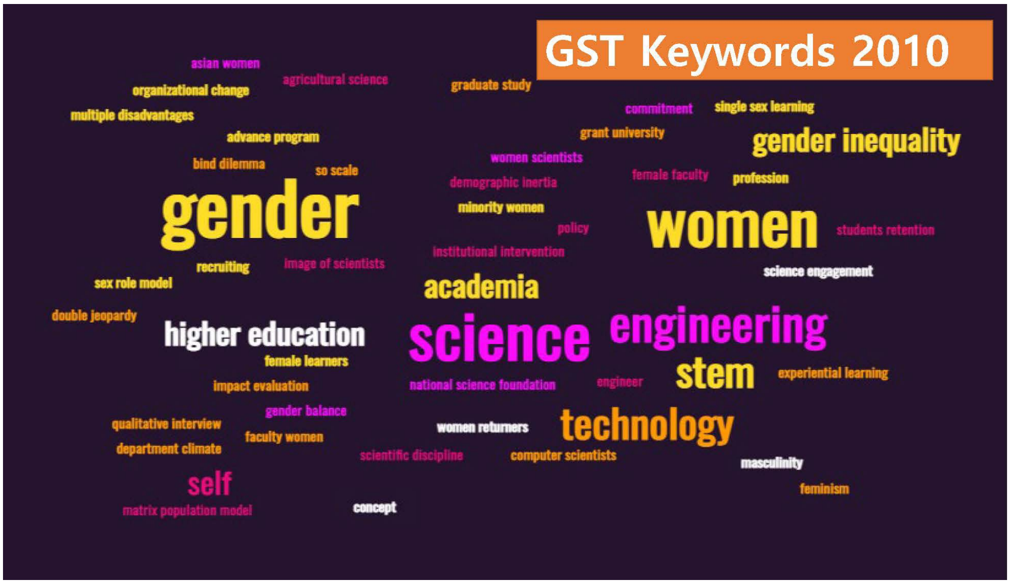
GST International Journal of Gender, Science and Technology

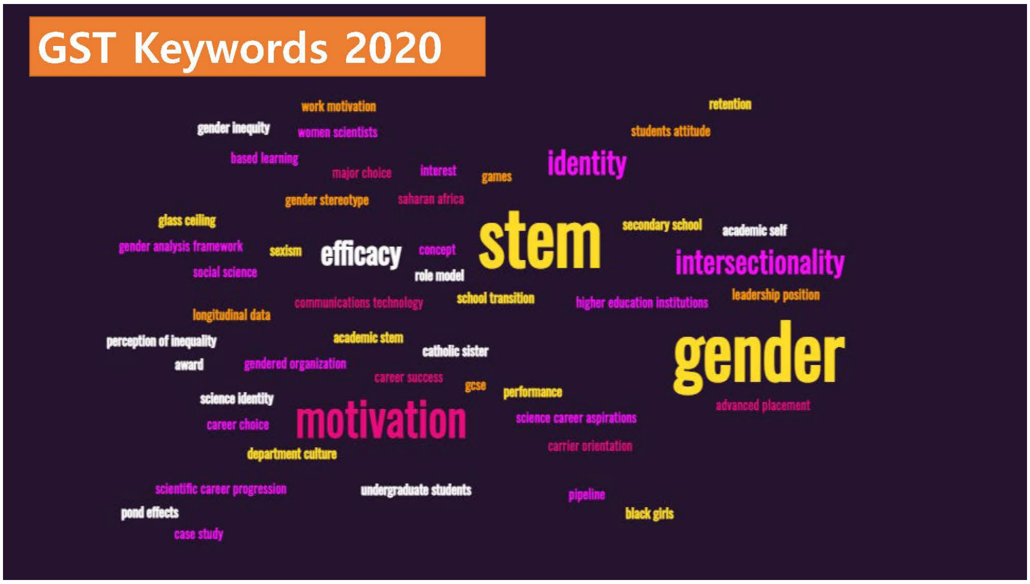
- In 2009, other journals that published work about gender and STEM were not accessible outside of universities, due to the cost.
- Start-up grant from the UK Resource Centre for Women in SET (UKRC), funded by the UK government.
- The Open University provides the website infrastructure and support for the journal and editorial team.
- Intentionally interdisciplinary – editors have a mixture of STEM, social science, education and humanities backgrounds.
- Original Editorial Board included KongJu Bock Lee ☺

Have our concerns and questions changed?

