Asian Journal of Physics
Vol. 33, Nos 3 & 4 (2024) 139-160
Available on: www.asianjournalofphysics.com

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Active learning in optics: Educational outreach activities in Pakistan

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Dedicated to Professor Anna Consortini for her significant contributions and pioneering works in the field of atmospheric turbulence and her continuous commitment to promote optics at global level

This article is dedicated to Professor Anna Consortini, my friend, my mentor and a source of constant inspiration. Her encouragement towards my teaching at Preparatory School to Winter College on Optics, at the Abdus Salam International Centre for theoretical Physics and her mentorship over the years that has encouraged me to carry on my Optics Outreach activities for under privileged girls/females educational institutes in Pakistan.

Keywords: Educational outreach, Hands –on optics, Girls education, Remote areas.

Brief history of my association with ICTP

I feel honored to have a chance to write about my association with the Abdus Salam International Center for Theoretical Physics (ICTP) and my "Optics family" I met there. I visited ICTP in 1988 for the first time to attend the winter activity in optics, as a young student of Department of Physics, Quaid-i- Azam University Islamabad, Pakistan.

(From L to R) Dr Amal Kasry, Chief of Basic Science Section UNESCO, Imrana Ashraf Zahid (QAU), Professor Joseph Niemela (Senior Research Scientist Emeritus ICTP).

Then in the past 35 years I visited ICTP, as a student, as an associate, as a tutor, as TRIL fellow, and now as lecturer to winter activity in Optics since 2007. I realized how much scientists there are committed to work for under-developed countries, like Pakistan. I would like to mention the name of my mentor late Prof Gallieno Denardo, who coordinated ICTP's optics events, whose trust and faith encouraged me to assist winter college attendees. Teaching at ICTP for the winter activity on optics is a very important part of my life and I greatly enjoy it. After Prof Denardo, I found a good friend and course director, in Prof Niemela,

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who not only trusted my teaching but also very kindly supported my outreach activities for young female students in Pakistan.

This time period of my association with ICTP is incomplete without mentioning my co-tutors for Preparatory School to Winter College on Optics since 2007 to 2020, namely Prof Anna Consortini and Prof Miguel Alonso. Over the years we had shared office space, had coffees and meals together apart from teaching. Miguel used to stay in city center while Anna and I stayed at Adriatico Guest house, during first week of activity. This gave me an opportunity to have a quality time with her during and after the dinner. She is a true source of knowledge in optics and in different aspects of daily life.

Anna Consortini: Initiatives on optics education, honors and awards

In 1987, at the General Assembly of ICO-14, in Québec, Canada, Anna Consortini was elected Vice-President, being the first woman to be elected as a member of the Bureau. At the next general conference in 1990, ICO-15, she was re-elected for another three years. During her six-year term as Vice-President of ICO, she worked hard with dedication to promote of many aspects of education and training in optics and photonics.

In 1993, Prof Consortini was elected ICO president (first female president) at the ICO-16 General Meeting, "Optics as a Key to High Technology", held in Budapest, Hungary. During her term as ICO president, Anna Consortini helped to clarify the role of ICO in conferences, topical schools and other scientific events. She broadened the ICO network over many countries of the world during her three years tenure. During her period of presidency she has done enormous needed work for the development of optics and photonics around the world. At the ICO-17 General Assembly held in Taejon (South Korea) in 1996, Anna Consortini became Past-President for another three years term, she continued with her tireless work as she did in previous terms with many activities and initiatives.

Prof Consortini always supported activities involving education and training, such as UNESCO sponsored program Active learning in Optics and Photonics (ALOP), co- sponsored by ICTP and SPIE. It offered hands on training in optics and photonics in educational institutes, in developing countries. Anna Consortini participated in some of these activities and helped to design new experimental set- ups, to be used for ALOP workshops.

The annual Winter College on Optics at the Abdus Salam ICTP started over three decades ago, with first in 1993 under the agreement between the Abdus Salam International Centre for Theoretical Physics (ICTP) and ICO. Then in 1995, Prof Anna Consortini co-directed Winter College in optics, with Prof J C Dainty and late Prof Denardo as local organizer from ICTP. It was the time when ICO started, under the presidentship of Anna Consortini, offering support and advice for the organization of the Winter College on Optics. During all these years Prof Consortini worked hard to promote Winter College on Optics at ICTP, with her suggestions and advices. Later on she designed affordable experimental setups for Preparatory School to Winter College on Optics at ICTP. She always helped Winter College participants to understand new optical experimental techniques.

In 1994, Anna Consortini proposed to the late Prof Gallieno Denardo, for the initiation of the ICO/ICTP award. The ICO and ICTP agreed to establish this joint prize for researchers from developing countries having less than 40 years old, active in research in Optics and have worked to the promotion of Optics in their own or another developing country. The award was finally approved in 1999.

