Final Report from an International Conference 2019 - 2021

Public Awareness of STEM and Advancing the Role of Women in STEM

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Institute for Learning Innovation

THE UNIVERSITY OF NEW MEXICO

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Executive Summary

The catalyst for this International Conference was a growing awareness globally, but particularly in South Asia and the western part of Southeast Asia of the challenges related to equity for women in STEM participation, employment, and leadership, as well as their important role as critical members of a science literate and engaged public. The conference was designed to foster opportunities for future collaborations between U.S. and S./SE Asian professionals, as well as provide insights into successful strategies and opportunities for domestic improvement in these areas since some of these Asian countries are worldwide models of gender equity in STEM education and careers.

The project had two broad goals:

1. Foster intra- and international collaborations between Science-Technology-Society and Popularization of Science professionals in order to craft effective, self-sustaining models that support the public's awareness, understanding and appreciation of STEM as significant forces for economic growth and societal well-being.
2. Examine the opportunities, challenges, and barriers to participation of women in STEM learning, participation, employment, and leadership.

Nearly four dozen ministerial level policy makers, science popularization professionals, and academics, representing the nine South and South East Asian countries (Bangladesh, India, Indonesia, Malaysia, Nepal, Pakistan, Singapore, Sri Lanka, Thailand) and the United States for participation in the project. Although originally planned as a multi-day, in-person meeting, the Covid-19 pandemic forced the project to adopt a virtual-only format. Over the course of two years, participants engaged in a series of large, all participant, and smaller, working group, meetings. Across all of these meetings, participants engaged in lively conversation about both the opportunities and the challenges they perceived currently existed in their countries; all with the goal of determining how opportunities to engage more women and girls in STEM-related education, employment, life-long learning, and policy could be facilitated.

Despite setbacks due to the Covid-19 pandemic, the Project was able to accomplish its goals. An indication of the value and significance of the meeting was the on-going participation of representatives from the U.S. Department of State's *Regional Environment, Science, Technology and Health Program* for South Asia. At the conclusion of the project, this office issued a call for projects from meeting participants with the hope of being able to provide continuing funding in the region for project participant's work related to engaging women and girls in STEM. In addition, Research Working Group participants collaborated on writing a series of articles on the topic of Women and Girls in STEM in Asia. Articles are currently published online and will be physically published in a forthcoming special issue of the journal *American Behavioral Scientist*. The Policy and Practice groups surveyed policies related to women and girls in STEM which can be used as a template for understanding and filling current gaps in the policy landscape and the Practice Working Group produced a number of pilot materials for direct action. Additional materials are posted on participant websites, e.g., *Challenges & Opportunities – Public Awareness of STEM & Advancing the Role of Women in STEM*, *Women in STEM Working Group Summaries*, and *Women in STEM Project Evaluation*.

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Introduction

The significance to societies of a science, technology, engineering, and mathematics (STEM)-informed and engaged citizenry is enormous, both because of the significant ways STEM professionals contribute to new scientific knowledge, technical leadership, industrial innovation, and economic growth, and equally, because of the increasingly important role that STEM understanding plays in the ability of the public to address the issues and challenges they face as 21st century citizens. For example, the U.S. National Science Board (2018) considers the STEM labor force a national resource for ensuring continuous productivity increases and innovative capacities that fuel long-term economic growth and raise public welfare. The U.S. is not alone in this belief as virtually all countries have, and if not launched at least considered, initiatives and programs designed to increase the number of STEM professionals to promote innovation and economic growth.

Traditionally, women have been underrepresented in STEM education and thus in the STEM workforce (Landivar, 2013). According to a recent report by the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2017), only 30% of STEM students in higher education globally are women. Catalyst (2020), a global nonprofit organization, reported that in 2016, women accounted for less than a third (29.3%) of those employed in scientific research and development across the world. Despite improvements at the senior leadership position, globally women accounted for only 3% of chief executive officers (CEOs) and 20% of chief financial officers (CFOs) in technology industries.

The equal representation of women, therefore, emerges as a significant issue, within the STEM education arena (Scantlebury, 2014), the STEM workforce (Metcalf, 2010; Cannady, Greenwald & Harris, 2014) and in civic STEM literacy (Boumlick, Jaafar & Alberts, 2016). The growing awareness globally, but particularly in South Asia and the western part of Southeast Asia (Bangladesh, India, Indonesia, Malaysia, Nepal, Pakistan, Singapore, Sri Lanka, and Thailand), as well as the United States, of the challenges related to equity for women in STEM participation, employment, and leadership, as well as their important role as critical members of a science literate and engaged public was the catalyst for this International Conference.