- SET – Science, Engineering Technology
- Leaky Pipeline
- Barriers
- Women
- Recruitment, retention and progression (Ahuja 2002)

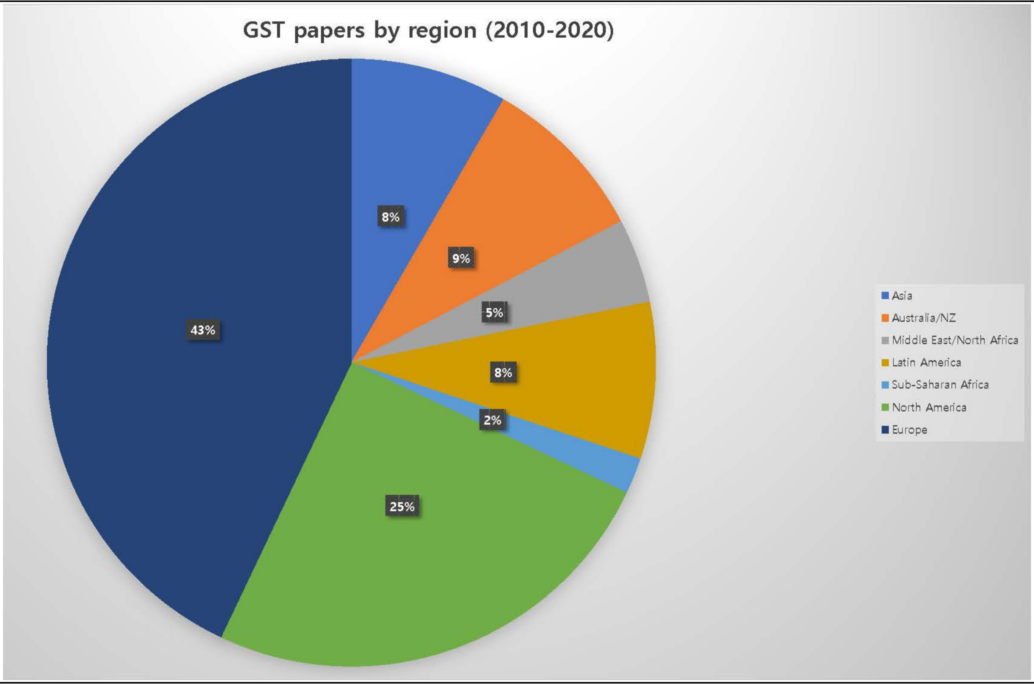
- STEM – includes Mathematics
- Motivation
- Inclusion
- Intersectionality
- Gender





What insights have translated from research into practice?

- Unconscious bias – has become a key tool for industry Equality Diversity and Inclusion strategy.
- Sense of belonging – inclusion and equity rather than the deficit model of 'equal opportunities' (Master, Cheryan and Meltzoff 2016)
- Role models - importance of language and representation in recruitment and advertising.
- Intersectionality – understanding the impact of intersecting identities.



How useful is our interdisciplinary approach?

Interdisciplinary research add insights – new and fresh thinking across disciplinary borders.

BUT researchers/ academics are constrained by their own discipline rules for publishing e.g. required to publish in certain journals for promotion. So we still operate in silos within the academy.

Methodologies – qualitative/ quantitative. Each has strengths and weaknesses, increase in novel and mixed methods

What is the desired impact? Most in this field want to change the gender balance and for this you need to be able to translate findings across boundaries and into the practitioner community

Comparison as method

Are we counting the same things

gsm-it

Gender, Skilled Migration And IT

What are the limitations of taking a comparative approach?

- "comparisons are never neutral: they are inevitably tendentious, didactic, competitive, and prescriptive... So, which subject is initiating the comparison and why? What is at stake in the comparison, and who will benefit from the comparative performance?" (Radhakrishnan 2009)
- Different educational systems produce different gendered opportunities and structures. Subject categories do not always count the same thing (computing/ ICT/digital)
- Categories of ethnicity and identity do not translate in the same way across countries. e.g. distinctions of caste/religion important in Indian context, whereas in the UK, ethnicity categories Black, Asian and Minority Ethnic (BAME) have different meanings.