The late Prof Denardo believed that knowledge of optics and photonics was important for a large subset of scientists and students around the world. In 2003, he proposed the creation of the so-called Trieste System for Optical Sciences and Applications (TSOSA) Advisory Group, with the mandate to promote

Optics and Photonics in developing countries. Prof Consortini is a very active member of TOSSA from the beginning until the present.

Winter College on Optics 1995, ICTP Trieste, Italy. Second row, seated, from right: Anna Consortini (4th), Christopher Dainty (5th), Kehar Singh (6th).

Winners of ICO/ICTP award 2004 with Prof Maria Yzuel (2nd from left) and Prof Anna Consortini (4th from left) .

She was the recipient of the Robert E Hopkins Award for her outstanding dedication to promoting optics at an international level involving valuable leadership and partnership with institutions and scientific societies including the International Commission for Optics (ICO), ICTP, OSA and SIOF in 2018.

Anna and I

Prof Consortini has an excellent research career. She has published more than160 papers and presented many Congress talks. In early years of her career she worked on radio waves, space vehicles and antennas, with special inclination on theoretical and experimental problems in classical and modern optics. Later on Prof Consortini headed the group of theoretical and experimental research on atmospheric propagation at the University of Florence. Her outstanding work as a scientist in the field of atmospheric optics spans over more than fifty years. She worked for many years on the subject of atmospheric turbulence, with her students and researchers of her group.

Prof Consortini during award ceremony at FiO LS 2018

Professor Anna Consortini embodies elegance in a professional and personal capacity. I personally learned a lot from Prof Consortini, during my visits to ICTP. She has been and continues to be my mentor, and above all, her positive support gave me confidence and inspiration to teach under- privileged students at ICTP and to do outreach optics activities for mainly under-privileged girls, mostly at female educational institutions, back home.

An important approach to increase student's interest in science is to trained teachers to be more effective in high schools. I had a chance to be one of the facilitators for UNESCO teacher-training workshop Active Learning in Optics and Photonics (ALOP) in Islamabad, Pakistan, in connection with the International Year of Light (IYL), with Prof Niemela [1].

The success of ALOP broadened my vision and inspired me to establish an Active learning in Optics (ALO) program that could bring the benefits of active learning to particularly disadvantaged students outside of the regular school curriculum. ALO is a self-funded program under the umbrella of ICTP and QAU to bring physical sciences to underprivileged girls high schools and colleges in remote areas of Pakistan. It has started in January 2016 as a way to provide girls an enriching science experiences, in a very friendly atmosphere [2]. More than 70 outreach activities were organized to support and encourage girl's students to pursue careers in Science. These activities were mostly done with schools, colleges and universities of twin cities Islamabad/Rawalpindi. In 2019, we extended these activities to Khyber Pakhtunkhwa (KPK). Almost ten hands-on activities were conducted for undergraduate students at Department of Physics at Quaid-i-Azam University,Pakistan.

Educational outreach and gender equity in Pakistan

Pakistan is a developing country that is aiming to improve its economical growth and meet with the speed of the fast growing economies of the region. Pakistan is endeavoring to achieve development, while diminishing gender disparity at all levels, especially in education. Although the status of women has improved in recent years, gender imbalance remains persistent. Women are about 49.2 % of Pakistan's total population. The dropout rate for primary age girls is 32% compared to 21% for boys. By grade six, 59% of girls versus 49% of boys are out of school and by grade nine only 13% of young women are still enrolled in school. For achieving national development it is necessary to train young female students and allow them to appreciate, and be inspired by Science. In order to address this issue we need to start from basic education in sciences for young students in general and young female students in particular. The challenge is how and where to start. Our ideas are to

- Reach out to government girl's schools/colleges to do outreach activities, using Active Learning in Optics (ALO) platform.
- Reach out undergraduate students- boys and girls, in public sector universities to do outreach activities using Active Learning in Optics (ALO) platform.
- Reach out undergraduate /graduate students in Physical Sciences to help them virtually/ online using Pak-ICTP Alumni Society (PIAS) forum.

Roadmap to active learning in optics (ALO)

The year 2015 was very special for many of us in Pakistan and elsewhere, as it was designated by the United Nations as the International Year of Light and Light-based Technologies (IYL 2015). That fact in itself created a special environment and "endorsement" that gave life to many ideas for outreach that could have a positive and lasting impact on society.

