Promoting Best Practices for effective Hands-on and Distance Learning Programs in future for Space Science and Technology Education

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Meeting of Directors of Regional Centres (UN affiliated)

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www.cssteap.org

Topics

Introduction:

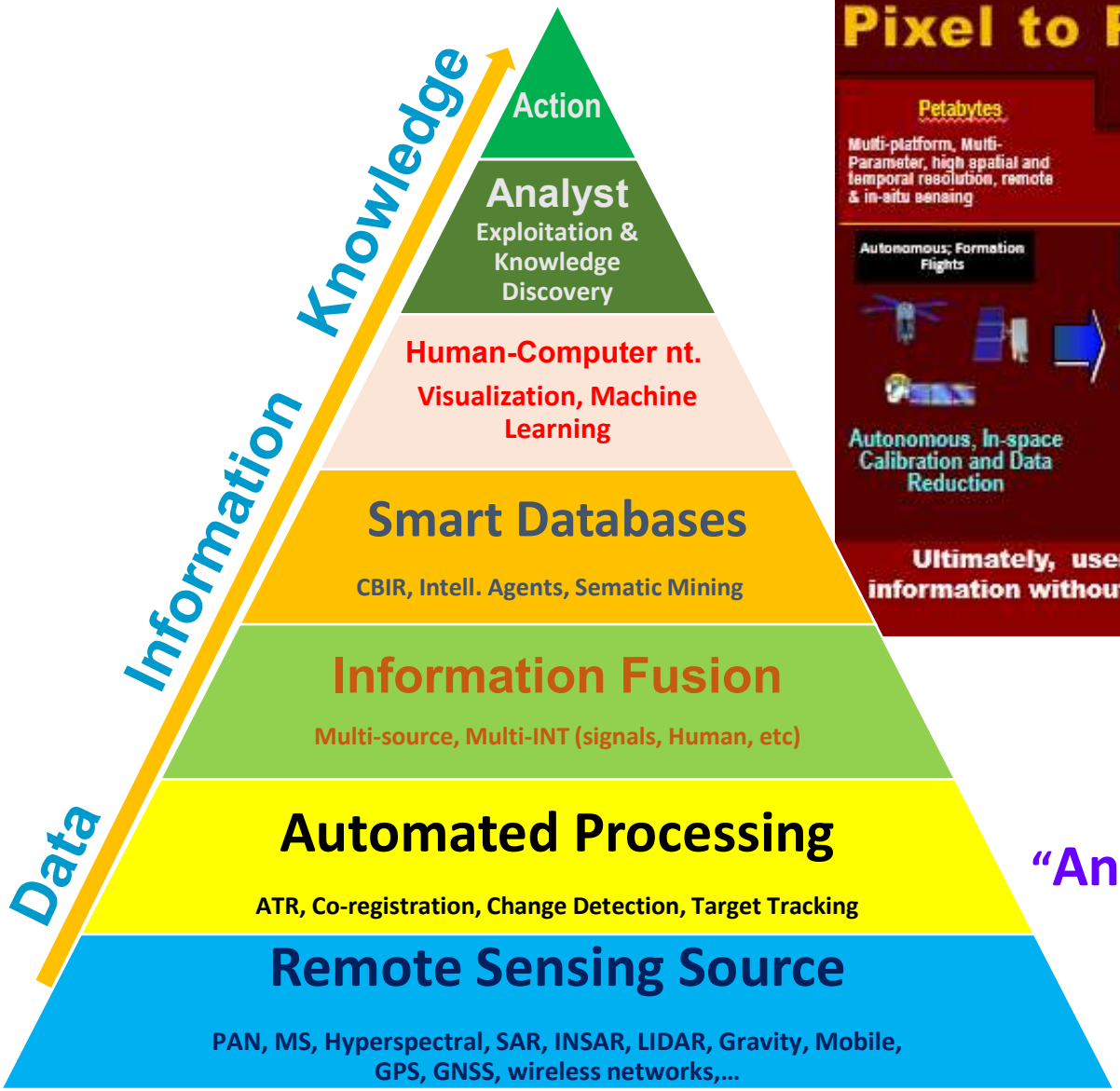
Multi-disciplinary Space Science & Technology Education (SSTE) – challenges in training

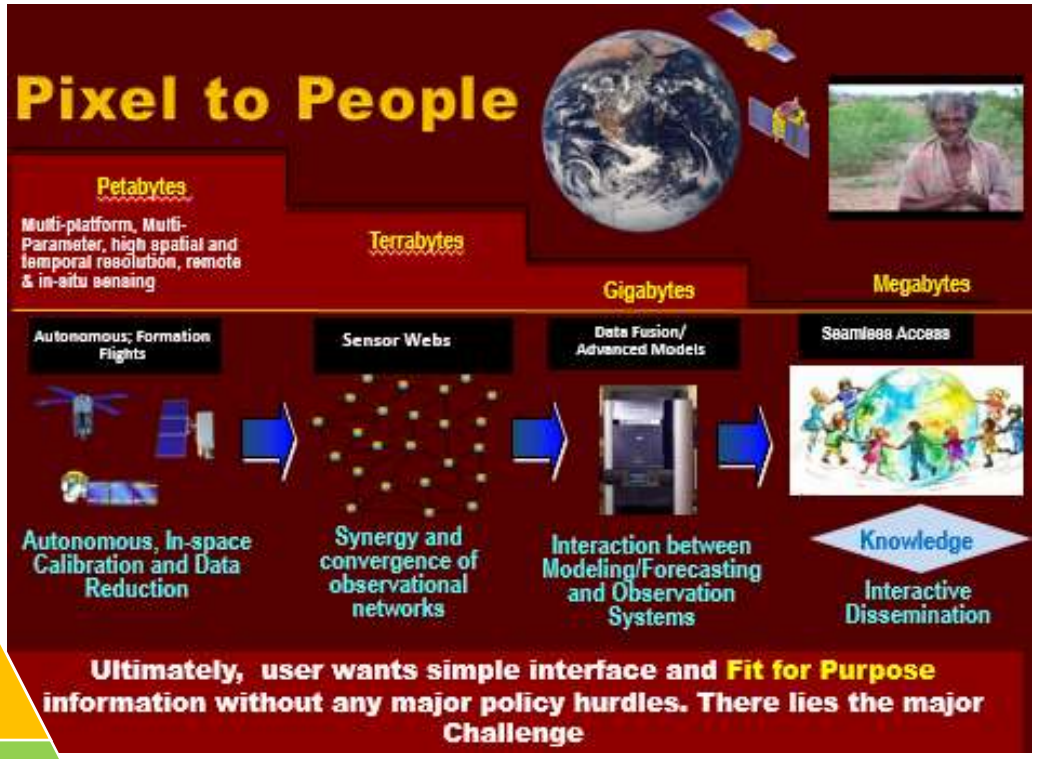
Best Practices:

- Instructional System Design in framing *training curriculum*
- Lessons learnt on *in-person* training
- Experience from *Distance Learning* Programs
- Post training Feedback from Alumni and way forward
- Multi-cultural / multi-ethnic environment - challenges

Conclusions

SSTE - Convergence of Technologies





Integrated Solutions for
"Fitness for Purpose" or
"Analysis Ready Data (ARD)"

Challenges in SSTE training

- **Ever evolving technologies :**
  - Advanced sensors,
  - innovative agile platforms,
  - intelligent processing,
  - multi-sources integration strategies (LEO/GEO, AB, GT,..)
  - Ready to Analyze data with high reliability,
  - Higher demand for specialized courses, …

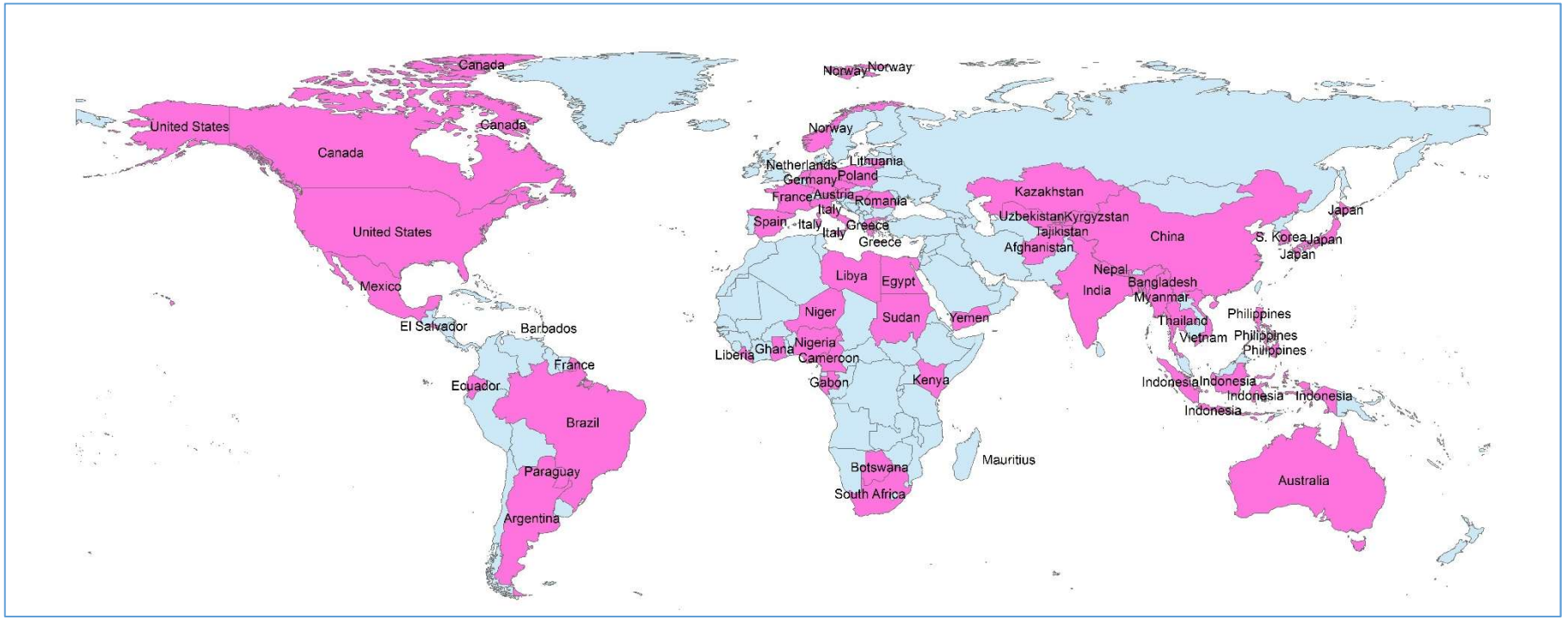
- **Challenges** in
  - Getting suitable “Trainers” with strong expertise and working knowledge;
  - Equipping lab. and field data such advanced sensors / platforms/software tools for demonstration and hands-on

