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Educational Importance of Communication Satellites in India

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A B S T R A C T

Improved communication facilities aid in achieving goals and achieve development in all spheres to the expected extent. Revolutionary changes occurring in the fields of communication and information technologies are one sign of it. Within in no time we witnessed the rapid transformation the communication aspects have undergone and the change they brought into the lifestyles of the individuals. Not only individual life, national level fields are witnessing a sea change in their functioning due to speedy availability of the information. Possession of information is the power for today's individual. Development communication is related to communication processes helping in national development. Immediate attention in this connection goes to the space program of Indian government that has started in 1970 and is continuously scaling new heights through its landmark achievements, even helping the defense forces. The present paper focuses on the important role played by communication satellites in national development with particular reference to education.

Introduction

Communication is an important tool helping in development. Particularly for Indian context with regional, geographical and language disparities, a communication system that could cater to the needs of people helps in establishing rapport to develop, to use opportunities to develop and to live in peace. Remote sensing that helps in weather forecasting aid in planning for agriculture, and networking of people help in dissemination of knowledge and skills. Exchange of information helps in improving information gallery and also in problem solving. With these goals in mind, Indian space program has been started in 1970 and is continuing with same spirit to achieve higher levels. Indian space program has gained prestige in launching its own education satellite EDUSAT to achieve its goal of UEE effectively. The present paper is discussing the role of these communication satellites in national development with particular reference to EDUSAT.

Education and National Development

National development could be visualized through many parameters of which education is one important aspect. The literacy level of a nation decides the extent of economic, social and cultural development achieved by the nation. Awareness of people about life in their surroundings, opportunities they can avail to come up in life and the way they can participate in the development of nation by using their knowledge and skills – all these happen because of educated level of the people. We can make people alive, awake and aware of everything every change and every need of nation through education. If we want to bring some change in the society, the first tool that is used is education. Particularly for Indian context with little literacy at the time achieving independence the credit of development goes to Indian government's policy of equal opportunities to all for education. The attempts that were made later to bring in masses into mainstreaming with continuous effort resulted in the present day society known for its power of youth, education and skills that are recognized worldwide. Simultaneous improvement of communication system also helped in this endeavour. The gradual development of Indian space program from 1970 onwards is discussed here in this connection.

Indian Space Program

India space programme has been started with two main intentions of achieving development in remote sensing and reducing the gap in communications. Indian government has launched its space program in 1970 with the launch of its first satellite by name 'Aryabhatta'. To support this program some organizations were established. A Space Science and Technology Centre (SSTC) was established in 1965 in Thumba. A Satellite Telecommunication Earth Station was created in 1967 in Ahmedabad. The Indian Space Research Organization (ISRO) was established in 1969 in the department of Atomic Energy. Since then ISRO started organizing Indian space program for peaceful purposes. A Department of Space (DOS) and a Space Commission were establishing in the 1972. DOS conducts the nation's space activities for ISRO at four space centres across the country. DOS reports directly to the Prime Minister. ISRO was placed under DOS on June 1, 1972, and made a government organisation on April 1, 1975. The first experimental launch from the Sriharikota Island launch site of a Satellite Launch Vehicle (SLV) rocket on August 10, 1979. With all these establishments Indian Space Program has achieved the results most of the times successfully. The following table reveals different satellites launched from 1975 onwards for various communication purposes.