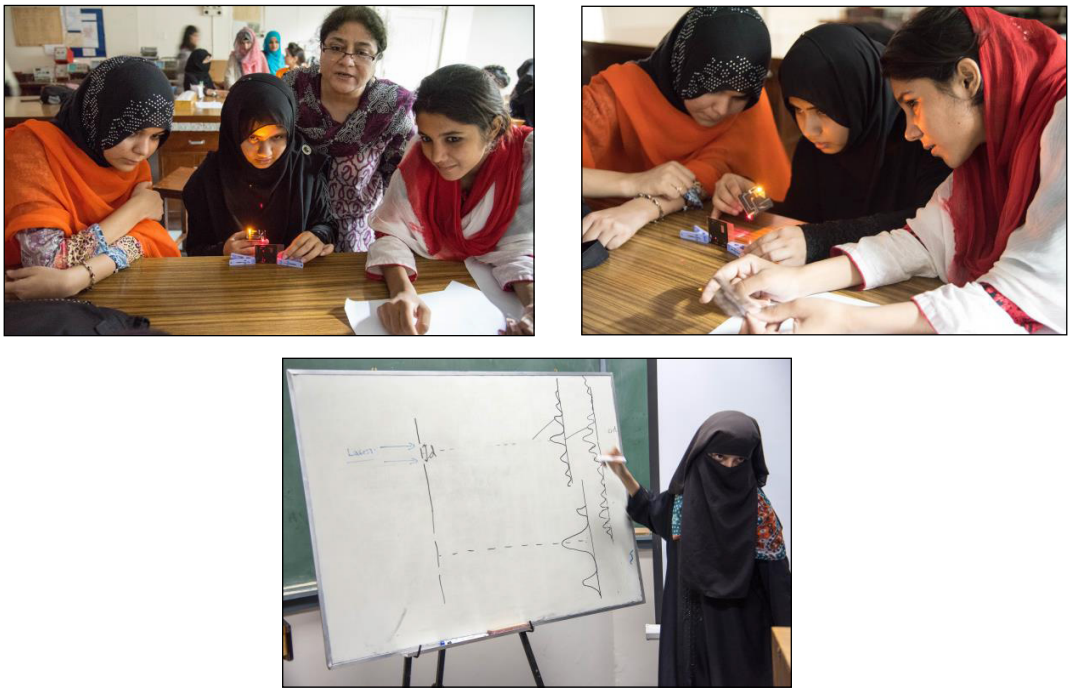
This story begins during first half of 2015. Being a physics teacher, tutoring young students each year for a decade during the Preparatory School to Winter College on Optics at the Abdus Salam ICTP in Trieste, Italy, it was easy to generate and refine those ideas.

All those past years, I realized that scientists at ICTP are committed to work in and for under-developed countries like Pakistan. Prof Joseph Niemela is one of them. During a coffee break at Winter College on Optics (2015), Joe and I discussed about a forth-coming IYL 2015 activity in Islamabad, a UNESCO teacher-training workshop financially supported by the International Society for Optics and Photonics (SPIE), named Active Learning in Optics and Photonics (ALOP). We also discussed the need to take some of this material directly to students at both the undergraduate and high school levels, and in particular to give special opportunities to young women for the related hands-on activities in optics. He had very kindly given me some Photonic Explorer kits (EYEST). Later he received some APS kits, which he delivered during a visit to Islamabad in July 2016, in which he was able to observe and photograph an outreach event for 20 female undergraduate students at Quaid-i-Azam University.

Winding back to 2015, I realized that I had all needed ingredients to take hands-on activities to schools and do something personal for IYL 2015. After coming back to Pakistan I discussed this with my colleague Dr Raheel Ali, a laser physicist, who at that time had agreed to work with me for the ALOP project, held during second week of December 2015. Our dream was to do something to help inspire a new generation to study science, through a hands-on, active learning-based session in optics dedicated to IYL 2015. For our first outreach visit, we went to a private school in Islamabad. When we were discussing the possibility of this visit with their science teacher he was very enthusiastic about it. At that school the teacher was much more involved in the learning process, than the students. This experience taught us a number of things and one of them was the realization that private schools didn't really require our support, whereas public or government schools had a real need. That is where we decided to focus our efforts. In coming sections of this article I will share some details about few activities done over the years.

Bringing the joy of scientific inquiry to girls in Pakistan

In January 2016, we started our optics activities at large scale by inviting undergraduate girls from local government colleges and schools for a one-day active learning event in optics. Each experience inspired us to do more. It is hard to describe the enjoyment of seeing young enthusiastic girls so keen to learn, so eager to get their hands (and minds) engaged. In fact, it was always difficult to say good-bye to these girls at the end of the day and they always wanted us to invite them again. And this was not something they got credit for. They did it presumably for the enjoyment of discovery, the same motivation that often inspires graduate students and established researchers to work the long hours that are necessary. It of course is our hope that some of these girls will decide to continue in science and that we may see them in our classes and, most of all, that they may choose to do outreach themselves one day and be a role model for a new group of girls [3].



One day hands on Optics workshop at Department of Physics at QAU on 16th July, 2016

We talk about the power of science in terms of great discoveries that have improved our quality of life. That was highlighted extensively in 2015 in the context of light technologies. All very true, but some of us learned in 2015 another lesson: that scientific inquiry in its most humble form, as an exercise for young girls, also has the power to significantly improve the quality of life, perhaps only for a day in our case, but probably for much longer.