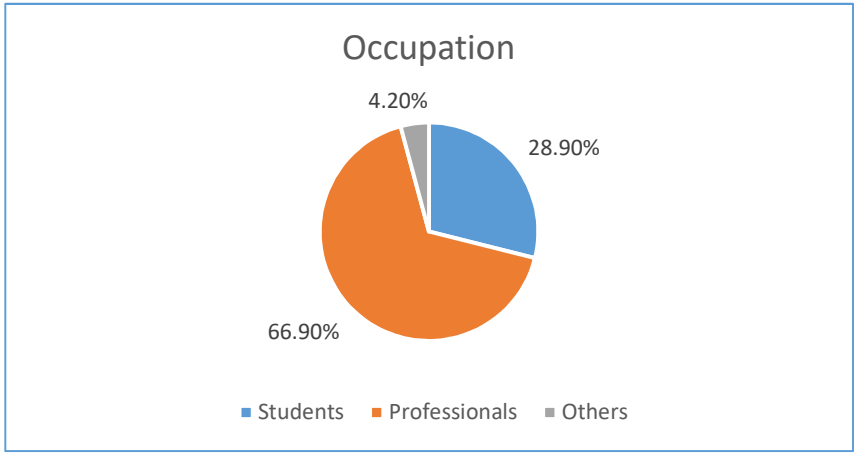
Possible Solutions for SSTE training Challenges

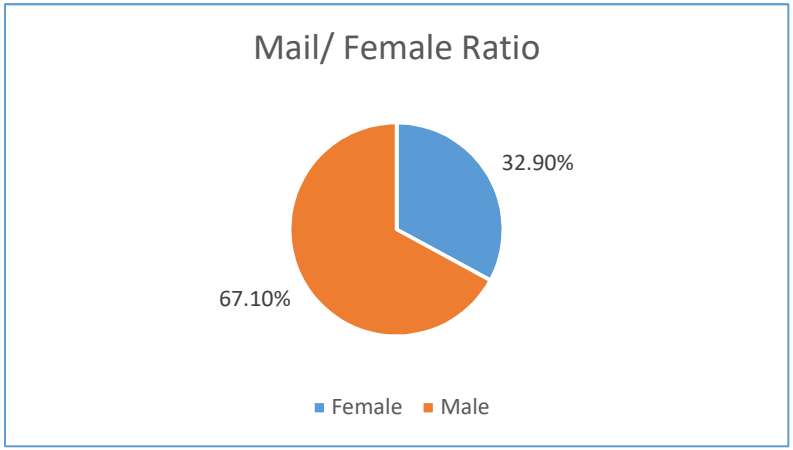
- **Cross-border Education**
  - Support, promote, stimulate and initiate cross-border joint education programs (JEPs), dissemination efforts such as: seminars, tutorials, workshops, symposia, e-bulletins and other mechanisms & tools,
  - Cooperating with other Geo-societies on issues of: common themes and goals; mobilizing lecturers; adopting efficient ways for planning and running the seminars; and how to share and cut expenses;
  - Cooperate with regional universities, organizations, and societies in order to stimulate them to cooperate, provide facilities, share local know how and offer a base for future further cooperation;
- **Webinars/Outreach programs with global expertise**
  - Promotion of web-based resources with free access, ……

Webinar Series: SAR Data Processing and Applications

Total No. Of Participants: 252 from 53 Countries (Apr.17-Jun 9, 2017)







Webinar Series: SAR Data Processing and Applications

Total No. Of Participants: 252 from 53 Countries **(Apr.17-Jun 9, 2017)**

Webinar No.	Webinar Topic	Instructors	No. of Participants	No. Of Countries
W1	Overview of SAR Remote Sensing	Mr. Shashi Kumar	135	43
W2	SAR Data Format, SAR Missions and data access	Dr. Magdalena	145	45
W3	SAR data processing	Mr. Shashi Kumar	96	36
W4	Basics of SAR Polarimetry and Interferometry	Mr. Shashi Kumar	99	36
W5	SAR Remote Sensing for Geological Applications	Dr. RS Chatterjee	86	35
W6	SAR Remote Sensing for Forest, crop and soil moisture	Dr. H. McNairy (Agrifood Canada) Dr. H. Padaliya	87	35
W7	SAR Applications in Snow and Glacier Studies	Dr. Praveen Thakur ISRO	95	32
W8	SAR data for Flood Mapping	Mr. Chris Stewart Dr. Erika Podest	88	32

Webinar on Disaster Management - 2015

NAME	INSTITUTION	ROLE
Hilcéa Ferreira	INPE	Coordinator/Instructor
S.P.Aggarwal	IIRS/ISRO	Coordinator/Instructor
Marie-Josee Bourassa	CEOS CEO	Contributor
Kim Holloway	CEOS SEO	Contributor/Instructor
Guy Aube	CSA	Contributor
Antonios Mouratidis	ESA	Instructor
Ivan Petiteville	ESA - WGDisasters	Contributor
Jesus A. G. Bernal	INAOE/CRECTEALC	Contributor
Claudia Lucaccioni	INPE	Moodle Tutor
Daniel Vila	INPE	Instructor
Alberto Setzer	INPE	Instructor
Fabiano Morelli	INPE	Instructor
Laercio Namikaya	INPE	Instructor
Su-Yin Tan	University of Waterloo and ISU(International Space University)	Instructor
Ana Prados	NASA	Instructor
Amita Mehta	NASA	Instructor
Nancy D. Searby	NASA	Contributor
Phila Sibandze	SANSA	Contributor
Lorant Czaran	UNOOSA	Contributor
Brenda Jones	USGS - WGDisasters	Instructor
Eric Wood	USGS	Contributor

Duration: April 6 – May 31, 2015

Feedback: WGCapD & WG-Disasters DE Course

1. Data handling and software skill

- Provision of some assignments to work on using the software discussed in the Moodle.
- More practical examples and tutorials on software used to get required results that matter.
- Further demonstrations & techniques in software used for analyzing data.
- Practical classes on programming TerraMA^2.
- A module that provides an introduction to image processing.

2. Data Access

- Include real processing of data instead of results. Demonstrate how to derive maps and products.

3. E-resources and Books

- Provide additional reference resources and/or e-books.

4. Language

- Can we go for more languages of instructions ?

Three Stages in Capacity Building:

Before

- What is the best way to accomplish
- To whom are we trying to accomplish
- How do we measure that it is the best way

While

- How to quantify the performance of trainers, trainees, material and methodology ..

Post

- What measures to be taken for improvement..
- What new topics for future training needs..
- Alumni Feedback and suggestions
- How to enhance retention of knowledge gained

What to Accomplish?

1) SAR / Geoinformatics Workshops

Process / Context	Sensors & Data Acquisition	Processing & Modeling	Storage & Retrieval	Dissemination & Use
Application Domain	Second Priority	Second Priority	Second Priority	Second Priority
Technology	First Priority	First Priority	First Priority	First Priority
Information Management	Second Priority	Second Priority	Second Priority	Second Priority
Institutional Setting & policy	Third Priority	Third Priority	Third Priority	Third Priority

*Source: **Prof. Martien Molenaar, ITC, Netherlands** www.isprs.org/proceedings/XXXIV/6-W6/papers/**molenaar**.pdf*

What to Accomplish?:

2. Disasters Management Programs

Process / Context	Sensors & Data Acquisition	Processing & Modeling	Storage & Retrieval	Dissemination & Use
Application Domain	Second Priority	Second Priority	Second Priority	Second Priority
Technology	Second Priority	Second Priority	Second Priority	Second Priority
Information Management	First Priority	First Priority	First Priority	First Priority
Institutional Setting & policy	Third Priority	Third Priority	Third Priority	Third Priority

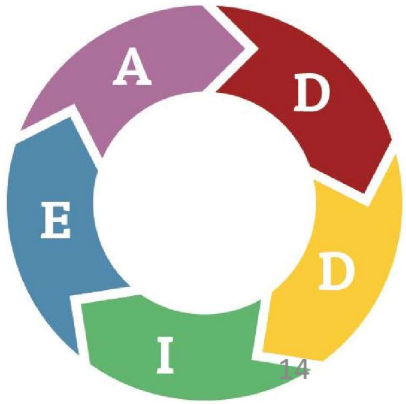
and so on ……

Whom To Accomplish:

PURPOSE	PRIME FOCUS
Human Resource Development	Supply of Technical and Professional Personal (K12, UG/PG students, Teachers)
Organizational Strengthening	Strengthen Govt./NGOs 1. Management Capacity on Geo-ICT solution (systems, processes) 2. Strategic Management Principles (professional, field managers, trainees…)
Institutional Strengthening	Strengthen Capacity of Organizations to 1. Develop appropriate Mandates & Modus Operandi 2. Legal & Regulatory Frameworks (Decision makers, Local & National Govt. / NGO Administrators, Law and Policy staffs, …)

Instructional Systems Design (ISD)

- **Definition**: Practice of creating "instructional experiences which make the acquisition of knowledge and skill more efficient, effective, and appealing."
- **Purpose**: Determining the state and needs of the learner, defining the end goal of instruction, and creating some "intervention" to assist in the transition.
- There are many instructional design models but many are based on the **ADDIE model** with the five phases:
  - **A**nalysis
  - **D**esign
  - **D**evelopment
  - **I**mplementation
  - **E**valuation



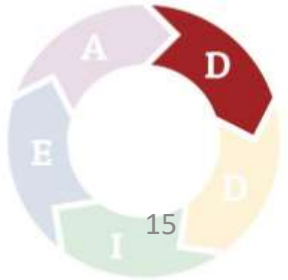
ADDIE Model – in detail

ANALYSIS - more general

- ***Gather all information*** which includes:
  - ❖ Instructional objectives, or what you wish to teach
  - ❖ Who the learners are, their abilities and circumstances
  - ❖ The setting and model of information delivery (online, classroom, workplace?)
  - ❖ Teaching considerations and barriers to learning
  - ❖ The timeline you're working with

After Analysis .. *Learning Solutions* → **DESIGN**

- ❖ Short/Long Course
- ❖ Delivery mode (online, onsite)
- ❖ Practical (Hands-on)/Theoretical
- ❖ Planning Milestones
- ❖ Deliverables
- ❖ Competencies
- ❖ Expected Outcomes
- ❖ Assessment design



ADDIE Model … in a nutshell

Gain Attention	• Present the learner with an introductory activity that engages him/her
Inform objectives	• Present the learner with learning objectives
Stimulate recall of prior learning	• Present the learners with an experience that stimulates their prior knowledge
Present Stimulus	• Present the learner with content materials
Provide Guidance	• Present the learner with examples
Elicit Performance	• Present the learner with practice activities
Provide Feedback	• Present the learner with practice and feedback
Assess Performance	• Present the learner with post-assessment items
Enhance Retention & Transfer	• Present the learner with resources that enhance retention & transfer of knowledge

The “in-person” training approach:

CSSTEAP experience

Facilities Provided to Participants

- Monthly Fellowship
- International travel support
- Single Occupancy Hostel Accommodation with kitchenette facilities, Gym, Sports
- 24x7 digital Library
- Medical facility
- Tuition fee, course fee waived off
- English Coaching
- Live lectures & video recording
- Technical Visits

- Symposium/Seminars participation
- Field visits / Institutional visits
- International Experts / Lectures/ Tutorials
- Satellite data (India / International)
- Books/ Project Allowance / Field work allowance
- Other administrative expenses (Visa, baggage allowance etc.)










Educational activities in and out-side the campuses







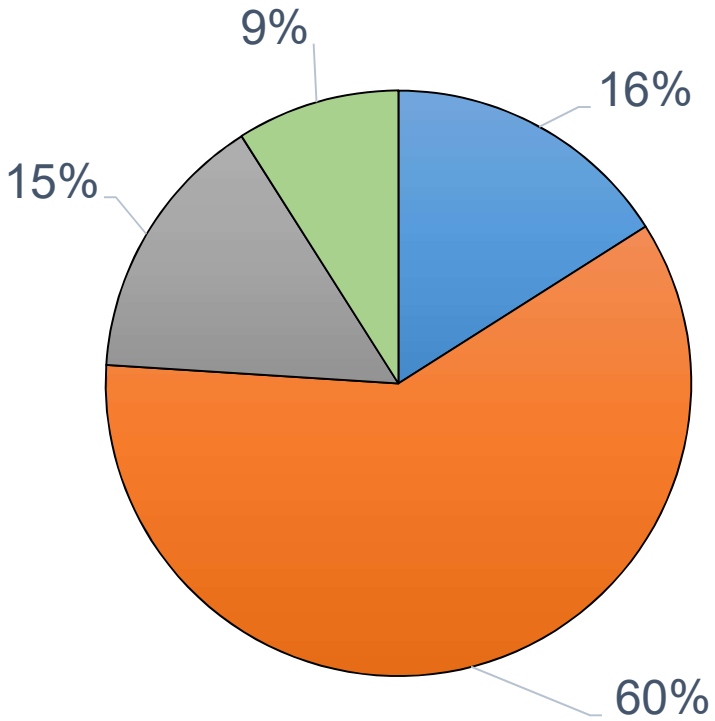


Cultural Activities – “Make feel at home”

(Best Practice # 3)

CSSTEAP: Structure of "in-person" training

PG Program : Skills Development + Education + Research

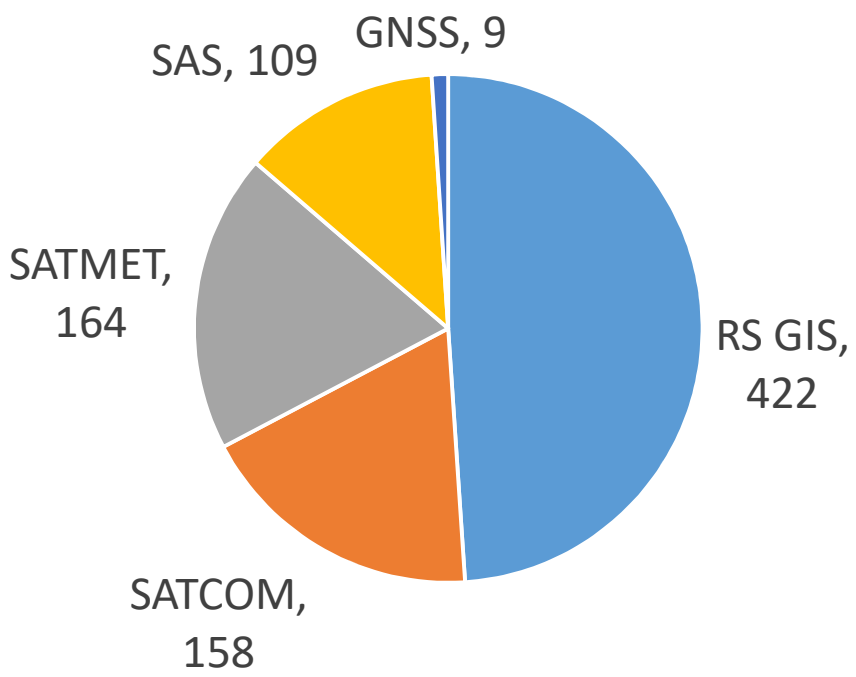


- Lectures
- **Hands-on**
- Practicals/ Demos/ Project Work
- Field Work
- Self study/Seminars/Examination

Total Hours: 1200+60 (Exams)
75% - Hands-on

Focusing on Special Themes

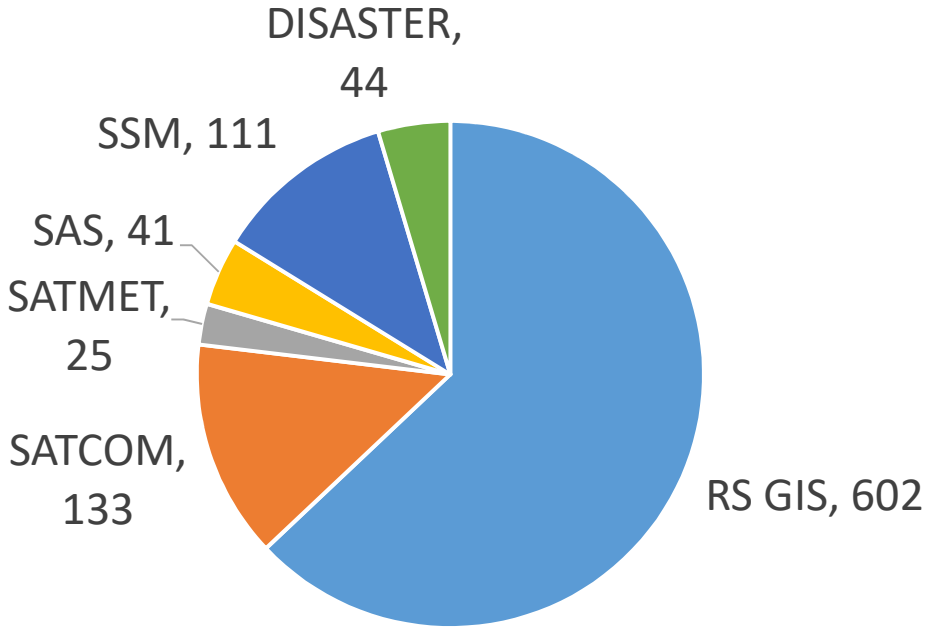
PG Courses till May 30, 2017 (Education)



Total participants: 862

Short Courses till May 30, 2017

CB @ Skills Development



Total participants: 956

Short-courses attract professionals !