Communication Satellites in Indian Space Program

Satellite	Launch Date	Remarks
Aryabhata	19 April 1975	Provided technological experience in building and operating a satellite system.
Bhaskara-I	7 June 1979	First experimental remote sensing satellite. Carried TV and microwave cameras.
Rohini Technology Payload	10 August 1979	Intended for measuring in-flight performance of first experimental flight of SLV-3, the first Indian launch vehicle. Did not achieve orbit.
Rohini RS-1	18 July 1980	Used for measuring in-flight performance of second experimental launch of SLV-3.
Rohini RS-D1	31 May 1981	Used for conducting some remote sensing technology studies using a landmark sensor payload.Launched by the first developmental launch of SLV-3.
Ariane Passenger Payload Experiment	19 June 1981	First experimental communication satellite. Provided experience in building and operating a payload experiment three-axis stabilised communication satellite.
Bhaskara-II	20 November 1981	Second experimental remote sensing satellite; similar to Bhaskara-1. Provided experience in building and operating a remote sensing satellite system on an end-to-end basis.
INSAT-1A	10 April 1982	First operational multipurpose communication and meteorology satellite. Procured from USA. Worked for only six months.
Rohini RS-D2	17 April 1983	Identical to RS-D1. Launched by the second developmental launch of SLV-3.
INSAT-1B	30 August 1983	Identical to INSAT-1A. Served for more than design life of seven years.
Stretched Rohini Satellite Series (SROSS-1)	24 March 1987	Carried payload for launch vehicle performance monitoring and for gamma ray astronomy. Did not achieve orbit.
IRS-1A	17 March 1988	Earth observation satellite. First operational remote sensing satellite.
Stretched Rohini Satellite Series (SROSS-2)	13 July 1988	Carried remote sensing payload of German space agency in addition to Gamma Ray astronomy payload. Did not achieve orbit.
INSAT-1C	21 July 1988	Same as INSAT-1A. Served for only one-and-a-half years.
INSAT-1D	12 June 1990	Identical to INSAT-1A. Still in service. A third stage motor landed from its launch, landed in Australia in 2008.
IRS-1B	29 August	Earth observation satellite. Improved version of IRS-1A.

Satellite	Launch Date	Remarks
	1991	
INSAT-2DT	26 February 1992	Launched as Arabsat 1C. Procured in orbit from Arabsat in January 1998.
Stretched Rohini Satellite Series (SROSS-C)	20 May 1992	Carried gamma ray astronomy and aeronomy payload.
INSAT-2A	10 July 1992	First satellite in the second-generation Indian-built INSAT-2 series. Has enhanced capability over INSAT-1 series. Still in service.
INSAT-2B	23 July 1993	Second satellite in INSAT-2 series. Identical to INSAT-2A. Still in service.
IRS-1E	20 September 1993	Earth observation satellite. Did not achieve orbit.
Stretched Rohini Satellite Series (SROSS-C2)	4 May 1994	Identical to SROSS-C. Still in service.
IRS-P2	15 October 1994	Earth observation satellite. Launched by second developmental flight of PSLV.Mission accomplished after 3 years of service in 1997.
INSAT-2C	7 December 1995	Has additional capabilities such as mobile satellite service, business communication and television outreach beyond Indian boundaries. Still in service.
IRS-1C	29 December 1995	Earth observation satellite. Launched from Baikonur Cosmodrome.
IRS-P3	21 March 1996	Earth observation satellite. Carries remote sensing payload and an X-ray astronomy payload. Launched by third developmental flight of PSLV.
INSAT-2D	4 June 1997	Same as INSAT-2C. Inoperable since 1997-10-04 due to power bus anomaly.
IRS-1D	29 September 1997	Earth observation satellite. Same as IRS-1C.
INSAT-2E	3 April 1999	Multipurpose communication and meteorological satellite.
Oceansat-1 (IRS-P4)	26 May 1999	Earth observation satellite. Carries an Ocean Colour Monitor (OCM) and a Multifrequency Scanning Microwave Radiometer (MSMR).
INSAT-3B	22 March 2000	Multipurpose communication: business communication, developmental communication, and mobile communication.
GSAT-1	18 April 2001	Experimental satellite for the first developmental flight of