International workshop on 'Optics and Photonics' (IWOP 11th to 15th Dec, 2017, QAU, Islamabad)

In 2017, apart from our usual outreach activity, we organized a five days international workshop on Optics and Photonics (IWOP) at the Department of Physics Quaid-i-Azam University (QAU), Islamabad, Pakistan (11th-15th December, 2017) [4]. The purpose of the workshop was to bring together the ICO-ICTP Gallieno Denardo Award winners and other leading scientists from around the world, working in the area of Optics and Photonics.

Our Chief Guest Prof Niemela (ICTP, Italy), while inaugurating the workshop said that it is an excellent platform to gather talent from different parts of the world. He emphasized that science is international and naturally involves collaborations across diverse national boundaries, and so it was good to have so many scientists from different parts of the world together, sharing their knowledge.

International speakers, foreign participants and organizers at IWOP 2017. First row, seated, from right: Imrana Ashraf (3rd), Joe Nimela (5th).

The activity was designed to promote Optical Sciences and applications within Pakistan's scientific community including students. The workshop structure allowed students and young researchers to meet and interact informally with the plenary speakers and other international participants. We were honored to have Prof Joseph Niemela (ICTP, Italy), Prof Miguel Alonso (University of Rochester- USA), Prof Ali-Reza Mouradi (University of Zanjan-Iran), Prof Parviz Elahi (University of Bilkent- Turkey), Prof Humberto Cabrera (Institute of Scientific Research, Venezuela).

A variety of topics were addressed in the workshop, including Classical Optics, Quantum Optics, Atom Optics, Nonlinear Optics, Optical Engineering, Fiber Optics, Optoelectronic Devices, Laser Spectroscopy, and Optical Imaging.

Winners of Oral and Poster presentations with OSA representative Prof Miguel Alonso (5th from left), Prof Imrana Ashraf (6th from left) and other Speakers.

In addition to the lectures, hands on activities were also conducted, covering a variety of topics, including the basics of optics, information processing, Fourier optics and laser spectroscopy.

The Optical Society of America (OSA) and SPIE, the International Society for Optics and Photonics, have sent prizes for the best oral and poster presentations. The prize for best oral presentation was shared between Ozge Demirtas (Middle East Technical University, Turkey) and Sviatoslav I Gusev (ITMO University, Russia). Poster prizes were given to three students: first prize was shared by Sidra Jamil (Quaid-I-azam University, Pakistan) and Vahideh Farzam Rad (Zanjan University, Iran), while M Khairol Anuar Zaini (University of Malaya, Malaysia) took the second place prize.

Optics Fair at Department of Physics, QAU, April 2018

Two days Optics Fair was organized at the Department of Physics, Quaid-i-Azam University (QAU), Islamabad, Pakistan on 27th -28th April, 2018. The purpose of the Optics Fair was to celebrate International Day of Light (IDL) in collaboration with SPIE.

We received almost 250-300 students on the first day of fair and approximately 80-100 students on second day from different schools of Pakistan, including 50-60 faculty members from these Institutes. The invited schools include:

- Lahore Grammar School, Islamabad Branch.
- Government Post Graduate College for Women, 6th Road Rawalpindi.
- Undergraduate Block, Quaid-i-Azam University, Islamabad.
- Islamabad Model College for Girls (IMCG), Quaid-i-Azam University road, Islamabad.
- Islamabad Model College for Girls (IMCG), G-8, Islamabad.

Some participants at two days optics Fair in 2018

Facilitators and demonstrator at Optics Fair during 27th-28th, April 2018

An opening lecture was delivered to students about importance of light and optics in our daily life. Then the organizers and student committee members demonstrated experiments related to light and optical processes.

- Adeela Rehman and Abdul Rahman: Hologram
- Shazeb Aziz: Absorption and Reflection of Light using Gummy Bears and M&Ms
- Bilal Shafique: Reflection, Refraction and Total Internal Reflection
- Sidra Jamil: Scattering of White Light, it's Generation and Color Swapping
- Saba Taj and Iqra Khalid: Optical Illusions

The International Society of Optics and Photonics (SPIE) provided financial support for the organization of the Optics Fair. The funding was mostly spent on decoration, refreshments, goodie bags and apparatus for demonstrations.

There is always a Light around the corner (2019)

After the cold period of winter, the month of March is a real spring season in Islamabad, as beautiful as it can in any other part of the world. The leafless trees start a new life cycle with fresh green, tiny leaves, fruit trees are full of blossoms and violet patches of wild flowers grow up in grass beds. Quaid-i-Azam University, situated at the foot of the Margalla Hills, shares this Spring season with the rest of Pakistan; its various plants show many shades of green from deep hues to lighter ones.

This beautiful and peaceful atmosphere, with its implicit hope for rebirth, brings a lot of energy to do something positive and useful for the people of Pakistan; in our case especially the young and talented female students in high schools and the university.