Firm size

Size:

1.1 Size

Large	> 250	1
Medium	< 250	2
Small	< 50	3
Micro	< 10	4

What does the size denote? Is it employee? If so, we need to rehash it as most of them will be at best medium sized organization

Usually large is defined as 5000 & above
Medium: 500-4999
Small: Less than 500

Q3. ASK ALL: Across all the offices put together in India (including all branches and offices) approximately how many employees do you have in your organization? **INTERVIEWER TO RECORD VERBATIM AND POSTCODE. SINGLE CODING ONLY** _

No of Employees: ____________

NUMBER OF EMPLOYEES	Code	Remarks
Less than or equal to 500	1	CLASSIFY AS SMALL SIZED
501-5000	2	CLASSIFY AS MEDIUM SIZED
5001 and 50000	3	CLASSIFY AS LARGE
>50000	4	VERY LARGE

Future directions for Gender and STEM research

- Publications are still focused on Europe (especially Nordic countries plus UK) and North America. And English language.
- Unpacking STEM. Different gender issues in each of the STEM disciplines e.g. Women obtain more than half of U.S. undergraduate degrees in biology, chemistry, and mathematics, yet they earn less than 20% of computer science, engineering, and physics undergraduate degrees (Master, Cheryan and Metzoff 2016; Sax & Newhouse 2018).
- New and hybrid subject areas – data science, bioinformatics, digital arts - do we need to rethink the category STEM? How useful is STEAM – adding the Arts.
- Decolonising the STEM curriculum (Fernandes 2020)

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Gender gap and perception in STEM in Okinawa

Aguri NAKANO[1,2*§]

[1]*Production Electronic Information System Technology, Institute, Okinawa Polytechnic College, Okinawa, Japan*
[2]*Japan Network of Women Engineers and Scientists, Tokyo, Japan*

**Presenting Author: Aguri Nakano (nakano@okinawa-pc.ac.jp)*
§Corresponding Author: Aguri Nakano (nakano@okinawa-pc.ac.jp)

Not limited to the STEM field, I would like to report on the gender gap in Japan and changes in life before and after COVID-19 from various aspects.

Okinawa, where I live, is often very different from the so-called "Japan", which has the image of Tokyo, in many parts, such as living and environment.

Since Okinawa is a tropical small island, the agriculture, livestock industry, and tourism are thriving, but there is almost no manufacturing industry. Therefore, Okinawa is known as the poorest prefecture in Japan.

In an attempt to raise the average income of Okinawa, income deductions of up to 40% and tax incentives to promote capital investment have been made. Special economic zones are recognized as areas specializing in the information and telecommunications industry, areas where international logistics bases are concentrated, and areas specializing in economic and financial revitalization.

In panel discussions like this, we often talk about the general situation of "Japan" such as Tokyo.

So, from a slightly different point of view, I will compare the average of Japan and various data of Okinawa and report what is happening in "Okinawa".

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Gender and STEM Education in Mongolia

Battsengel BAATAR*

German-Mongolian Institute for Resources and Technology, Ulaanbaatar, Mongolia
Member of Board of Directors and Vice President of the International Network of Women in Engineering and Science (INWES)

**Presenting Author: Battsengel Baatar (battsengel.baatar@inwes.net)*

According to the World Economic Forum, only 30 percent of the world's researchers are women. Less than a third of female students choose STEM higher education, and women working in STEM fields publish less and are often paid less [1]. Women are primarily underrepresented in the IT branch of the STEM disciplines, e.g., less than 1 percent of the Silicon Valley applicant pool for technical jobs in artificial intelligence and data science are women [2].

In the case of gender and STEM education in Mongolia, the situation is similar: a lower number of female students in STEM and higher numbers in the fields of health, education, and welfare. Modern Mongolian education is divided into two time periods, the Socialist period up to 1990, and the period thereafter. In the first period, the leading educational achievements were the planned economic society, high literacy rates, and gender equality in education and work fields. STEM education was highly supported by organizing many STEM events and competitions and by building science palaces and centers. Due to the planned economy principle, the number of students in each discipline was precisely defined and implemented. But Mongolia's development was highly dependent upon the Soviet Union.

Since 1990, a market economy, and a democratic and free society has been forming, and the educational system has been changing along with it. The positive results are an open society with freedom of choice, and an orientation towards global education. However, many low-quality private (for-profit) universities have sprung up, and gender equality has not been sustained in the education sector, particularly in higher education. The importance of STEM fields has declined, and young people are increasingly choosing careers in law, business, social sciences, and the humanities.

For more than a decade, STEM education has received increasing attention from the Mongolian government. Positive measures are being implemented, such as providing scholarships to students in these fields, and a growing number of funded projects and programs.