Dr. Fahmida Chowdhury, Program Director in the Office of International Science and Engineering (OISE), was instrumental to start this project. She was joined by Dr. Jessie Dearo, Program Director for ADVANCE: Organizational Change for Gender Equity in STEM Academic Professions (ADVANCE), and Dr. Frederick Kronz, Program Director for Science and Technology Studies (STS). The overall goal of the international conference was to address collective national and international strategies for promoting public awareness and appreciation of STEM as important factors in economic development and societal well-being, with a particular focus on gender equity and inclusion (NAS, 2011; West, 2011; Nazneen & Mahmud, 2012; Holman, Stuart-Fox & Hauser, 2018). The conference was intentionally designed to foster opportunities for future collaborations between U.S. and S./SE Asian professionals, as well as provide insights into successful strategies and opportunities for domestic improvement in these areas since some of these Asian countries are worldwide models of gender equity in STEM education and careers. Specific project goals were:

3. Foster intra- and international collaborations between Science-Technology-Society and Popularization of Science professionals in order to craft effective, self-sustaining models that support the public's awareness, understanding and appreciation of STEM as significant forces for economic growth and societal well-being.
4. Examine the opportunities, challenges, and barriers to participation of women in STEM learning, participation, employment, and leadership.

There was an initial two-fold plan for accomplishing these goals: (1) with support from Program Officers in the Office of International Science and Engineering (OISE) of the U.S. National Science Foundation (NSF), PIs selected a small group of roughly four dozen ministerial level policy makers,

science popularization professionals, and academics, representing the nine S. and S.E. Asian countries and the U.S. (**Appendix A**) and (2) convene a 2.5 day working conference in Bangkok, Thailand in May 2020.

Unfortunately, the Covid-19 Pandemic forced the cancellation of the in-person conference in May 2020, as well as a subsequently scheduled October 2020 in-person meeting. The PI team regrouped and a virtual, large group meeting for the Public Awareness in STEM and Advancing the Role of Women (and girls) in STEM was hosted by the Institute for Learning Innovation (ILI), and held on Tuesday, October 27th 2020 from 9:00 – 11:00 am Thailand (Bangkok time) (**Appendix B**). The meeting attendees included 33 of the representatives, including individuals from all countries but Pakistan and was designed to start building momentum for a still-planned face-to-face meeting in 2021. Thus, the primary goals were to gather participants and begin to build a sense of community and commitment to this effort. Participants engaged in lively conversation about the opportunities they perceived currently existed in their countries that could be built upon to engage more women and girls in STEM-related education, employment, life-long learning, and policy.

As it became clear that the continuing, and unfortunately, worsening pandemic made the prospect of a face-to-face meeting untenable, the Project PIs again regrouped and formed three "Working Groups" –Research, Policy, and Practice to work virtually on these aspects of the issue. Participants were asked to prioritize which of the three Working Groups they wished to join, and the team roughly divided participants equally into the three groups to be organized and led by one of the Project's PIs; Policy by Falk, Research by Varma and Practice by Dierking. The goal of each Working Group was to harness participant interest, expertise, and energies into addressing and accomplishing the Project's goals in each of these three focal areas. Over a five-month period, each Working Group independently met and worked on their respective tasks.

Participants convened for a final large-group meeting in 2021 for two consecutive days on Tuesday, August 8 and Wednesday, August 9 – both meetings were held from 10:00 – 12:30 (Bangkok Time) (**Appendix B**). A total of 37 of the representatives from all countries but Indonesia participated over the course of this second two-day meeting. The meeting began with a brief project overview by Project Director Falk and a welcome by the US-NSF Program Director, Dr. Fahmida Chowdhury. The majority of the 1st day was spent with representatives from each of the three Working Groups summarizing their work (Goal 1). The 2nd day was devoted to addressing five overarching issues identified by the group as critical to facilitating effective, self-sustaining models that support increased awareness by and participation of women and girls in STEM-related education, careers. and civil society (Goal 2), as well as discussing next steps.

Large Group Meeting Outcomes

2020 October Meeting

Prior to the meeting, each participant was requested to develop a short document outlining the current challenges and opportunities their country faces with regard to the promotion of women and girls in STEM. As PIs had hoped, this pre-conference activity proved useful in that it coalesced participants' ability to talk succinctly and clearly about the state of these issues in their countries. Participants engaged in a lively conversation about the opportunities they perceived currently exist in their country, as well as challenges they face, and how the activities and products of this group might be able to optimize opportunities to engage more women and girls in STEM – both in terms of educational opportunities as well as over the long-term through careers, hobbies and general public awareness and engagement – as well as ameliorate to some degree, current challenges.

A wide variety of innovative ideas were offered, which helped inform the Project's next steps. Here is a selection of ideas shared via *ZOOM* chat that demonstrate how animated and engaged the group was both during a whole group discussion and responding to points in the chat:

> We are doing STEAM too. Works well to engage non-science audiences as well, and it would be good to include in the discussion (Singapore)
>
> I very much resonated with the use of art to help connect girls to STEM; I am particularly excited to work on connecting math education and problem solving to art. I look forward to collaborating with some of you on this topic (Bangladesh).
>
> I am looking to develop STEAM-based learning modules across K-12, to even undergrad general studies enrichment courses so def (sic) happy to talk to all interested. I've been researching on the role of science fiction as a world-building research approach for improving public participation in conceptualizing science research to develop critical thinking about science and science literacies, even if they do not become STEM professionals. This is part of the enculturating science in society [STS] process (Malaysia)
>
> You probably know them, but Clark Miller out of Arizona State has produced some good work on using science fiction pedagogically. Also, very good work from Shannon Conley. This is something I use in my classes as well. I am also interested in how STS can overlap with science communication/advocacy...is there room in this discussion to critique the role of science and tech? (Singapore)
>
> I would also encourage looking at puzzles and board games, as a way to teach and communicate science and math. I have been a puzzle solver for a while which covers a very broad range of things, but in a very playful manner. This can also be used to teach concepts. (Bangladesh)
>
> I agree with [Singapore] that there needs to be room to critique STEM, rather than seeing it as an unproblematic and inscrutable configuration that has impact on how science (and mathematical) and tech education are approached. (Bangladesh)
>
> I totally agree we can share like-minded programs and projects, best practices, policies and explore if we can replicate in our own country, institution etc. This could be the best learning & sharing platform too. I am very much interested to explore further. (Nepal)
>
> So far, what I have heard is what my colleague from Singapore, mentioned about the male-bias in S&T, something that is very important and has been well-documented (male clinical trials, car safety, etc.). But it has to go beyond creating "his and hers" tech (sic), to thinking of the inherent politics of scientific knowledge production and tech development (from an