Unfortunately, while Nature was celebrating its annual passage from winter, it was a very tense time for mankind, especially at the Eastern border. Our airspace was closed repetitively during this time and the peace and tranquility was quite fragile. We as a nation have learned over many such years that life must go on in it's own pace.

Inviting students from schools, which are far from Quaid-i-Azam University (QAU) appeared to be problematic at the time, so a decision was made to invite students from a government school located near QAU on the 13th of March (2019). The purpose of this activity was to celebrate the International Day of Light in collaboration with The Abdus Salam International center for Theoretical Physics (ICTP), the Optica-, SPIE, and the International Commission for Optics (ICO) [5].

Group photo of participants with tutors and foreign delegates (13th March 2019)

Dr Muhammad Ali, the Vice chancellor of Quaid-i-Azam University, Islamabad, chaired the session. We also had some honorable guests with us from The Abdus Salam International center for Theoretical Physics (ICTP), which include Prof Sandro Scandolo (Head, Scientific Programs, ICTP), Prof George Thompson (Head Associate and Federation Schemes ICTP) and Prof Joseph Niemela (Optics Coordinator ICTP).

1. Hands on Optics for 7th and 8th graders:

The activity had been designed to promote Optics, Photonics and its applications among students in Pakistani Government (public) schools. The intention was to allow students to understand, using their minds and their hands, the natural phenomena of light and to develop new perspectives on related natural processes. This particular activity was mainly focused on students of 7th, 8th standards. An opening lecture was delivered to students about the importance of light and optics in daily life just to get them oriented towards science and society at the beginning. The rest was lots of active learning to let them -if nothing else- enjoy a day of science without any barriers.

Fun with diffraction glasses

2. Hands on optics for girls in remote areas of Khyber Pakhtunkhwa

The twin cities of Rawalpindi and Islamabad are always convenient for us, in terms of facilities, we also felt it was important to go where fewer other opportunities presented themselves to students. Specifically, we arranged a one-day event “Hands on Optics for Girls”, in Mardan Women’s University on the 12th of April 2019. Mardan is a city in the Khyber Pakhtunkhwa Province of Pakistan, home to the Pakistani Nobel

Peace Prize laureate Malala Yusufzi. Located in the Valley of Peshawar, Mardan is the second-largest city of Khyber Pakhtunkhwa, after the nearby city of Peshawar, and is known for the hospitality of it citizens. Mardan is also known for its archaeological importance, particularly because of the Buddhist stupas of Takht-e-Bhai.

It was our first 'Hands on optics activity' in that region. Being a conservative part of Pakistan, female education is a challenge. We were expecting to have some variety of audience, from local girls' school/colleges and of course undergraduate students from Mardan University. After spending whole day with beautiful young enthusiastic girls we left quite satisfied that we had made a difference.

Some of the participants from Mardan Women University (12th April 2019)

Illuminating Masses

As a third step to celebrate IDL we arranged a one day activity named "Illuminating Masses" at Department of Physics, Quaid-i-Azam University Islamabad, Pakistan on 29th April 2019 in connection with International Day of light 16th May 2019. We invited young female students of undergraduate level from a new emerging university "Rawalpindi Women University". For this activity, we used Photonic Explorer kits (courtesy of EPS Physics for Development Group), the Explore Optics Kit by SPIE and the Optics Suitcase from OSA.

Photo of laymen participants along their teachers and organizers

We arranged a special activity for Laymen to Science on the same day, which included clerical staff and security personnel from Quaid-i-Azam University in general and from the Department of Physics in particular.

In all, it was a successful Spring for many young women in Pakistan, a time to flourish in scientific discovery alongside Nature's display of colors, and a brief moment in which to join others from around the world to experience joy and peace within the UNESCO International Day of Light.

Let the light always be on (2020)

There is no doubt that 2020 has been one the most challenging years in recent memory for all of us; a year that will be marked in our lives. We faced difficulties and uncertainties and we did our best to face the situation. Despite the challenging realities of 2020, some positive things also happened. We learned to have unity in the necessary things, respect freedom in doubtful things and to show solidarity in all things.

Countries around the world began closing their educational institutes in March 2020 due to Covid. For a developing country like Pakistan, with limited Internet facilities, going for online education was not an easy step. Reaching out to students virtually, especially those living in remote areas of Pakistan with no electricity at times and no connectivity most of the time, was the biggest challenge. It was difficult for students to take online classes and virtual laboratory sessions and it was almost impossible to do outreach in person activities. In the most challenging times, we find our strength, and Active Learning in Optics (ALO) group at Department of Physics, Quaid-i-Azam is no exception.

After the end of first lock-down due to COVID 19 in Pakistan, Active Learning in Optics (ALO) group found a narrow window of time and decided to make good use of it. Our group is among the ones, if not the only one, which did in-person outreach activity in October 2020, to celebrate the International Day of Light. One-day event was organized at The Swabi Women University, Swabi, Pakistan.