Selection of Short-courses themes – critical for higher acceptance

Special Courses for Skills Development

- **NWP**: Weather Forecasting using **Numerical Prediction Models** during April 18-May 17, 2016 (**23** participants from 7 countries)
- **AFEA**: **Advances in Geospatial Tools in Forestry & Ecology Applications** during May 23 - June 21, 2016 (**20** participants from 9 countries)
- **DDLA**: **Disaster Damage and Loss Assessment** in Natural Heritage and Cultural Sites using Geospatial Techniques, September 11 – October 2, 2016 (***24*** *participants from 11 countries*).
- **DRDA: Disaster (post Earthquake) Rapid Damage Assessment** was jointly conducted with UNOOSA, UN-HABITAT, and UN-SPIDER designed and developed the course curriculum and conducted the training course from 28 March to 2 April 2017 at Yangon, Myanmar. A total of **44 participants** from 16 disaster management agencies and stakeholder departments participated in the training programme.
- UAS and its applications with special emphasis to DRR (23 participants from 11 countries, June 12-23)
- LIDAR RS and its applications (completed, May 15-26, 22 participants from 8 countries)

CB @ Educational + Research

- **Award of PG Diploma by CSSTEAP Completion of 9 month PG course curriculum**
- **One year follow-up project in home country for academic requirement of M.Tech. research**
- **Submission and evaluation of M. Tech. thesis by internal & external experts.**
- **Award of M. Tech. degree by Andhra University, India. About 143 received M.Tech. degree till date.**
- **CSSTEAP offers 1 Yr. Fellowship in India to meritorious students for M.Tech. Research**

(Best Practice # 5)

Research as part of Education

Remote Sensing & GIS

- ***Advance RS & data analysis:*** High resolution, microwave, Hyper-spectral, LIDAR and Planetary science mission data analysis & processing
- ***Natural Disaster Monitoring and Management:*** Landslide risk analysis, Soil erosion modeling & nutrient loss, Forest fire risk zonation, Flood modeling, etc.
- ***Modeling Earth processes:*** LULC change prediction, Crop & forest productivity, Ecological Niche, Hydrological & hydro dynamic, Debris flow, Ground water modelling, etc.
- ***Advance GIS:*** 3D GIS, Spatial Data Quality Uncertainty, Geoweb, LBS, SDI, Network analysis.

Satellite Communications

- ***Communication Techniques:*** Modulation and Coding, Communication link design, Satellite data network,
- ***Earth Station Technologies:*** Terminal development, Receiver technologies,
- ***Signal Processing:*** Compression techniques,
- ***Antenna Systems:*** Design mechanism and realization techniques

Satellite Meteorology & Global Climate

- ***Meteorology:*** Extra Tropical, Weather Systems, Tropical Weather Systems, Monsoon,
- ***Image processing and interpretation:***
- ***Advanced concepts in Satellite meteorology:*** Geophysical parameter retrieval, Application of satellite derived parameters, Satellite data assimilation in NWP,
- ***Global Climate Environment:*** Short term climate variability, long term climate change,

Space & Atmospheric Science

- **Solar physics, Astronomy, Space weather:** solar X-ray impact on ionosphere; studies of satellites of various planets; mesophere and thermospheric airglow emissions; plasma temperature density; solar wind, solar radiation, comets, Novae and Glonular clusters; binary stars; space weather.
- **Atmospheric Science:** satellite retrieval of aerosols, ozone, ionospheric irregularities, satellite observations of tropical cyclones; modelling of atmospheric chemistry of aerosols.

(Best Practice # 6)

Exposure of Advanced Research to Course participants in Symposia and workshops

Symposium

- 25 Course participants of RS GIS, SATCOM and GNSS PG courses participated in Asia Pacific Remote Sensing organized by SPIE during April 4-7, 2016 at New Delhi.

- 22 CSSTEAP Course participants of RS GIS course which includes 2 M.Tech students have participated in ISRS Symposium & National Convention during Dec. 7-9, 2016 at Dehradun.

Tutorials

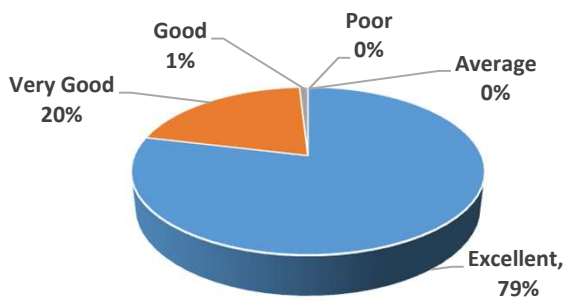
- Above 22 participants were also attended tutorials on UAV, Hyperspectral RS, Microwave RS, Watershed, Health GIS, Close Range photogrammetry based on their choice.

Performance Assessment (2010-2015):

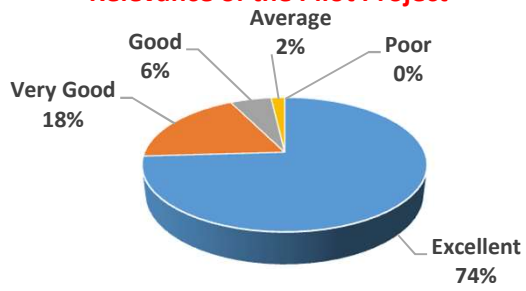
Feedback from Alumni

During the Course …

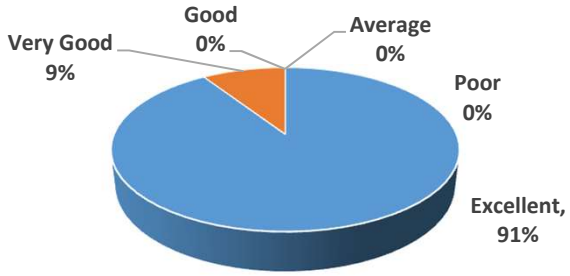
Overall Objective of the Course Achieved



Relevance of the Pilot Project

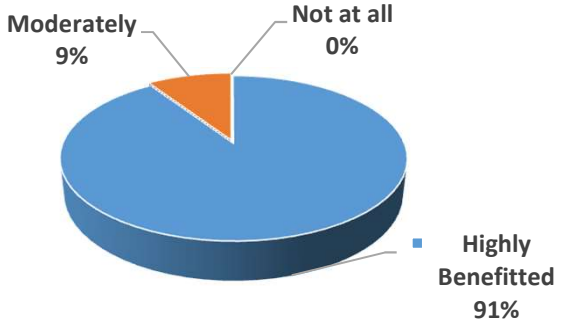


Physical Facilities (Class Room, Computer Room and Lodging)

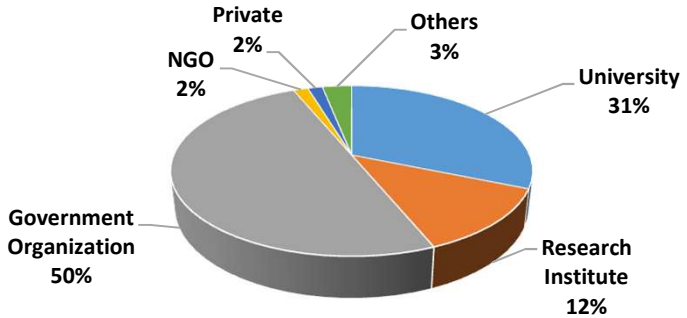


After the Course …

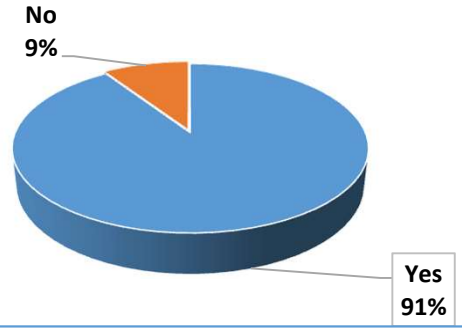
How CSSTEAP Course Beneffitted to your current job



Current Organization



Do you need any Refresher Course



CSSTEAP Alumni Meets

Alumni meet at Kathmandu, Nepal on October 6, 2010

Meeting with the CSSTEAP alumni in Colombo, Sri Lanka on October 21, 2011

CSSTEAP Alumni Meet in Thimpu, Bhutan on November 15, 2011

CSSTEAP Alumni Meets

Colombo, Sri Lanka
October 20, 2016

Recommendations:

- Short Course on UAS
- Short course on Lidar
- Refresher course

Alumni meet at Nay Pyi Taw, Myanmar on March 22, 2012

(Best Practice # 7)

Observations & Comments from Alumni Meets

Major observations:

- Courses were useful in career development and improving profession aptitude in their organizations/institutions;
- Alumni have taken lead role as team leader and are assigned important projects to handle based on the PG diploma / M.Tech degree obtained from CSSTEAP.