STS perspective). What are other areas where science communication and STS meet? (Singapore)

We can share the National STEM Strategy which has been accepted as a National Policy so that other countries also can pick what is relevant to them. (Sri Lanka)

We are in the process of developing a STEM policy in Bangladesh too. We can start with a shared document to formalize the thoughts … (Bangladesh)

This issue of gender is a very big topic. Probably helpful to narrow the scope for discussion and for some actionable goals, also socio-economic status colours the picture as it could affect both males and females. (Singapore)

I was going to bring up that it is important to revisit the history of science and gender, esp. (sic) in developing worlds where there is very little work in this or history of STEM and gender...to collect data on historical cases that would be useful in informing contemporary practices. Many times, we tend to reinvent wheels because we have no knowledge of what past (sic) before. (Malaysia)

Investing in STEM learning and education opportunities in informal settings is very important. STEM Learning and Playing can generate impressive experience regarding STEM with kids, girls and boys. Interactive museums, marine national parks and safe public parks are way to improve STEM education in informal settings. (Thailand)

So, we can see what areas of overlapping interest for further collaboration. (Malaysia)

Analysis of this *ZOOM* chat session demonstrated that participants were engaged, and not merely sharing their pre-meeting assignments, but already thinking about how this initiative might help them to move their research, practice and policy work forward in order to engage more women and girls in STEM-related education, employment, life-long learning, and policy, as well as ameliorate some of the challenges. This was viewed as extremely positive, and a critical step in the project's achievement of its goals.

August 2021 Meeting

The purpose of this final meeting was to share the activities and products/product prototypes of the three working groups. Participants were eager to hear about what other working groups had accomplished since the initial October 2020 meeting. A chat session during the working group sharing session, as well as one after small groups discussed issues that emerged from working groups were analyzed.

As with the first meeting, the accompanying *ZOOM* chat during the working group sharing session was illuminating in terms of the questions they had, as well as ideas for moving forward:

> My question concerns how difficult it is for girls and women in such countries who missed accessing STEM in their earlier years to participate in STEM? I am thinking about disadvantaged groups who might only come to be interested in STEM later in life, [rather] than from childhood. I think we need to consider an ageing society in policies relating to STEM. (Malaysia)
>
> I have a question for the policy group: which four countries had [a] policy for girls? Wanted to know the names. (Bangladesh)
>
> I would also like to know how out-of-tertiary opportunities are expected to look like (sic). Does this mean that present resources for 'lifelong' learning in the sciences is unavailable to adult learners (thinking andragogy), especially since museums and science centres tend to cater to children and youths? (Malaysia)
>
> Could I ask if the policies specifically mention girls/women? If it is understood that it is the right of every citizen to have equal opportunity for education where does that fit? Under general education, rather than STEM, but not specific to women or girls? (Singapore)
>
> The Department of Science & Technology (DST) has several schemes for women. KIRAN (Knowledge Involvement in Research Advancement through Nurturing) embraces women-exclusive schemes of DST with the mandate to bring gender parity in S&T through gender mainstreaming. (India)
>
> Sri Lanka has one policy specific for STEM Education (Sri Lanka)
>
> [Malaysia] is right - about older age lifelong learning and also those who missed access to STEM learning in younger days. The best Practice framework covers Golden Age …. and we need to look at this - as they are also citizens, as well as influencers.

> In Malaysia, [there is] lots of Policy – it's the IMPLEMENTATION where it fails (Malaysia2)
>
> I agree about implementation failure and the failure has to do with ignorance and understanding of STEM cultures from the ground up...and this is why lifelong learning is important. (Malaysia)
>
> To [India's] comments, your points about social perspective - is almost the same issue in Malaysia!! (Malaysia)
>
> Well, work is being done in collecting primary and secondary data on gender aspects of STEM fields in Sri Lanka focusing on tertiary (higher) education (students, educators, and administrators). There were some disruptions in data collection [die to COVID], but the work is in progress. (Sri Lanka)

The Whole Group discussion was also captured after small groups focused on these issues that had emerged from working groups: Cultural Assumptions, Workforce, Work-Family Balance, and Poverty and Access. In a couple cases, and where possible, responses are roughly organized around countries.