Satellite	Launch Date	Remarks
		Geosynchronous Satellite Launch Vehicle, GSLV-D1.
Technology Experiment Satellite (TES)	22 October 2001	Experimental satellite to test technologies such as attitude and orbit control system, high-torque reaction wheels, new reaction control system, etc.
INSAT-3C	24 January 2002	Designed to augment the existing INSAT capacity for communication and broadcasting and provide continuity of the services of INSAT-2C.
Kalpana-1 (METSAT)	12 September 2002	First meteorological satellite built by ISRO. Originally named METSAT. Renamed after Kalpana Chawla who perished in the Space Shuttle Columbia.
INSAT-3A	10 April 2003	Multipurpose satellite for communication, broadcasting, and meteorological services along with INSAT-2E and Kalpana-1.
GSAT-2	8 May 2003	Experimental satellite for the second developmental test flight of Geosynchronous Satellite Launch Vehicle (GSLV)
INSAT-3E	28 September 2003	Communication satellite to augment the existing INSAT System.
RESOURCESAT-1 (IRS-P6)	17 October 2003	Earth observation/remote sensing satellite. Intended to supplement and replace IRS-1C and IRS-1D.
EDUSAT	20 October 2004	Also designated GSAT-3. India's first exclusive educational satellite.
HAMSAT	5 May 2005	Microsatellite (42.5 kilograms) for providing satellite-based amateur radio services to the national as well as the international community.
CARTOSAT-1	5 May 2005	Earth observation satellite. Provides stereographic in-orbit images with a 2.5-meter resolution.
INSAT-4A	22 December 2005	Advanced satellite for direct-to-home television broadcasting services.
INSAT-4C	10 July 2006	Geosynchronous communications satellite. Did not achieve orbit.
CARTOSAT-2	10 January 2007	Advanced remote sensing satellite carrying a panchromatic camera capable of providing scene-specific spot images.
Space Capsule Recovery Experiment (SRE-1)	10 January 2007	Experimental satellite intended to demonstrate the technology of an orbiting platform for performing experiments in microgravity conditions. Launched as a co-passenger with CARTOSAT-2. SRE-1 was de-orbited and recovered successfully after 12 days over Bay of Bengal.
INSAT-4B	12 March	Identical to INSAT-4A. Further augments the INSAT

Satellite	Launch Date	Remarks
	2007	capacity for direct-to-home (DTH) television services and other communications. On the night of 7 July INSAT-4B experienced a power supply glitch which led to switching 'off' of 50 per cent of the transponder capacity (6 Ku and 6 C-Band transponders).
INSAT-4CR	2 September 2007	Identical to INSAT-4C. It carried 12 high-power Ku-band transponders designed to provide direct-to-home (DTH) television services, Digital Satellite News Gathering etc.
CARTOSAT-2A	28 April 2008	Earth observation/remote sensing satellite. Identical to CARTOSAT-2.
IMS-1 (Third World Satellite – TWsat)	28 April 2008	Low-cost microsatellite imaging mission. Launched as co-passenger with CARTOSAT-2A.
Chandrayaan-1	22 October 2008	Unmanned lunar probe. Carries 11 scientific instruments built in India, USA, UK, Germany, Sweden and Bulgaria.
RISAT-2	20 April 2009	Radar imaging satellite used to monitor India's borders and as part of anti-infiltration and anti-terrorist operations. Launched as a co-passenger with ANUSAT.
ANUSAT	20 April 2009	Research microsatellite designed at Anna University. Carries an amateur radio and technology demonstration experiments.
Oceansat-2 (IRS-P4)	23 September 2009	Gathers data for oceanographic, coastal and atmospheric applications. Continues mission of Oceansat-1.
GSAT-4	15 April 2010	Communications satellite technology demonstrator. Failed to reach orbit due to GSLV-D3 failure.
CARTOSAT-2B	12 July 2010	Earth observation/remote sensing satellite. Identical to CARTOSAT-2A.
StudSat	12 July 2010	First Indian pico-satellite (weighing less than 1 kg). Developed by a team from seven engineering colleges from Karnataka and Andhra Pradesh.
GSAT-5P/ INSAT-4D	25 December 2010	C-band communication satellite, failed to reach orbit due to GSLV-F06 failure.
RESOURCESAT-2	20 April 2011	RESOURCESAT-2, ISRO's eighteenth remote-sensing satellite, followed RESOURCESAT-1. PSLV-C16 placed three satellites with a total payload mass of 1404 kg - RESOURCESAT-2 weighing 1206 kg, the Indo-Russian YOUTHSAT weighing 92 kg and Singapore's X-SAT weighing 106 kg – into an 822 km polar Sun Synchronous Orbit (SSO).
Youthsat	20 April 2011	Indo-Russian stellar and atmospheric satellite with the