Major recommendations:

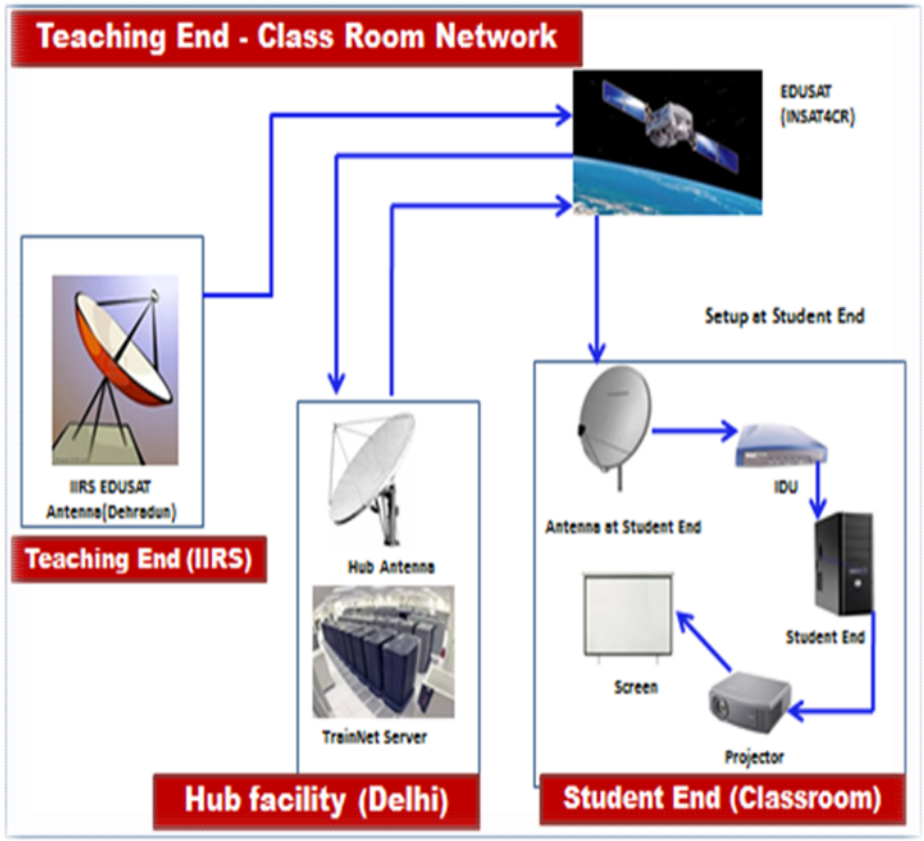
- To organize refresher courses in emerging applications
- To organize special short courses jointly with institutions in their country on Microwave Remote Sensing, Disaster Risk Reduction; short-range forecasts; Monsoon variability; Hazard & risk analysis in their country so that more participants can take benefit of the programme.

Experience from *Distance Learning* Programs

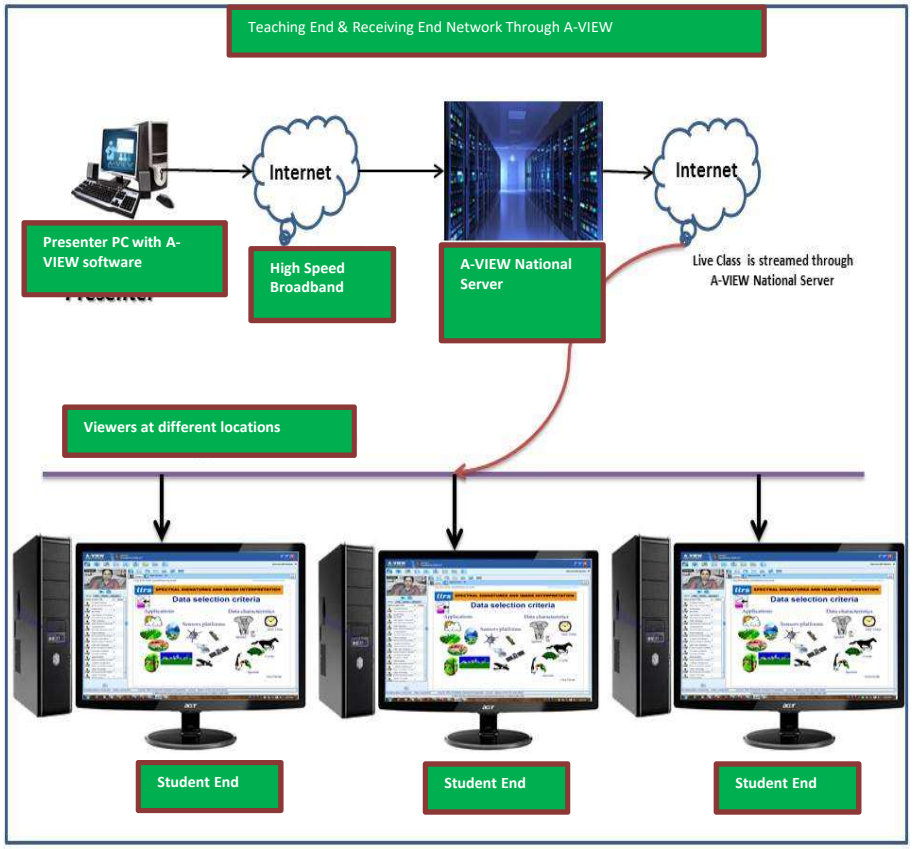
ISRO Outreach Programme Initiative:

Live & Interactive (classrooms model rather than webinars)