<u>Cultural Assumptions</u>

> Malaysia: Gender stereotypes in STEM fields are often viewed as masculine and teachers and parents often underestimate girls' STEM abilities. STEM education and career are considered male-dominated cultures in the community.
>
> Nepal: Low percentages of women in STEM correspond with Nepal's patriarchal societal values.

Overall, the challenges for women themselves are the ultimate challenges for community as gender stereotypes and socialization say that "Technology is not for girls or women." Studies show that 95% of young girls are interested in science & mathematics subjects during their primary and secondary school years. The number decreases from 35% to 25% when they reach high school. Possible reasons might be the fact that they lack an appropriate mentor, someone who could train and mentor them in STEM subjects, regardless of whether, or not, they succeed.

Another possible reason for women not taking up STEM as a field of study (or lifelong pursuit/avocation) is the impact of social norms and parental influence – these suggest that boys are better than girls in subjects such as mathematics and science. Girls and women often downplay their ability to succeed in STEM, and often they assume these fields are more appropriate for men. Perceiving barriers to entry and success as too high, may lead undergraduate women to opt out of STEM fields and hence STEM careers. In addition, because as societies we do not always honor STEM avocations and pursuits, such as birdwatching, astronomy, and rock collecting, etc. women who have not been able, or are not interested in pursuing these, are not recognized as well.

Gender stereotypes tend to be activated in situations in which women, and other underrepresented groups, are fewer in number and the work being done is conceived as masculine. If, and when women do persist in pursuing careers in STEM, the stereotype of the successful 'scientist' is one who is devoted to the work, with few to no external responsibilities.

Connected specifically to the issue of STEM education in higher education, and careers, many university STEM departments, particularly in engineering, computing, and mathematics, tend to be male dominated both in terms of the faculty and the student body. The lack of female mentors and

peers may act to deter all but the best performing women from entering due to the feeling of being a token and the fear of being treated as different.

Workforce

India: Fewer in workforce; women make up only 25% of the STEM workforce (e.g., only 22% of AI professionals and 12% of machine-learning experts are women, according to a WEF-LinkedIn study.[1]

A major challenge is retention in STEM workforce: A high proportion of degree holders do not translate into a similar proportion in jobs. For example, although the number of computer degrees are quite high for women (48% of degree holders are women; AISHE 2018-19), their chief recruiters, the IT and ITES fields indicate only 34% women in their workforce[2] and a large proportion of women leave after the first five years of employment (Gupta 2020).

Another challenge is how to recruit more women into research careers: They constitute only about 16.6% of the R&D FTE personnel. There is a huge gap between the number of women doctorates and women in careers in STEM.

Indonesia In Indonesia, there is the idea that participation opportunities in STEM from K-12 through tertiary education, and ultimately in careers, are technically considered equal for both women and men. However, there are still traditional conceptions stating that STEM-related careers are for men, especially when it comes to engineering. This prevailing conception has led to less women in STEM fields, particularly in engineering.

Work-Family Balance

A report commissioned by NITI (National Institution for Transforming India) Aayog, the premier policy 'Think Tank' of the Government of India in 2016-17, stated that 30 percent of women in science, felt that their career affected family commitments and household responsibilities adversely. Additionally, 47 percent cited family care as a reason for refusing a challenging opportunity in their careers.

Apart from the domestic burden, women in STEM are also subjected to subtle biases in their workspaces. According to research by the Institution of Engineering and Technology, gender bias begins as early as when adults start differentiating their behavior with children of different genders through social interaction. Play, even with toys, can perpetuate gender stereotypes. They affect children's future career choices and interests — for example, boys are three times more likely to receive a STEM toy than girls.

There is also a tremendous challenge in implementing diversity policies at the organizational level. Although flexibility and work-life balance programs exist, those are not readily available to women employees in practice; in fact, taking advantage of such programs has negative consequences for their careers (PwC, 2016).

Poverty & Access

Income inequalities disproportionately affect women. In the informal learning ecosystem, there are major disparities when it comes to one's accessibility to inspiring programs/activities, influencers, materials and places that impact science learning. Informal learning centres that already exist are quite well attended where available, but they are out of reach to many, case in point in Malaysia. In addition, the lack of locally-created content in the Malay language for both television and the internet/social media presents a challenge in making science relevant for many Malaysians.

By conclusion of the two-day meeting including analysis of whole-group presentations, working group activities and products, as well as whole-group discussions about the products. and small

group discussions about major issues, participants indicated they were eager to continue to work on addressing the project's important issues and to take advantage of the opportunities provided and challenges they face in building intra- and international efforts to advance the role of women and girls in STEM (Goals 1 & 2).

Project Evaluation

At the conclusion of the project, participants were sent a short, three-question project evaluation survey. Approximately two-thirds of participants (N-21) responded to the survey.

Did this meeting allow you to make new contacts and connections both inside and outside of your country?

Responding participants were overwhelming positive about this question with all 21 individuals answering YES. Typical responses included:

> It was truly a pleasure to discover that others both inside and outside my country share my interest and sense of urgency around this critical issue. (Malaysia)
>
> I met several new colleagues and have begun to work with them on some interesting efforts. (Thailand)
>
> Yes, I ended up collaborating with three individuals that I would never have met or known about if I hadn't participated in this meeting (U.S.)
>
> I invited one of the researchers I met through this meeting to give a presentation to my university class. (Nepal)
>
> I participated in a regional meeting on STEM organized by one of the members of this group. This was a meeting I would have been unlikely to know about or be invited to were it not for this [meeting]. (Singapore)

Did this meeting improve your understanding of and commitment to the issue of enhancing the role of women and girls in STEM?