However, although the legal and policy framework related to gender equality is well established on paper, these policies have not been effectively implemented. According to the UNESCO report, STEM education for girls and women in the Asia Pacific has not improved, and the situation worsened due to the Covid-19 pandemic [4]. There is a shortage of engineering and technology workers in Mongolia, so men are more likely than women to have the jobs and career advancement. Statistics also show that women are more affected by the Covid-19 pandemic. Gender barriers in STEM, gender stereotypes, women underrepresentation, gender sensitivity, and working environment should be considered and discussed.

[1] https://www.weforum.org/agenda/2020/02/stem-gender-inequality-researchers-bias/
[2] UNESCO, 2020. Global Education Monitoring Report - Gender Report: A New Generation: 25 Years of Effort for Gender Equality in Education. Paris: UNESCO
[3] Ariunzaya, A., Munkhmandakh, M., Women and the future of work in Mongolia, 2019
[4] STEM Education for Women and Girls - Breaking Barriers and Exploring Gender Inequality in Asia, UNESCO Bangkok Office, 2020

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Gendered gap & perception of STEM in India

Seema SINGH*

INWES Board Member (South Asia),
Department of Humanities, Delhi Technological Universities, Delhi, India

**Presenting Author: Seema Singh (seemasinghdtu@gmail.com)*

Traditionally, STEM has been considered as a male domain as in other parts of the globe (ref Figure-1). However, scenario has changed over the period which may be divided in three phases as discussed below:

Phase I between 1950 - 1990- Pre-Globalization	Phase II between 1991 to 2019: Post-Globalization	Phase III between 2019 to 2020 Impact of COVID-19
Demand side 1. Emphasis on education during planned period in India, 2. Employment opportunity was generally in government sector/ public sector with formal employment relation [1] Supply side 1. Traditional Mindset restricted entry of women in STEM area. 2. Due to general emphasis, even STEM field experienced gradual expansion.	Demand side- 1. Globalization & application of IT in business operations. 2. Enhance technological intensity of even non-technical processes/ sectors. 3. Return on science & engineering education is higher Supply side 1. Strict implementation of family planning norms of two-three children in 1970s led to attention on daughter's education in 1990s 2. Exponential expansion of engineering education during 1990s onwards.	1. No effect is visible on enrollment (from all India data). 2 Placement of institutions in metro cities (data from engineering institution of Delhi) has shown an increasing trend even during the phase of COVID-19. During this phase they shifted to online mode. However, all India data shows a decline of 19 percent [2]. 3. Working women engineers have found stress in managing work-life balance.

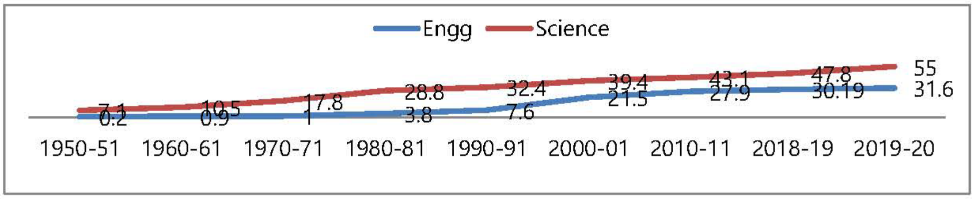

Figure- 1- Percentage Share of Women Enrollment at Graduate Level; Source: [3]

Salient feature of women education & employment in STEM

1. Gender Parity Index for Science in higher education level is more than one.
2. Beyond 2010, women enrolment in engineering education is almost stagnated.
3. Women join the workforce but difficult to reach up to the top.

[1] Singhg Seema, "Indian Continuing Engineering Education System in context of Globalisation", 2020, Rathore Academic Research Publications, ISBN 978-81-948753-2-1pp. 04.

[2] AICTE, DashBoard, https://facilities.aicte-india.org/dashboard/pages/dashboardaicte.php on 04.8.2021

[3] UGC, Annual Reports for various years, Universiry Grants Commission, India; New Delhi.

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STEM Education through Robotics and Coding Competition-based Learning

Siew Kien MAH[1,2*§] **and Cheryl NG**[3]

[1]*Women Engineers Section, The Institution of Engineers, Malaysia*
[2]*Department of Electrical Engineering, Nilai University, Negeri Sembilan, Malaysia*
[3]*Rero EDUteam, Cytron Technologies, Penang, Malaysia*

**Presenting Author: Siew Kien Mah (mahsiewkien@gmail.com)*
§ Corresponding Author: Siew Kien Mah (mahsiewkien@gmail.com)