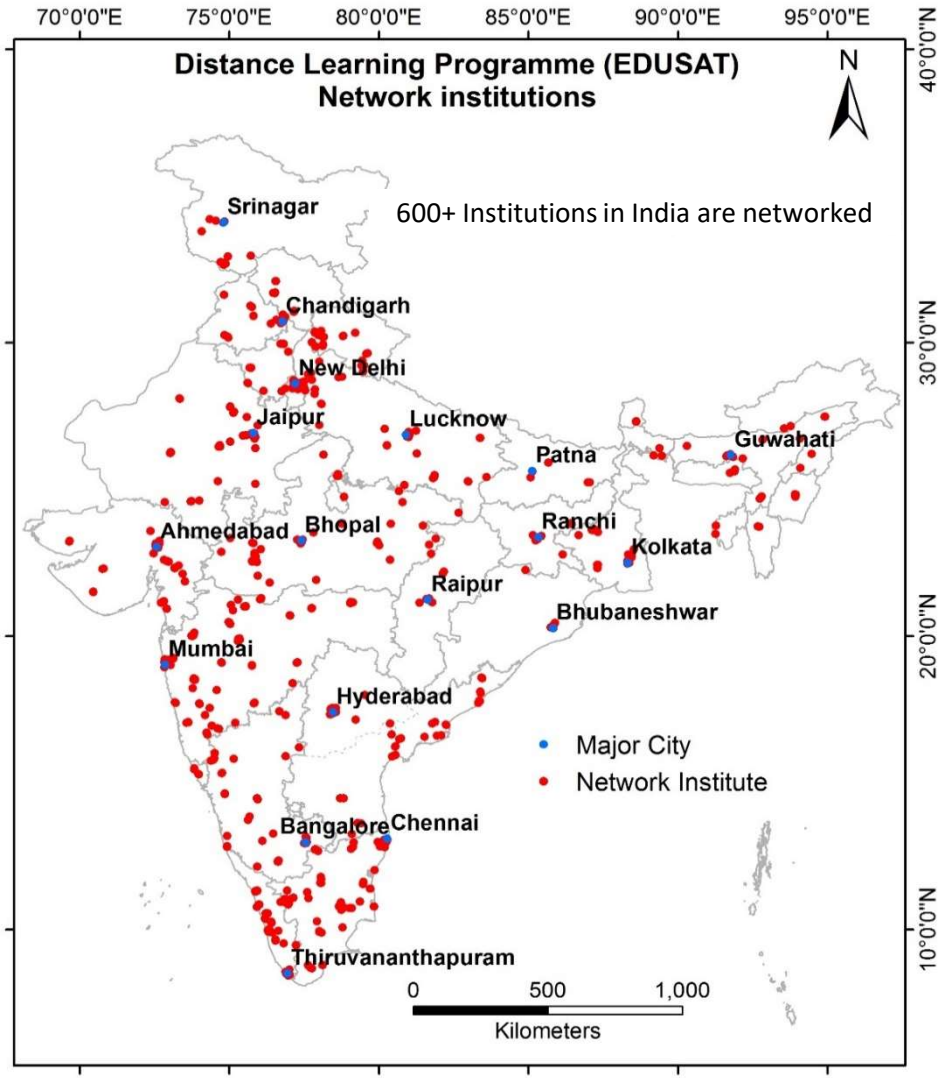
Satellite based



Internet based



Network for Education & Skills Development



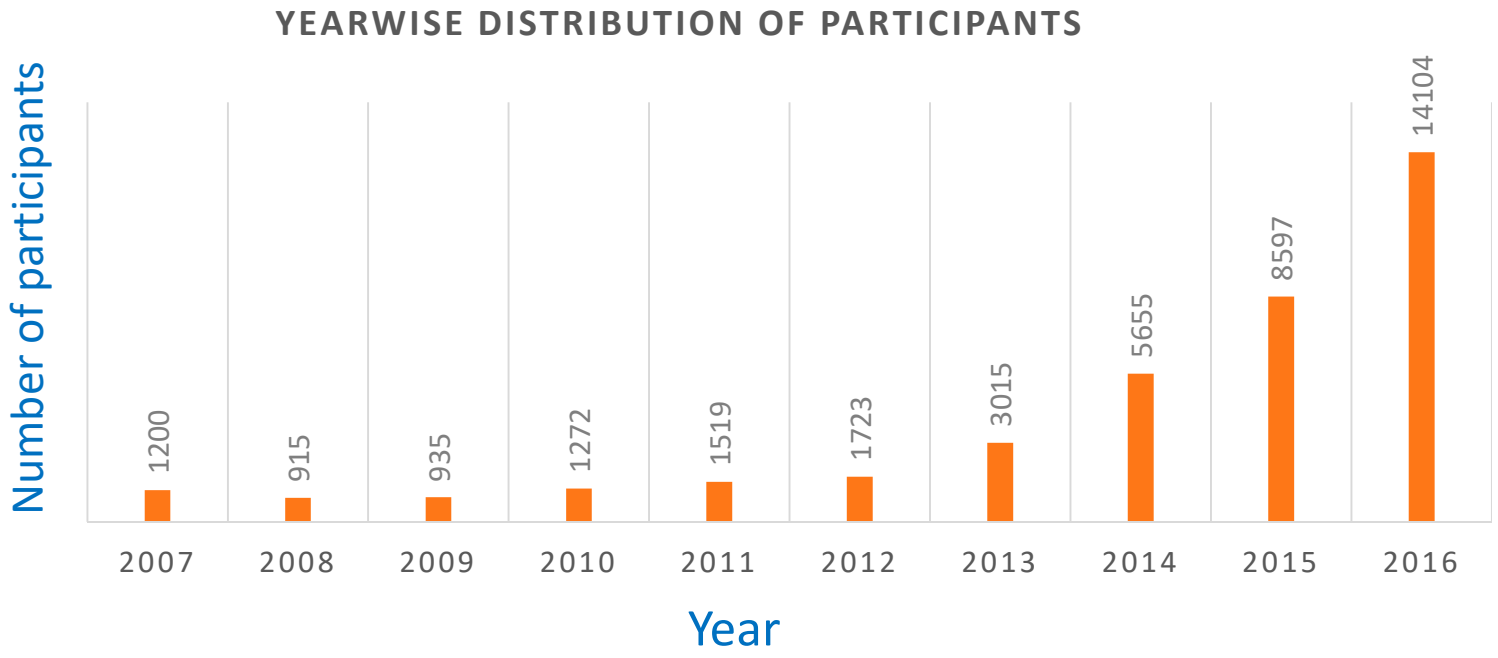
National Distribution of IIRS Outreach network

Institutions within India

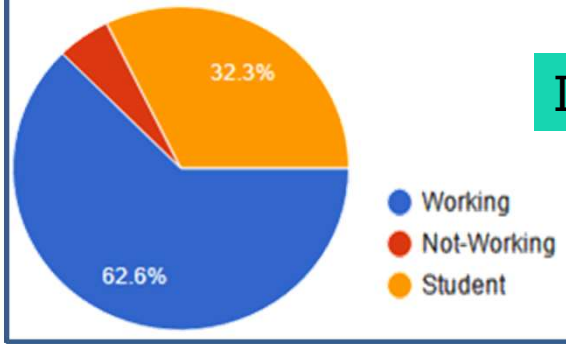
Type of Institute	Number
University/Institute/College	554
Central Govt. Ministry/Department	12
State Govt. Ministry/Department	24
Industry/ Corporate	9
other	12

(Best Practice # 8)

Institutional Networking Outreach Program

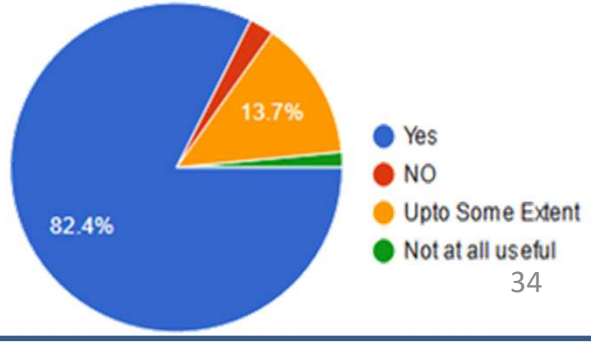


Current employment status of users



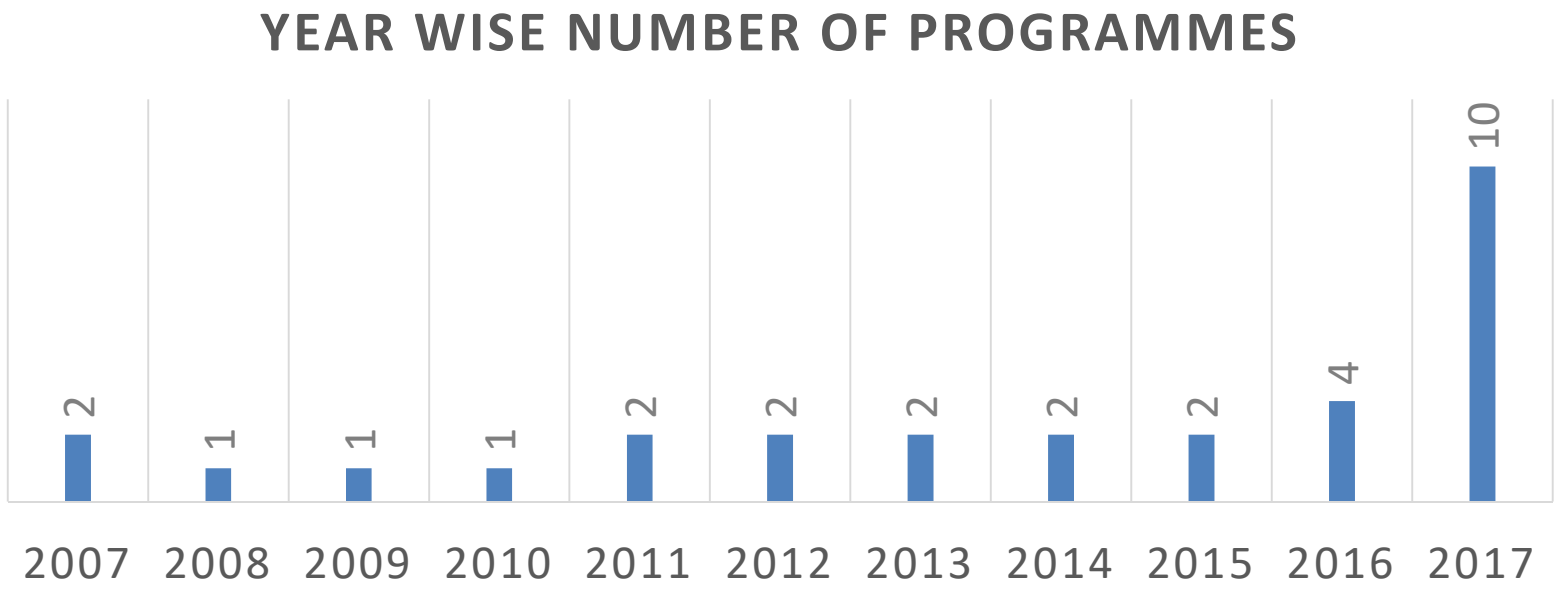
Impact based on online Survey

Impact of IIRS outreach programme in career growth of the participants



IIRS Outreach Programme

Live & Interactive courses



From 2016 onward more focus is on:

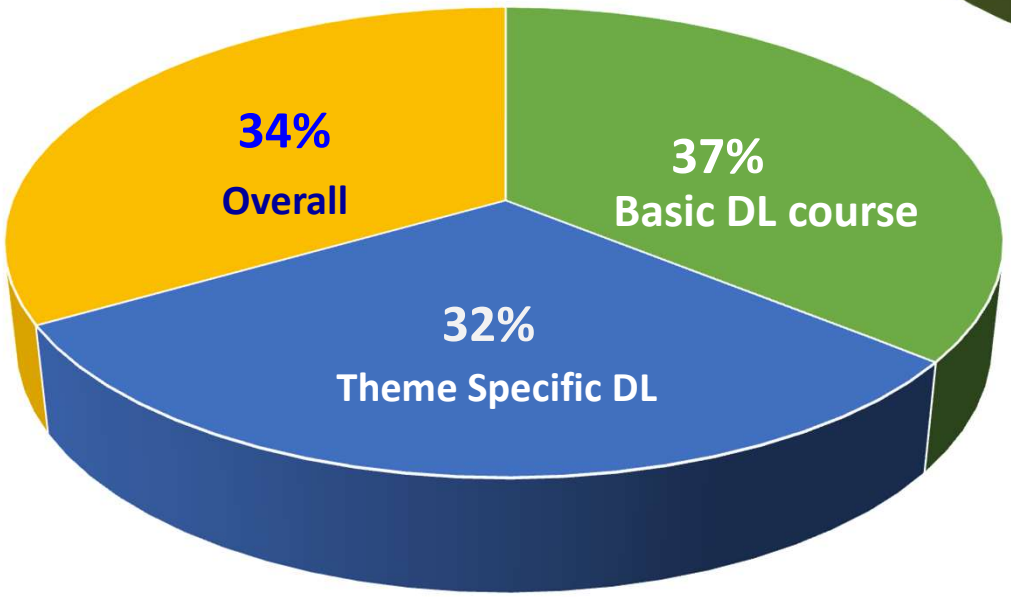
- Theme based user centric courses;
- National Project oriented programmes;
- Short duration special courses;
- Monthly Webinar series.