Again, participants were overwhelming positive in their response to this question with all 21 individuals answering YES. Typical responses included:

> I was already knowledgeable and committed, but this project inspired and redoubled my commitment and provided me with the opportunity to see how others in the region are attempting to further this important effort. (Nepal)
>
> In part because of my participation in this effort I was able to learn about several new regional projects on women and girls in STEM that I have now used to inform my own work as well as even how I now think about the issues of women and girls in STEM. (Malaysia)
>
> I collaborated with a colleague from Malaysia [who I met through this project] to jointly host a joint Malaysia-Singapore workshop on STEM education. That meeting allowed me, and others as well, to learn about a range of regional efforts and explore new partnerships. (Singapore)
>
> I never before appreciated all of the gaps that currently exist in my country's policies around equity and STEM, in particular the gap that exists in the area of out-of-school time. (Sri Lanka)

Did this meeting support and extend the work you are doing related to women and girls in STEM?

The majority of participants were also very positive in their response to this question, but unlike the previous two questions, they were not unanimously positive. Eighteen individuals answered YES and 3 answered NO. Typical responses included:

> Because of this project I was given an opportunity to publish my work [on women in STEM]. (India)
>
> I found great support for the work I'm doing with girls in STEM and was able to identify some new partners for this work, including partners from outside the university world I usual communicate with. (Pakistan)
>
> I am very positive about the experience. I was able to share a lot of the work we are doing and found others were quite interested in these efforts. Also, influenced in part by the working group conversations of this project, I helped to organize a national survey of Indian science centres to better gauge what is currently happening in terms of gender equity in the country. This information is helping to inform addition efforts by the National Council of Science Museums. (India)
>
> Although I had hoped to be able to share and extend the work we are doing in Bangladesh, I was a little disappointed in the lack of tangible examples emerging from the project. (Bangladesh)

Working Group Meeting Outcomes: Research

The major focus of the Research Working Group was the development of a series of themed articles related to women and girls in STEM from the South Asia/Western Southeast Asia region that could be assembled into a journal special issue. Each country's participant(s) submitted a brief abstract. Based on the abstracts submitted, Co-PI Varma secured a firm commitment from the journal, *American Behavioral Scientist* (ABS) to bring out a special issue on women in STEM in selected Asian countries.

Included in this special issue was an overview and introduction by project PIs Drs. Varma, Falk and Dierking, followed by a half-dozen in-depth treatments by other project participants, specifically:

Dr. Fahimda Chowdhury discusses the importance of role models in inspiring and influencing the career path of young people, particularly women and girls. Her paper includes case studies of several Asian women as a way of illustrating this point.

Dr. Namrata Gupta focuses on the challenges faced by Indian women in STEM, using the perspective of social construction as an analytical lens. This perspective helps to focus on the specific socio-cultural issues that act as both barriers to career advancement as well as suggesting possible solutions.

Dr. Nova Ahmed, Dr. Arshad M. Chowdhury, Tamanna Urmi, and Dr. Lafifa Jamal explore the current state of female student enrollment in tertiary education in Bangladesh, followed by the challenges female graduates of tertiary education face in the technical workplace. The paper seeks to provide guidelines for policies to ensure a more inclusive future for women in STEM.

Dr. Clarissa Lee Ai Ling discusses how the role of women in STEM can be enhanced through the vehicle of "fan-fiction." She discusses how this novel approach can be deployed to mainstream the incorporation of indigenous and cultural ways of knowing within Malaysia into the rubrics of institutionalized STEM education, with particular benefits for girls and women.

Finally, Dr. Roli Varma provides an overview of the status and reality of Asian women in STEM in the U.S. Although there are many Asian women participating in both higher education and careers in the U.S., most encounter the "double bind" of both ethnicity and gender bias resulting in significant barriers to work satisfaction and professional advancement.

Research Group Members

Nova Ahmed, Bangladesh; Arshad Chowdhury, Bangladesh; Namrata Gupta, India; Tamanna Urmi, Indonesia; Clarissa Lee, Malaysia; Anjana Singh, Nepal; Thilinakumari Kandanamulla, Sri Lanka; Prae Piromya, Thailand; Roli Varma, USA.

Working Group Meeting Outcomes: Policy

After a series of meetings, the Working Group decided that the most fruitful contribution it would make to this effort was to review and analyze the current regional and country-by-country policy landscape related to advancing the role of women and girls in STEM. To actualize this goal, Working Group members focused on the following two tasks:

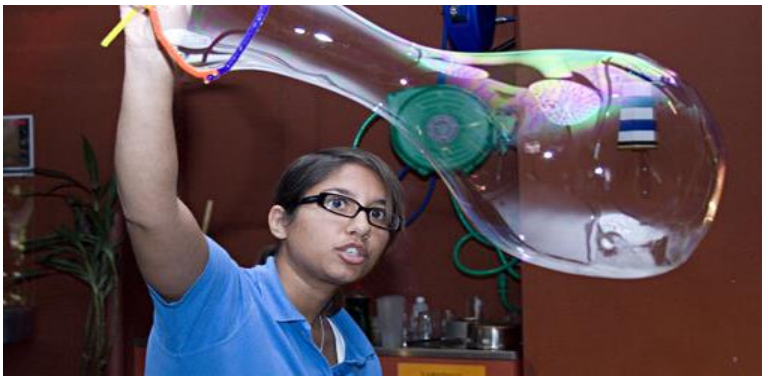
1) Collecting relevant policy documents from each of the 10 countries in the project study area; and
2) Identifying relevant policies within each of these documents related to the issue of promoting opportunities and equity for Women and Girls in STEM.