The Swabi Women University is newly established university with non-existent experimental facilities in the teaching laboratories. The city of Swabi is situated in Khyber Pakhtunkhwa (KPK), almost 100 km from capital Islamabad. The event started with a presentation on importance of female education in Pakistan and especially in KPK. Then role of ordinary light, laser light, LED and light based technologies was explained to the students. Different optical experiments, including but not limited to, scattering, laws of geometrical optics, total internal reflection, polarization, optical fiber communications were performed with students. OSA, SPIE and ICTP provided the teaching kits used. A group of 45 undergraduate girl students attended this activity with full interest along with their Physics teachers, namely Dr Ambreen Ayub, Dr Shuja and Ms Maria Tabraiz [6].

Swabi Women University, KPK Oct. 2020. Imrana Ashraf (3rd, standing from left to right)

Optics for you: As you matter (2021)

In many ways, it is a relief to bid adieu to the upheaval of 2020. Nature does not follow any calendar, boundaries, democracy or monarchy and is not aware that we wish for better times. We hope that the experience of last year will leave us with the consciousness to be more respectful of nature and natural resources. Solidarity and open science are the most precious assets for humankind. As we flip the pages of

the calendar to the New Year, we should recognize the opportunities before us. We started the New Year 2021 with lot of positive hope, hope to have access to vaccination, hope to have in person education, hope that life will be back to normal soon.

The first activity of IDL 2021 was organized at Islamabad Model College for Girls (IMCG), a public sector college, situated near Quaid-i-Azam University, Pakistan. This college was among many other government schools/colleges that remained closed during 2020. In comparison to the private School's students, government school's students were promoted to the next grade without examination as per government policy during pandemic. Students from public schools/colleges have lost one year of learning. Most of these students belong to families living in suburbs of Islamabad, use public transport to reach school, have no internet at school, no smart phones at home to acquire knowledge [7].

Students of grade 10 at IMCG College on 10th Feb. 2021

A day full of learning cannot compensate the loss of one year of knowledge but a day full of fun with optics can bring joy for learning. Following the SOPs of Covid-19, we decided to start activities of

2021 with an in-person event for IMCG students. It is not so much about what the girls learned on that day, but rather that they had on that day a level of respect independent of their gender, and independent of their social status. It also communicated to those bright-eyed, curious girls that they are important for us, their loss of knowledge matters to us.

Light on girls' education during lockdowns (Fall 2021)

The COVID-19 pandemic has added a new variable of uncertainty in our respective lives. It has caused dramatic loss of human life across the globe and has led to devastating social and economic disruption. Closure of educational institutes impacted student learning and it is yet to be ascertained as how the rapid conversion to online instruction affected student achievement. The leadership of educational institutes continues to grapple with the difficult decision to find the balance between health risk associated with on-campus learning and educational needs of the students, which are better served by in-person instruction. These unprecedented circumstances bring a new set of challenges for the already struggling academic communities. The impact is more severe for developing and economically disadvantaged countries and has led to interrupted learning, compromised healthcare, nutrition and worsening economic conditions.

Before 2020, we used to look for a time window to do hands on activities in the middle of each teaching year in annul system colleges, after mid-term examination in semester system based universities, and just before final exams in most needed government girls schools to support students with hands on knowledge. Now, we need to wait for a time window in which educational schools are open again, for in-person teaching at the end of each fresh Covid wave. Even being a developing country we have been lucky to have good supply of Covid vaccination. This brings a positive hope of coming back to more or less a normal life.

At the end of fifth wave in November 2021, we decided to do hands on activities in December. Usually these time windows are short and uncertain, so we needed to move fast and did couple of activities, one after another. During first week of December 2021 we had managed to do two hands on activities, especially for under privileged girls' institutions.

(i) Optics Workshop for girls:

We organized and directed one day optics workshop for high school and college students at Sir Syed school and college Campus-IV, Wah Cantt, Pakistan on 3rd December 2021. This institute is a unique example of co-education, boys section is on ground floor of huge building, while girls section is on first floor. I asked why it is no other way around those girls on ground floor and boys on first floor. The answer was in this way they can keep them segregated in a better way.

We initially planned this activity for girl's section only but when we reached, their Principle requested us to accommodate boys at least for my presentation and demonstration of optical phenomena that we usually do on stage. Being an educator I cannot refuse it although I am always more inclined to girls' education than boys. When we entered auditorium it was full to its capacity with almost 150 female and 140 male students, eagerly waiting for this wonderful event. The session started with a lecture on importance of Light and Light based technologies, followed by demonstrations of some properties of ordinary light. LED and Laser lights. After this first part boys were needed to leave as school did not have enough space and we did not have enough kits to cater both genders. Before saying goodbyes, we made a promise with boys to visit again for them. The hands on session was consists of various optical experiments, based on refraction, reflection, diffraction and total internal reflection. They were performed with the help of kits provided by OPTICA, SPIE and ICTP.