IIRS Outreach Programme

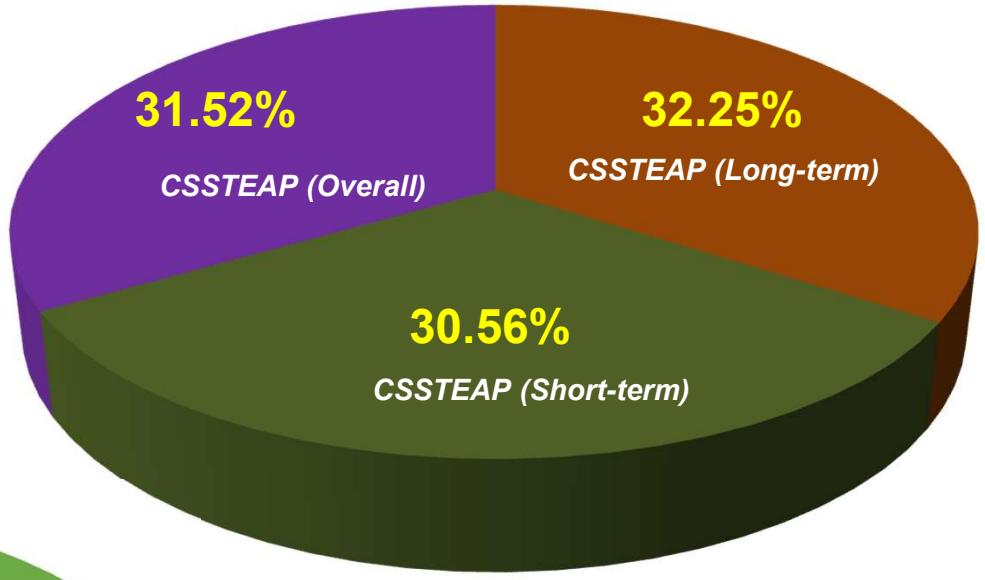
Live & Interactive classrooms- Contents Delivery

Comparison of Women Participation in ISRO-DLP & in person CSSTEAP

Outreach (ISRO)



In-person (CSSTEAP)



IIRS Outreach Programme – Model 2

IIRS e-learning Initiatives- English & Hindi

- e-learning courses are self-paced and learner centric;
- The syllabus of the courses are as per latest developments and trends in geo-spatial science and technologies;
- Learning is made available through online interactive 2D and 3D animations, audio, video for practical demonstrations, software operations with free data application
- Registrations are Free and Open to all at http://elearning.iirs.gov.in

Available courses :

- Comprehensive certificate course on Remote Sensing and Geo-information Science- 4 Months duration.
- One month fundamental certificate courses on Remote Sensing, Photogrammetry, GIS, Digital Image Processing

Uniqueness:

- Learner centric teaching methodologies implemented;
- Self paced learning;
- Learning anywhere, anytime;
- Interactive 2D and 3D animations.

(Best Practice # 10)

DLP: Internet Based e-Learning Courses

- e-learning courses are self-paced and learner centric;
- The syllabus of the courses are as per latest developments and trends in geo-spatial science and technologies;
- Learning is made available through online interactive 2D and 3D animations, audio, video for practical demonstrations, software operations with free data application
- Registrations are Free and Open to all at http://elearning.iirs.gov.in

Topics
Image Statistics
Basic Remote Sensing
Photogrammetry and Cartography
Digital Image Processing
Geographical Information System
Global Navigation Satellite System
Customization of Geospatial Tools
Applications of Geospatial Technologies

Available courses :

- Comprehensive certificate course on Remote Sensing and Geo-information Science- 4 Months duration.
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Uniqueness:

- Learner centric teaching methodologies implemented;
- Self paced learning;
- Learning anywhere, anytime;
- Interactive 2D and 3D animations.

Hindi Version of IIRS e-learning courses-

https://elearning.iirs.gov.in/hindi/

Details	Number of Participants
Total learners (foreigners)	2575 (214)
Total learners registered for certificate	783
Participants with fee payment	143
Number of Certificates issued	58
Total e-learning Participants	**3358**

(Best Practice # 11)

ISRO Digital Knowledge Repository

Challenges in multi-cultural / multi-ethnic learning environment

- Multi-cultural environment creates obstacles and opportunities for research and learning.
- Students/trainees come from different higher education systems each with diverse missions, history, and societal context
- Learning and teaching styles differ depending on cultural identity and heritage.
- **Challenge -** how to bridge differences in culturally dependent learning and teaching styles related to cultural identity and heritage in a time bound training
- This calls for specific feedback Questionnaire that helps to understand how the students feel about current courses offered.

(Best Practice # 12)

Survey with International Participants: Questionnaire

A. Education/ Academic (19 queries)

- Are you able to follow the rigor in Mathematics/Physics w.r.t to your earlier education?
- Do you feel this course is more technology or Application oriented?
- Do you feel that the field tours/ excursion were adequate?
- How do you rate the structure and organization of the course?
- How do you compare yourself in a classroom ambiance in your country vis-à-vis at IIRS?
- How do you rate your proficiency of English?

Rating Scale: 4 Point
Agreement :
Grater extent : Score 4
Large extent : Score 3
Moderate : Score 2
Not at all : Score 1

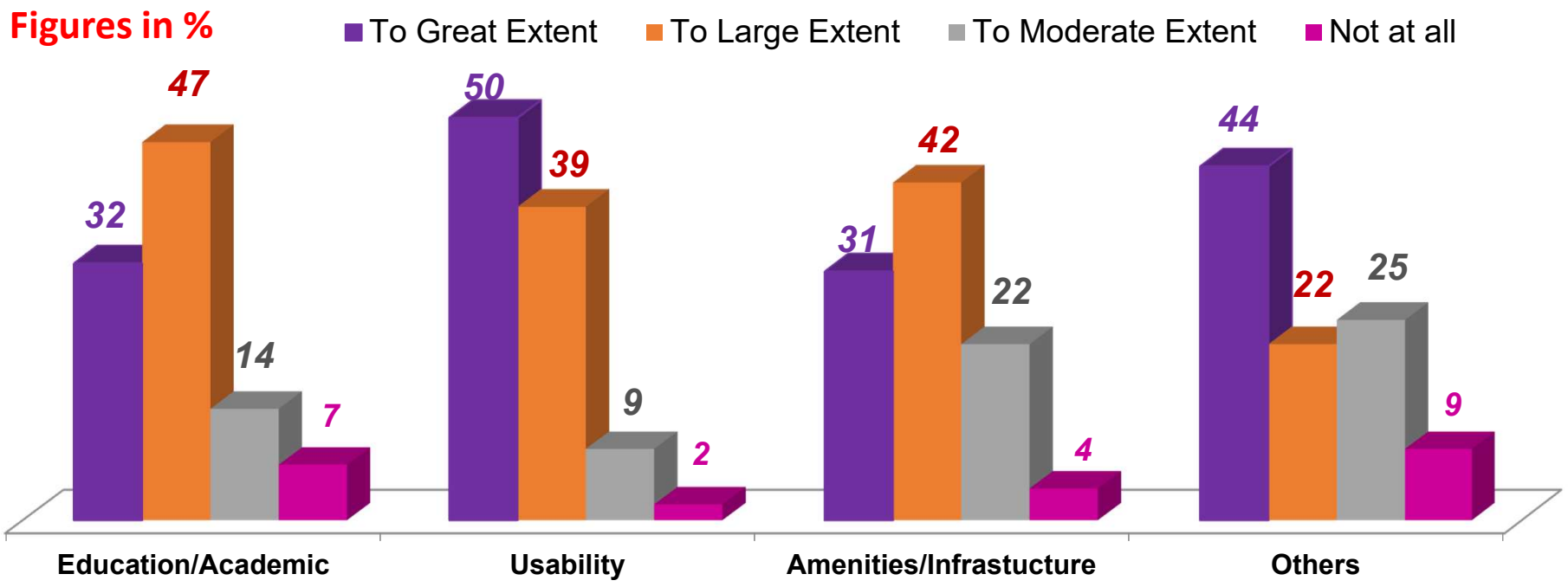
B. Benefit of the courses (08 queries)

- Have you acquired information and knowledge that is new to you?
- The content of this course matched announced objectives?
- Did you had opportunities to discuss issues of interest with other participants?
- Would you recommend this training to your colleagues ?
- Were there any unexpected areas of learning for you?