Five distinct types of documents from each country were targeted – National Constitution, National Education Policy, National Science and Technology Policy, National Development Policy and "Other" – any other relevant document that might pertain to the subject of Women (and girls) in STEM.

The project ultimately was able to assemble a total of 66 documents across these five categories from 8 out of the 10 countries, including Policy documents from Bangladesh, India, Indonesia, Nepal, Pakistan, Sri Lanka, Thailand and the U.S.[1]

The group generated a list of 18 keywords to use in combinations as search terms for relevant sections of each document. Some examples of the selected search terms were, "girls AND equity", "gender AND policies", "sex AND rights", "women AND STEM", "girls AND technology", "gender AND engineering", "discrimination AND science", "equity AND STEM", "policies AND science", and "rights AND math." Using the qualitative software *NVIVO*, analysis of these document resulted in more than 4,409 "hits" of possible policy statements.

The group reviewed each of these "hits" to determine which were truly relevant. Then, building on the work of the Practice Working Group, indicated what stage/position each of these relevant statements fit into – Table 1 is a summary matrix of <u>generally</u> relevant statements as a function of lifelong time period from 8 countries – The United States, Thailand, Sri Lanka, Pakistan, Nepal, Indonesia, India, and Bangladesh, Table 2 is a summary matrix of statements that <u>specifically refer to Women/Girls and STEM</u> as a function of lifelong time period from 8 countries – The United States, Thailand, Sri Lanka, Pakistan, Nepal, Indonesia, India, and Bangladesh). What should already be clear from both of these tables is that all countries indicate a general commitment to basic education for all citizens, including girls, and at least half of the investigated countries have relevant policy statements specific to girls and STEM for the Primary Age-School and STEM-Related Career time categories/time frames.



[1] We obtained documents from all but two of countries; both of which were un-represented on the committee.

Table 1: Aggregate country policy statements generally relevant to women/girls and STEM by lifelong time period and source document type

	Early Childhood / Pre-School Age	Primary Age - School	Primary Age – Out-of-School	Secondary Age - School	Secondary Age – Out-of-School	Tertiary Age – College, Univ. Technical School	Tertiary Age – Out-of-School	STEM-Related Careers	Lifelong Pursuits - Hobbies, Citizenship & other
National Constitution	1	8	1	8	1	1	1	1	2
National Development Policy	1	3	1	3	1	1	0	2	2
National Education Policy	2	6	1	4	1	5	2	3	3
National Science & Tech. Policy	1	2	1	3	1	1	1	5	4
Other	1	1	1	1	1	1	1	2	2

Table 2: Aggregate country related policy statements specifically focused on women/girls and STEM by lifelong time period and source document type

	Early Childhood / Pre-School Age	Primary Age - School	Primary Age – Out-of-School	Secondary Age - School	Secondary Age – Out-of-School	Tertiary Age – College, Univ. Technical School	Tertiary Age – Out-of-School	STEM-Related Careers	Lifelong Pursuits - Hobbies, Citizenship & other
National Constitution	0	0	0	0	0	0	0	0	0
National Development Policy	1	0	0	1	0	1	0	2	0
National Education Policy	1	4	0	2	0	3	0	1	0
National Science & Tech. Policy	1	0	0	2	0	0	0	5	2
Other	1	2	1	1	1	0	0	2	2

Conclusions

The above analysis revealed that although several countries have policies for Early Childhood/Pre-School Age, Secondary Age School, Tertiary Age School, and Lifelong Pursuits related to STEM, virtually no countries have specific policies in other critical categories/time frames such as Primary and Secondary Age Out-of-School and no relevant policies exist for the Tertiary Age Out-of-School time category. This represents a clear need and clear area where future efforts need to be focused.

Policy Group Members

Dinesh Bhuju, Nepal; Ganigar Chen, Thailand; Laura Djuragic, U.S.A.; Mismah bint Jimbun, Malaysia; Paige Miller, U.S.A.; Sachie Panawala, Sri Lanka; Jay Pal Shrestha, U.S.A./Nepal; Sasitorn Srisawadi, Thailand; Germaine Shalla, Singapore; KC Vijaya, Nepal; Shehnila Zardari, Pakistan; and John Falk and Dave Meier, U.S.A.