COVID-19 has brought many challenges in the education front. Competitions, which are often incorporated into game-based learning, have also moved to virtual modes. Integrating competition components into project-based-learning (PBL) is a great way to motivate students during virtual learning [1]. Rero Annual Championship (RAC) is a national level robotics and coding competition inaugurated in 2016 to promote Science, Technology, Engineering and Maths (STEM) content and skill learning among primary and secondary school students through educational robotics competition [2]. Design and Technology (RBT) subject was introduced to Form One students since 2017 and to Year Four students since 2020 for them to learn micro-controller programming. In RAC competitions, goal-oriented and PBL approaches are employed whereby participants use rero Planner software, MakeCode Editor and Arduino IDE to program their robots to perform various tasks. The students are required to pass state-level qualifying round before proceeding to national level. RAC moved to virtual mode in 2020 due to the pandemic. Researches on gender and STEM have indicated that female students are less inclined to learn robotics than male students [3]. Gender stereotyping can be changed positively by creating situational interest in robotics and coding subjects. It is observed that the percentage of female students' participation has increased to better reflect the male-female ratio of our school population when the competitions moved from physical to virtual mode. Robotics competition provides benefits such as increased confidence in using technology, STEM usage in solving real-world problems, increased interest in STEM careers and the importance of teamwork [4]. In order to reduce the gender gap in robotics, exposure to educational robotics activities at an early age will have an added advantage.

[1] A. Eguchi, "RoboCupJunior for promoting STEM education, 21st century skills, and technological advancement through robotics competition," *Robotics and Autonomous Systems,* vol. 75, pp. 692-699, 2016/01/01/ 2016.
[2] *Rero Robotics and Coding Competition*. Available: https://sites.google.com/view/rac2021
[3] S. Kucuk and B. Sisman, "Students' attitudes towards robotics and STEM: Differences based on gender and robotics experience," *International Journal of Child-Computer Interaction,* vol. 23-24, p. 100167, 2020/06/01/ 2020.
[4] J. Cross, E. Hamner, L. Zito, I. Nourbakhshh, and D. Bernstein, "Development of an assessment for measuring middle school student attitudes towards robotics activities," in *2016 IEEE Frontiers in Education Conference (FIE)*, 2016, pp. 1-8.

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Gender gap and perception in STEM in Korea

Jihye Gwak[1,2*]

[1]Renewable Energy Institute, Korea Institute of Energy Research, Republic of Korea
[2]International Network Committee, The Association of Korean Woman Scientists & Engineers, Daejeon, Republic of Korea

**Presenting Author: Jihye Gwak (bleucoeur@kier.re.kr)*

According to the Global Gender Gap Report 2017 published by the World Economic Forum (WEF), in Korea, 96% of the gender gap in educational achievement has been resolved, while the labor participation rate for women is 55.9%, which is only 73% for men. While the labor participation rate of highly educated women and men is higher than that of the whole population, the gender gap in labor participation rate is much larger in the highly educated population. This is fundamentally due to social and structural gender inequality.

The analysis of the gender perspective among international indicators related to human resource development can be a cornerstone for the development of a balanced policy that reflects gender equality. In Korea, both the Human Development Index (HDI) and the Inequality-Adjusted Human Development Index (IDHI) are higher than the average among member countries of the Organization for Economic Co-operation and Development (OECD), but the gap between the two is large. In particular, the HDI for men is noticeably higher than the OECD average, while the HDI for women is lower than the average, indicating a large development gap between the genders. Looking more closely at the Gender Inequality Index (GII) and the Gender Gap Index (GGI), in the GII-based ranking that measures gender inequality in terms of human rights and fundamental rights, Korea ranks highest among 162 OECD countries, unlike most Asia and Pacific Nations Network (APNN) countries. On the other hand, in the GGI-based ranking that measures the gender gap in the economic, education, health, and political domains, it ranked 108th out of 153 countries, showing a high level of inequality. It can be seen that the gender gap in Korea in terms of economic participation, opportunity, and political authority has not improved significantly over the past decade.

If we look closely at the GII and GDI, there are issues among APNN countries that show similar inequality levels in terms of type or opportunity of economic activity or educational achievement and political authority, which are different from issues common to OECD countries, such as the gender gap in the participation rate in economic activities. Therefore, it seems useful to find specific solutions by in-depth analysis of the causes while examining the social and cultural similarities and differences among APNN countries. Considering that equitable human resource development is the basis of a sustainable society, it is necessary to continuously promote balanced policy development through cooperation between APNN countries.

[1] UNDP, Human Development Report 2010-2019,

[2] WEF, Global Gender Gap Report 2014-2020