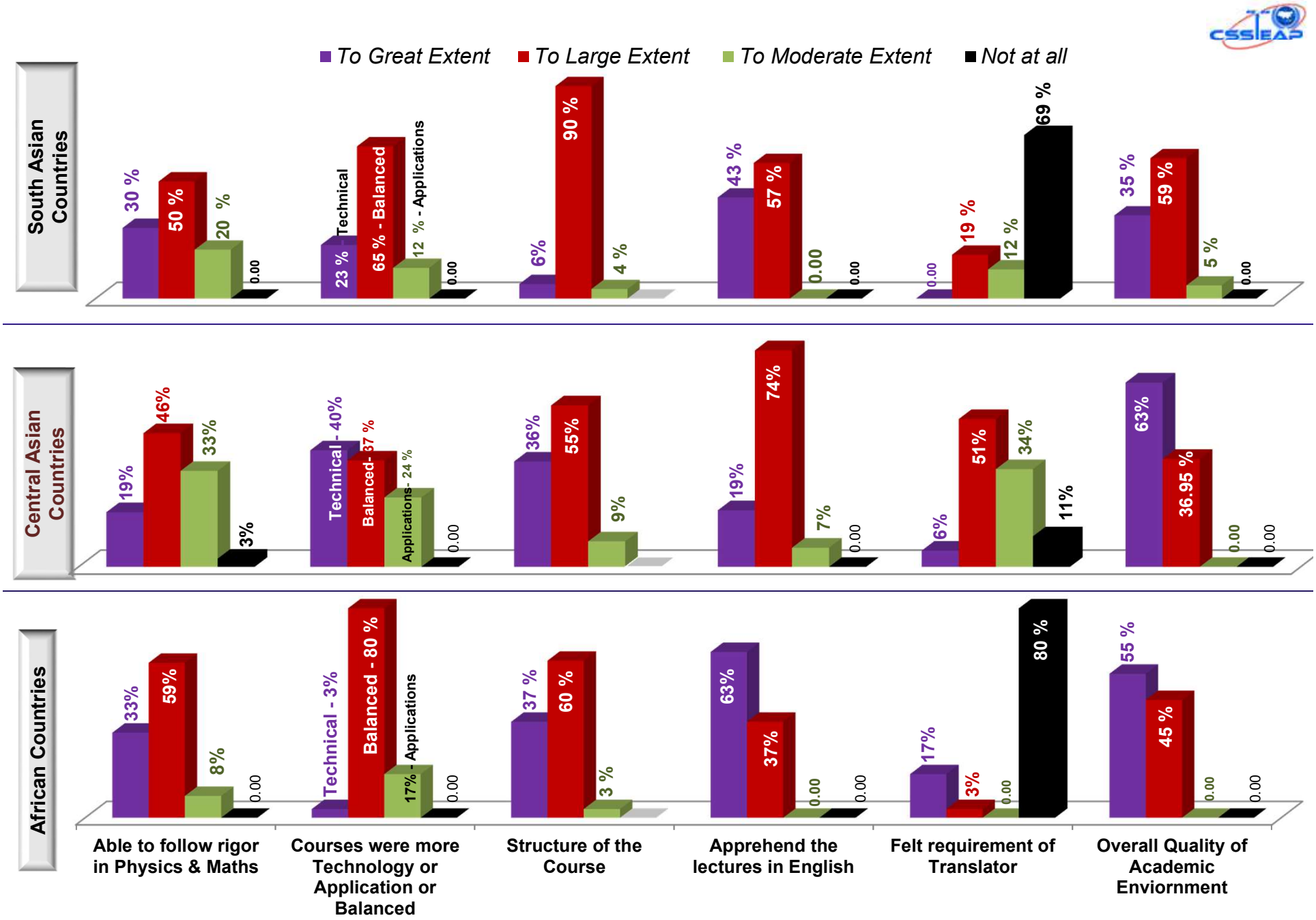
C. General Ambience (12 queries)

- Was the class composition adequate and did not hinder the learning process? (Yes/No)
- Participants should be only from the same geographical region? (Yes/No)
- Multi-ethnic class composition does not affect the learning process ? (Yes/No)
- Educational background diversity does not affect the learning process? (Yes/No)
- How effective are your general working practices e.g. time management?

Survey analysis of International Participants

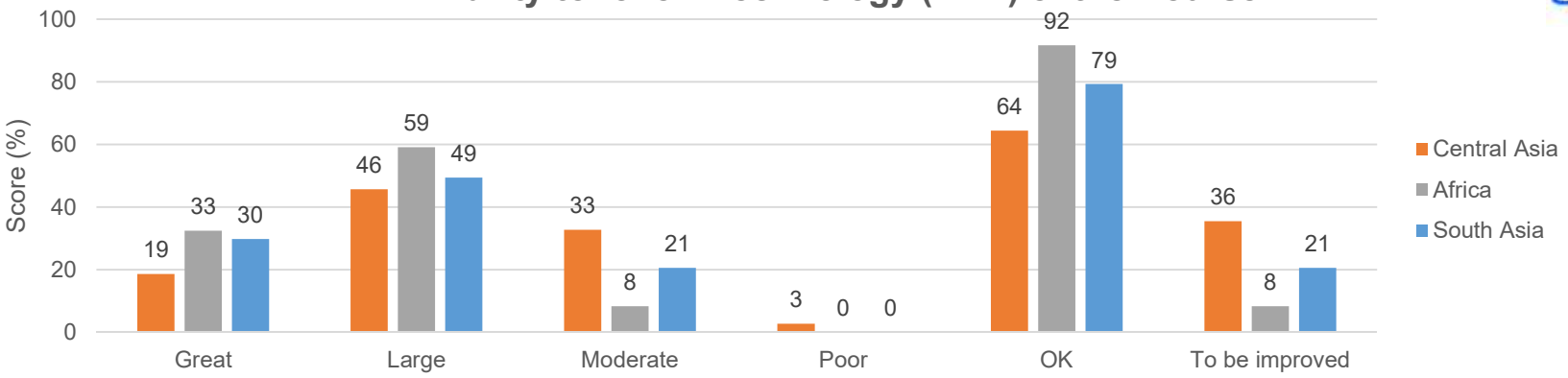


79 participants *(participated) from* ***22 countries*** *in* ***5 Courses*** *(IIRS-ITEC and CSSTEAP-RS&GIS, SAS, SATMET & Short Course on LiDAR*

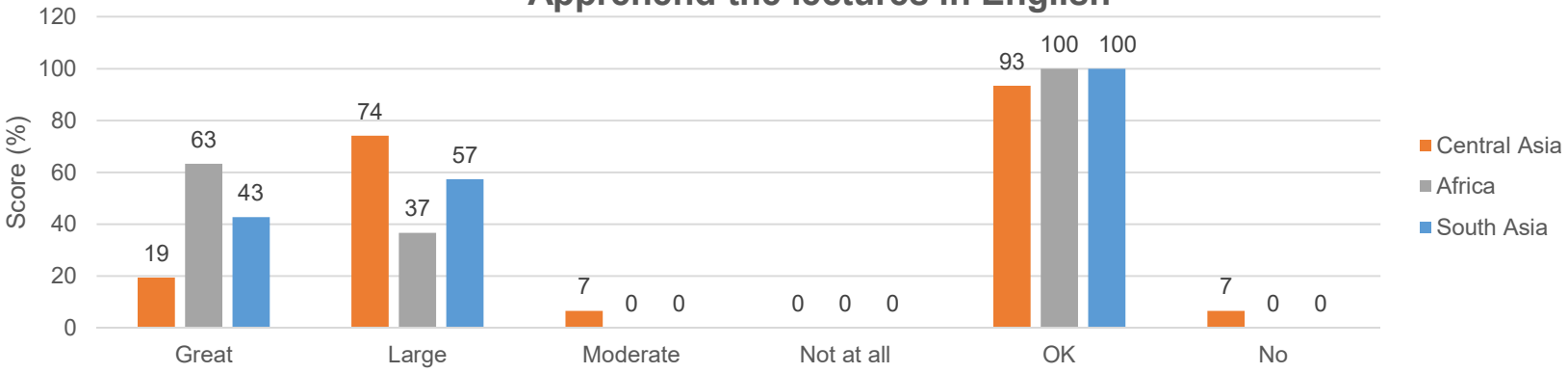


79 participants *(participated) from* ***22 countries*** *in* ***5 Courses*** *(IIRS-ITEC and CSSTEAP-RS&GIS, SAS, SATMET & Short Course on LiDAR*

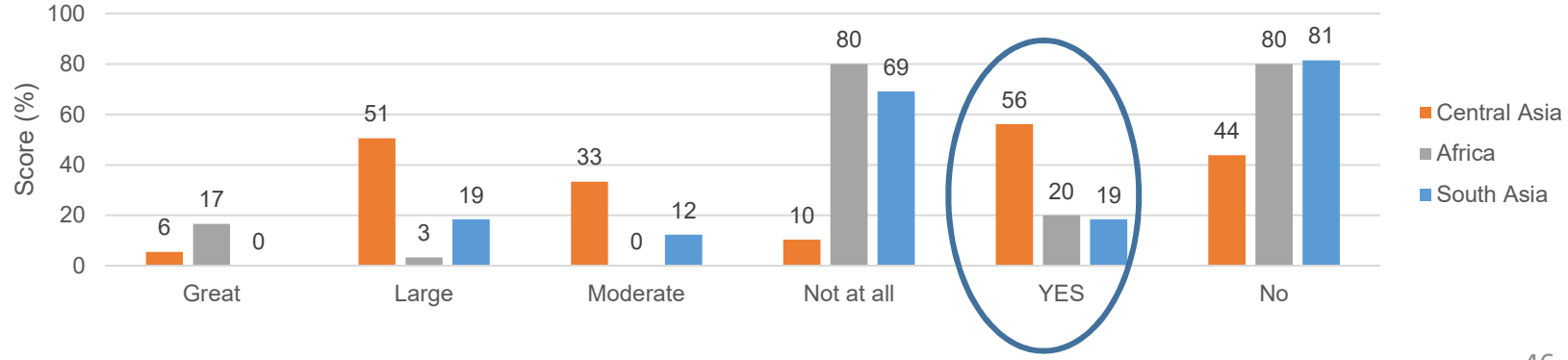
Ability to follow Technology (M+P) of the Course



Apprehend the lectures in English



Felt requirement of Translator



Summary of Best Practices for effective training in Space Science & Technology education

1. Cross border Education with sharing global expertise
2. Instructional Systems Design (ADDIE) for curriculum planning
3. Greater percentage on Hands-on in “in-person” training
4. Specialized short courses for skills development programs
5. Advanced research with field experiments as part of higher education
6. Exposure to State-of-art knowledge thro’ Symposia & W/S
7. Alumni feedback – post training to learn effectiveness of training undertaken – and future course recommendations
8. Institutional networking for Interactive distance learning
9. Encouraging women participation in all programs
10. Internet based e-learning courses for different time zone participation
11. Digital Knowledge Repository for record and archival of teaching material
12. Handling multi-cultural/multi-ethnic learning through survey analysi

Thank you for your kind attention

Q & A