Working Group Meeting Outcomes: Practice

After the first whole working group meeting, the Practice Group decided that the most fruitful way to proceed would be to create four subgroups: (1) a **STEM Framework for Effective Practices** sub-group; (2) a **STEM Practice Partnerships** sub-group; (3) a **Network of Networks in Practice** sub-group; and, (4) a **STEM Careers and Mentoring** sub-group. Each of these sub-groups met independently, but also a whole working group, creating templates for a variety of products:

1) The **STEM Framework for Effective Practices** sub-group created and refined a career-wide/lifelong "CRADLE to GOLDEN AGE" STEM learning framework in which to organize effective practices and Professor Dato, Malaysia, hosted a virtual Roundtable for 162 participants on May 26th; some Practice group members joined (Tengku Nasariah; Anne Dhanaraj; Zartaj Ahmed; and, Lynn Dierking), as well as additional people from India, Malaysia, and Indonesia, and Australia and The Philippines, not involved in this initiative;
2) The **STEM Practice Partnerships** sub-group focused on gathering effective partnership ideas, many of which are incorporated into the aforementioned STEM Framework for Effective Practices matrix and shared on Miro board[1] by India, Nepal and Thailand, including ideas such as …… a national integrated framework to build STEM awareness and interest among youth and the public, proposed by the Ministry of Education, Singapore. If endorsed, Science Centre Singapore will play a significant role contributing to the informal education in the report.
3) The **Network of Networks in Practice** sub-group worked on mechanisms to connect a variety of existing networks, within and between countries in this Initiative; they have created a draft data-collection form for those interested in being a part of this Global Network of Networks in Practice and submitting details of their STEM network, as well as a mock-up for a website that could lead to a digital hub for collaborative events, etc. as the coalition moves forward; and,
4) The **STEM Careers and Mentoring** sub-group extended Pakistan's Zartaj Ahmed's QrisoityNet.com platform (a LinkedIn-like platform for youth, connecting them to internships, jobs and admission opportunities, as well as a global pool of mentors) to other Initiative countries to share local and international opportunities with women and girls; three communities were created: Women In STEM to discuss issues, exchange ideas on solutions and showcase Role Models; Global Women Mentors who volunteer time to inspire women and girls to pursue STEM careers; and, Women in Entrepreneurship, offering global training and opportunities to support women entrepreneurs or those aspiring to become one.

Mock-ups of these products were shared at the final August meeting, and some have subsequently been enacted, such as the three STEM Careers and Mentoring communities through the QrisoityNet.com platform. Others, such as the mock-up for a Network of Networks in Practice website that could lead to a digital hub for collaborative events, would require some funding to continue.

Practice Group Members

S. (Samarendra) Kumar, India; SE Karmila, Indonesia; Tengku Nasariah Syed Ibrahim (Nasariah Malaysia; Dr. Noraini Idris (Dato); Malaysia; Swati Thapa, Nepal; Zartaj Ahmed, Pakistan; Ram Qureshi, Pakistan & Canada; Anne Dhanaraj, Singapore; Rashane Sala-Ngarm, Thailand (also w involves Burma, Cambodia, Indonesia, Lao PDR, the Philippines, and Vietnam); Karen Peterson U.S.A.; Lynn Dierking, U.S.A.

[1] The Practice Work Group thanks Zartaj Ahmed for providing Miro Board training.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Festival2019
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नेहरू विज्ञान केन्द्र
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Conclusions

Overall, the project was able to meet both of its key goals, though as noted below with some qualifications. The project very successfully accomplished the first part of Goal #1 (Foster intra- and international collaboration between Science-Technology-Society and Popularization of Science professionals). There was a great deal of intra- and international collaboration between participants, with professionals actively forging new relationships and engaging in efforts to synthesize and discuss the critical issues (opportunities, challenges, and barriers) related to women and girls in STEM in their individual countries. There was also some evidence that the bringing together of these two, historically separate communities – Science-Technology-Society and Popularization of Science – was valuable and led to some interesting cross-fertilization of ideas and new collaborations.

Although there was considerable discussion about approaches and strategies related to resolving current inequities for women and girls in STEM, the second part of Goal #1 (to craft effective, self-sustaining models that support the public's awareness, understanding and appreciation of STEM as significant forces for economic growth and societal well-being), it was not clear such models were ever fully crafted. It was not that there were no efforts to achieve this part of Goal #1, but to be fair, this was likely too ambitious a goal for such a limited meeting/project; a limitation that was only exacerbated by the pandemic. Over the course of numerous group discussions, only a few examples of new, self-sustaining models that might support the public's awareness, understanding and appreciation of STEM as significant forces for economic growth and societal well-being emerged. Professionals in both of the two areas represented by the project seemed to struggle with creating solutions, in large part because most are still grappling with the significant systemic and long-term cultural factors at play in the region; factors that make widescale solutions daunting.

The project was also quite successful at accomplishing Goal #2 (Identify and examine opportunities, challenges, and barriers to participation of women in STEM learning, participation, employment, and leadership) – this issue was the major focus of the second day of the 2021 virtual meeting and all participants were deeply engaged in this effort. As will be discussed further below, project PIs see continued efforts in this area as a critical and much needed next step for these countries, including the U.S. There was considerable agreement among participants that resolving long-standing societal systems of male dominance and prejudice will not be easily accomplished, but without those changes, the development of effective, self-sustaining models that could support the public's awareness, understanding and appreciation for an equitable role of women in STEM careers and avocations will ultimately not be possible.