(ii) One Day Outreach for Girls:

The second workshop was organized on 7th December 2021 at International Islamic University, Islamabad (Girls campus) for undergraduate students. The girls campus of Islamic University lack teaching

laboratories of Physics. Therefore they need to walk down to boys section once per week to perform basic experiments of Physics, that is also not a straight forward arrangement, no boys are allowed near their laboratory on that particular day. The day we conducted this workshop was quite exciting and informative for the girls. The session started with a lecture on Importance of Female education in Basic Sciences, followed by a four hours long hands-on session with girls for experiments of light additive & subtractive colors, filters, polarizers, reflection laws, scattering, converging & diverging lenses. Then time for all of us simply flies and soon we needed to say goodbyes, promises of visiting again were made. On our way back we were taken to a research laboratory and it was surprising to see huge setups of very sophisticated research laboratory on the same campus where there is no teaching laboratory for girls. Again I had no answer to my simple question "Why?".

Sir Syed school and college Campus-IV, Wah Cantt. Dec 2021.Imrana Ashraf seen in picture (3rd from R to L)

Outreach activities during first quarter of 2022

The year of 2022 comes with different set of challenges for strangling economies of countries like Pakistan. For Active Learning in Optics (ALO) group, the start of 2022 brings many positive hopes of doing outreach activities uninterrupted. We visited various public sector universities; colleges and schools for outreach Optics activities

Now as this year is ending we can say that it was productive year for us and for students we catered. In first half of this year, our first visit was for a newly established university called University of WAH

(2nd April 2022), Department of Physics. It has total strength of 350 students. The program started with the lecture of light and light-based technologies. Later using Optics kits, we performed different experiments including diffraction, scattering, geometrical laws of Optics, total internal reflection and fiber Optics etc. It was very satisfying experience for us.

International Islamic University, Female Campus 7th Dec. 2021

Imrana Ashraf (Extreme Right) with students

Department of Physics, University of WAH, Pakistan (2nd April 2022)

Imrana Ashraf (7th from left)

A- and O-level students from Head-start school, Imrana Ashraf (3rd from left) (6th April 2022)

Then second activity was in a private school named Head-start that is never in our priority list of optics activities. Most of these schools opt for Alternate to Practical (ATP), a theoretical course instead of laboratory but again being educator we cannot ignore students that need our help, knowledge is still their right. We hope students had learn something in one-day activity at least they touched some optical elements and see some optical phenomena first time in their course of studies.

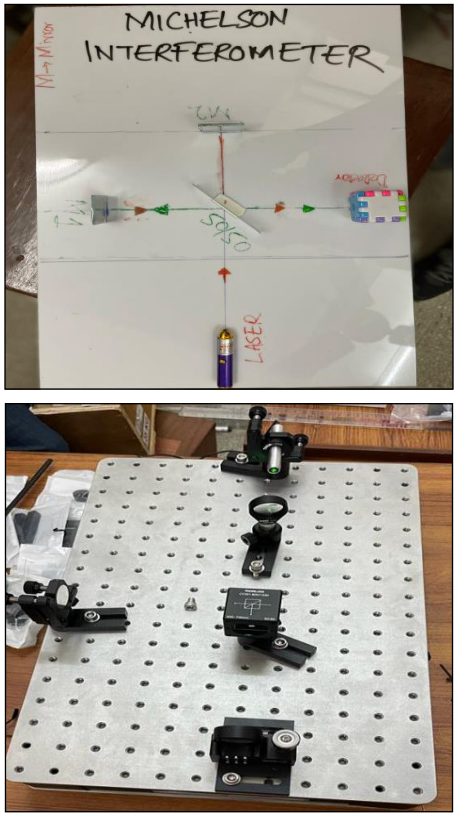
We would like to mention about our third activity that is very close to my heart. The school we visited on 25th of April is located in a sector that belongs to middle salaried class. Usually in Asian culture, middle class families have many children. One needs to fight for almost everything with your siblings, sometimes even for love. For this hands on Optics activity we had 73 girls students from grade 4/5. We carried ten Explore Optics Kits by SPIE, so ten reflectors and almost 70 girls. Their effort to hold one and do not let it go till the virtual image of clown is done neatly. They were happy after the activity and what a rewarding day we had. Would like to add one photo that is the reflection of their determination and strong will to learn. Our future is bright if we let these girls to SHINE.