Satellite	Launch Date	Remarks
		participation of university students. It weighed 92 kg
GSAT-8/ INSAT-4G	21 May 2011	Communications satellite carries 24 Ku-band transponders and 2 channel GAGAN payload operating in L1 and L5 band.
GSAT-12	15 July 2011	GSAT-12 communication satellite built by ISRO, weighs about 1410 kg at lift-off. GSAT-12 is configured to carry 12 Extended C-band transponders to meet the country's growing demand for transponders in a short turn-around-time.The 12 Extended C-band transponders of GSAT-12 will augment the capacity in the INSAT system for various communication services like Tele-education, Telemedicine and for Village Resource Centres (VRC).Mission life About 8 Years.
Megha-Tropiques	12 October 2011	Megha-Tropiques weighs about 1000 kg Lift-off Mass, developed jointly by ISRO and the French Centre National d'Études Spatiales (CNES). PSLV-C18 is configured to carry four satellites in which, one satellite, developed by India and France, will track the weather, two were developed by educational institutions, and the fourth is from Luxembourg.
Jugnu	12 October 2011	Nano-satellite weighing 3 kg developed by IIT Kanpur
RISAT-1	26 April 2012	RISAT-1, first indigenous all-weather Radar Imaging Satellite (RISAT-1), whose images will facilitate agriculture and disaster management weighs about 1858 kg.
SRMSAT	26 April 2012	Nano-satellite weighing 10.9 kg developed by SRM University.
GSAT-10	29 September 2012	GSAT-10, India’s advanced communication satellite, is a high power satellite being inducted into the INSAT system. Weighing 3400 kg at lift-off.
SARAL	25 February 2013	SARAL, The *S*atellite with *AR*GOS and *AL*TIKA (SARAL) is a joint Indo-French satellite mission for oceanographic studies.
IRNSS-1A	1 July 2013	IRNSS-1A is the first satellite in the Indian Regional Navigation Satellite System (IRNSS). It is one of the seven satellites constituting the IRNSS space segment.
INSAT-3D	26 July 2013	INSAT-3D is the meteorological Satellite with advanced weather monitoring payloads .

(Source: Wikipedia Website)

Looking into the various kinds of satellites launched it is understood that India is using the satellites for various developmental purpose through increasing the coverage to remote parts of the nation and awareness and education in different required aspects to rural people occupied important aspect of this communication. Launching of these satellites is not only helping to achieve indigenous purposes, but is also being used to initiate, improve the space programs of other nations too.

National Development and Communication Satellites

Public access to information gets enhanced with the development of communication channels and also creates ways to broaden public access to information reforms, thus making development a participatory process. But this process remained unachieved till the start of communication satellite and satellite television programmes in 1975 in India. Satellite television made inroads in 1975 in India with the world's largest Satellite Instructional Television Experiment (SITE) that was conducted to provide informal education to rural population in India through an accessible and well-used medium of communication. This programme was followed by STEP, TDCC and finally to EDUSAT in 2003, which is exclusively for educational purposes and provided one way video and two way audio teleconferencing channels.

The satellites launched in space at various orbits have helped in many ways to avoid damage to life during natural calamities. Remote sensing satellites have helped in providing data on cyclones, weather changes and other natural calamities which help people in planning for agriculture and move to safe places during danger etc. Communication field has witnessed a sea change with the launch of INSAT series. Many programs in health, education and media development have been made possible due to these satellites. Television and media are particularly used to telecast educational programs countrywide. Some of the important programs in this connection are ETV, SITE, Countrywide Classrooms, Gyan Jyoti, organized in collaboration of UGC, ISRO.

'A convergence of hundreds of available television channels, mobile devices, mass communication institutions and non-government organizations dealing with development communication to launch a series of capacity building exercises at the earliest has immense potential to make India surge ahead in the effective use of satellites for development purposes. The country has a plethora of training institutes for television production, news reporting, anchoring and editing. In a proportionate manner, the need of the hour is development of viable projects on development communication and attention of funding agencies to this sector.' (R. Sreedher, 2013)

Educational Importance of Communication Satellites

The concept of utilizing communication satellites for educational programmes telecast was effectively demonstrated for the first time in India in 1975-76 through the Satellite Instructional Television Experiment (SITE) conducted using the American Application Technology Satellite (ATS-6).