In conclusion, the ***International Conference: Public Awareness of STEM and Advancing the Role of Women in STEM*** project was a successful effort, even though it was not able to, by itself, significantly "move the dial" on creating new, self-sustaining models for supporting the public's awareness, understanding and appreciation of STEM. The project was successful, though, at laying an important foundation for that outcome. As hoped for, the meeting fostered significant international and intranational collaboration and cross-fertilization of ideas and further the understanding and commitment to efforts to enhance gender equity in South and Southeast Asia.

Recommendations

1. This meeting highlighted the desire for and value of creating international and intranational efforts in support of women and girls in STEM. Policy Makers and Funders should consider assisting representatives from the region in the establishment of an on-going vehicle for fostering these kinds of conversations, sharing of materials and ideas, and generally supporting on-going regional networking and information exchange between professionals.
2. Consistently highlighted in all project meetings of participants, and highlighted by the research, was the persistent challenges created by deep-seated cultural values and historic practices related to the role of women in the workplace. Future meetings such as this one specifically focused on just this issue might be a way to facilitate the kind of creative and sustained solutions that will be needed in order to achieve a break-through on this deep-seated and highly intractable problem.
3. On the policy front, a critical gap was identified in the out-of-school/free-choice learning space – this was equally true for both children and adults. Crafting and implementing policies that clarifies the importance and establishes the need for a lifelong commitment to the support of women and girls in STEM should be a key priority.
4. In terms of practice, there are excellent models and examples already existing in the countries involved in this effort. What is lacking are opportunities for communication, the sharing of ideas for critical review, collaboration and most importantly, research and evaluation to provide evidence for the effectiveness of these efforts.
5. Although the project went out of its way to try and includes a diverse array of participants to the meeting, limitations created by both funding and group dynamics placed significant limits on both the size and types of individuals who could be invited to participate. Duly noted was the absence of many key sectors and types of expertise, including representatives from business and industry, various community organizing groups, as well as the K-12 formal education sector. Should a future meeting be held, it would be ideal if these groups too could be represented.
6. Finally, this meeting underscored the potential critical role that the USA (through the NSF) can play in helping to catalyze international efforts to broaden public understanding of and engagement with science; both regionally and internationally. Project PIs highly encourage the U.S. NSF to continue to support projects such as this.

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Appendix A: Participants

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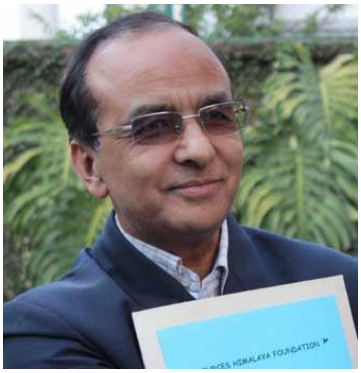

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Appendix B: Conference Agendas

AGENDA
Women (and Girls) in STEM
October 27, 2020

9:00 – 9:15 Welcome and very brief overview of project and goals

9:15 – 9:45 Introductions by all participants

9:45 – 10:45 Sharing & Discussion about opportunities and challenges (based on pre-meeting assignment)

10:45 – 11:00 Sum up discussion and next steps/plans (including journal issue)

1. Your Name – In particular, how you would like to be referred to during this meeting.
2. Your Affiliation – In particular, the ONE professional affiliation you consider most relevant to this meeting.
3. One Issue or Challenge - In particular, related to women & girls in STEM in your country you think needs to be addressed.

9:45 – 10:45 Sharing & Discussion about opportunities and challenges (based on pre-meeting assignment)

- What insights did you see from the assignments?
- As you read, what assets do each of these two communities bring to our group, as well as what assets do different countries bring?
- Building on the assets of our group and countries that already exist, are there things that a group like this might already have the capacity and leverage to make a difference in the foreseeable future?

10:45-11:00 Next Steps

AGENDA
Women (and Girls) in STEM
August 10-11, 2021

August 10, 2021

10:00-10:15	Welcome, Dr. John Falk, Executive Director, Institute for Learning Innovation & Sea Grant Professor Emeritus, Oregon State University
10:15-10:30	Welcome, Dr. Fahmida Chowdhury, Program Officer, International Programs, U.S. National Science Foundation
10:30-10:45	Overview of the 2-Day Workshop
10:45-11:15	Policy Group Presentation
11:15-11:45	Research Group Presentation
11:45-12:15	Practice Group Presentation
12:15-12:30	Advance Organizer for Day 2

August 11, 2021

10:00-10:15	Welcome/Set-Up/Framing – Dr. John Falk, Executive Director, Institute for Learning Innovation & Sea Grant Professor Emeritus, Oregon State University
10:15-11:30	Small Group Discussions Issues affecting equity & opportunity for Women & Girls in STEM • Work Force Challenges • Challenges presented by Cultural/Gender Assumptions • Challenges presented by Poverty & Access • "Glass Ceiling" Challenges in Government, Academy & Business • Challenge of Ensuring an Ecosystem-wide Approach to Equity (across age, setting & time of day)
11:30-12:15	Whole Group Sharing & Discussion – led by Dr. Lynn Dierking, Principal Researcher, Institute for Learning Innovation and Sea Grant Professor, Oregon State University.
12:15 – 12:30	Next Steps