Students on 4th and 5th grades at a Hands on Optics activity, 25th April 2022

Imrana Ashraf (2nd from left) with students

Transition from Toys to Thorlabs (16th -20th May 2022)

In Feb 2020, Winter College on Optics was last in person activity that took place at ICTP before COVID lock-down. Then ICTP went into silent mode for a long period. Slowly online activities started and first virtual ICTP College on Optics took place from 16th - 20th May 2022, in connection with international Day of Light. The topic was ' Theory and Applications of LIDAR'. The hands on sessions are always very important part of Preparatory School to Winter College on Optics, but for online activity it was not possible. For ALO hands on activities, we planned to make models to describe working principle of LIDAR. We made models of Michelson, Mach-Zehnder and Sagnac Interferometers and two models of Ring-laser and Fiber-Optics Gyros. Our students got an idea how they work but were not able to play with these models made of toys. At this point in time ICO president John Howell made an entry and feel sorry for my students and me. He very kindly offered me to send some equipment from his laboratory in Hebrew University in Israel so that we can make our own interferometers and LIDAR at department of Physics, QAU, Pakistan. Unfortunately, he was not able to send me these equipments from Israel to Pakistan. He came up with many ideas to get support for my students and me. Finally with his sincere efforts we managed to have meeting with Thorlabs representative, Jamie LaCouture. She very kindly agreed to send me two educational kits from their office in Germany and put me in touch with Francesco Zingariello, Sales Team leader. He proved to be very kind and positive person. He supported me all the way from Germany Sales office to Quaid-i-Azam University. Now, I am proud to have two educational kits for my students and a very good friend Francesco. These two kits contain most advance equipment that we have for our outreach activities. They will help our under-graduate and even graduate students to see and understand physical effects of experiments.



From toys to Michelson Interferometer: an educational kit by Thorlabs, Inc.

With the addition of these kits, we can now organize some advance workshops on Optics. As these kits can easily fit in a car trunk, we are planning to take them to some newly established women universities in remote areas of Pakistan.

What we learned…

As we have learned now from these experiences, the active learning environment provides a very friendly atmosphere (potentially different from their normal class experience), where students are encouraged to ask questions (also potentially different!) and make predictions about the possible outcome of an experiment based on a carefully chosen set of observations, rather than going into mathematical equations. During the process they are encouraged to interact with their fellow students as well as their facilitators. Unheard of! Speaking of light: their smiles, their laughter, the glow in their eyes reminded me of exactly that: light is as beautiful as any rainbow, or reflection from a pool.

If I seem overly poetic about the experiences of these girls it is because I have been affected as well. Being a woman, being a daughter and later a daughter- in law, being a wife, being a mother of young girl and also knowing the realities how female children have been treated in remote areas of my beautiful country makes me want to do so much more, especially in those areas where having an uneducated male heir is a greater source of pride to a mother than a daughter with an advanced degree. Maybe it is not so much about what the girls learned on any particular day, but rather that they had on that day their own voice, a level of respect independent of their gender, and the chance perhaps to just have fun and follow the path where their natural curiosity took them.

Therefore, I slip back into poetry: for me, these young Pakistani girls really do embody light and their faces transmit a positive energy that says clearly: We are your future, take care of us and we will take care of you, as good citizens, mothers, teachers, and as productive members of an enlightened society, where culture and traditions do not have to be in conflict with the realization of the potential of young girls.

Acknowledgement

I would like to acknowledge the moral support of Prof Consortini for my outreach activities and Prof Niemela for paving my way to optics outreach in remote areas of Pakistan. A special thanks to Dr Abdul Rehman for all of his help and support during these activities. Last but not least I would like to extend my gratitude to ICTP, Optica, SPIE and ICO for their constant support in terms of optics kits and other resources.

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RECOGNITION WEB LINKS:

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Dr Imrana Ashraf is the first Pakistani woman who did her Ph D in Quantum Optics. She is affiliated with Department of Physics, Quaid-i-Azam University, Islamabad, Pakistan. She is senior member of OPTICA (formerly Optical Society of America), Senior Associate at The Abdus Salam Center for Theoretical Physics (ICTP) from 2019-2024), member of SPIE and managing director of International Commission for Optics in Pakistan. She visited ICTP first time in 1988, to attend winter activity on Optics. Then from past more than three decades, she visited ICTP, as a student, as an associate, as a tutor, as TRIL fellow, and now as lecturer to winter activity in Optics since 2007. She had been one of the facilitators for UNESCO teacher-training workshop namely ALOP in Islamabad in connection with IYL in 2015. http://www.ncp.edu.pk/alop-2015.php

Ashraf established Active learning in Optics (ALO), a self-funded program under the umbrella of ICTP and QAU to bring physical sciences to underprivileged high schools and college girls in remote areas of Pakistan. It started in January 2016 as a way to provide girls an enriching science experiences, in a very friendly atmosphere. https://www.facebook.com/opticsworkshops

In 2020 Ashraf realized that the global Pandemic was greatly impacting the social nature of science and collaboration. International travel restrictions contributed to isolating conditions for scientific communities. She was especially concerned about scientific communities in developing countries, where access to reliable internet and vaccines can both be uncertain. Known as an energetic scientist and mentor, Ashraf came up with the idea for and drove the launch of the Pak-ICTP Alumni Society (PIAS). It aims to nurture research collaborations, organize scientific outreach activities, provide career and vocational mentorship and help to develop active academic linkages between Pakistani and Italian educational institutes. https://www.facebook.com/Pak ICTP Alumni.