Satellite Instructional Television Experiment (SITE)

The Satellite Instructional Television Experiment or SITE was an experimental satellite communications project launched in India in 1975, designed jointly by NASA and the Indian Space Research Organization (ISRO). The project made available informational television programmes to rural India. The main objectives of the experiment were to educate the poor people of India on various issues via satellite broadcasting, and also to help India gain technical experience in the field of satellite communications.

The experiment ran for one year from 1 August 1975 to 31 July 1976, covering more than 2400 villages in six Indian states and territories. The television programmes were produced by All India Radio and broadcast by NASA's ATS-6 satellite stationed above India for the duration of the project. The project was supported by various international agencies such as the UNDP, UNESCO, UNICEF and ITU. The experiment was successful, as it played a major role in helping develop India's own satellite program, INSAT. The project showed that India could use advanced technology to fulfill the socio-economic needs of the country. SITE was followed by similar experiments in various countries, which showed the important role satellite TV could play in providing education. (Source: http://en.wikipedia.org/wiki/Satellite_Instructional _Television_ Experiment

Satellite Telecommunication Experiment (STEP)

SITE was followed by Satellite Telecommunication Experiment (STEP) in 1977-79, another experiment of the ISRO that majorly demonstrated communication applications of space. In the 1980s, India launched its own communication satellite INSAT (Indian National Satellite System) and the experiments continued. The Satellite Telecommunication Experiment Project (STEP), conducted using Franco-German SYMPHONIE satellite during 1977-79, was another major demonstration of long-distance satellite telecommunication application of space. It was the largest sociological experiment ever carried out in the world.

Training and Development Communication Channel (TDCC)

ISRO introduced the use of one-way video two-way audio teleconferencing interactive networks for education and training. Such networks cater to specialised audiences and provide for interaction and are therefore being termed as interactive narrow casting networks. Three major areas of applications have emerged. These are distance education, training/continuing education, and training for rural development.
The Indira Gandhi National Open University was one of the early users of the network, followed by AIMA and other agencies involved in distance education. Of course, now, IGNOU has shifted the teleconferencing to the Gyan Darshan channel, but DPEP continues to be a major user of the network. The TDCC networks are being utilized by the State Governments for regular training of their field staff and of late engineering college networks have been established in Gujarat and Karnataka to conduct engineering classes over the network. (Source: http://www.gits4u.com/edu/setedu.htm)
EDUSAT

‘EDUSAT is the first Indian educational satellite built exclusively for serving the educational sector. Its main aim is to meet the demand for an interactive satellite based distance education system for the country. It strongly reflects India's commitment to use space technology for national development, especially for the development of the population in remote and rural locations. EDUSAT is expected to have a life of seven years in space, during which it will help educational institutions make up for, among other things, the dearth of good teachers by providing connectivity with classrooms far away.

The universalisation of education has become the top priority in India, especially for the developing countries. But the extension of quality education to remote and rural regions becomes a Herculean task for a large country like India with multi-lingual and multi-cultural population separated by vast geographical distances. There is a lack of adequate rural educational infrastructure and non-availability of good teachers in sufficient numbers which adversely affect the efforts made in education.

Compared to other satellites launched in the same series so far, EDUSAT will have several new technologies. Satellites can establish connectivity between urban educational institutions and a large number of rural and semi-urban educational institutions to provide an educational infrastructure. Besides supporting formal education, a satellite system can facilitate the dissemination of knowledge to the rural and remote population about important aspects like health, hygiene and personality development and allow professionals to update their knowledge base as well. Thus, in spite of limited trained and skilled teachers, the aspirations of the growing student population at all levels can be met through the concept of tele-education’. (as cited by Hanlon)

EDUSAT is a collaborative project of ISRO, the Union ministry of human resource development, state departments of education and the Indira Gandhi National Open University. EDUSAT is the first exclusive satellite for serving the educational sector in India. Growing demand for an interactive satellite based distance education system through audio-visual medium, employing Direct to Home quality broadcast prompted the government to launch it. The satellite has multiple regional beams covering different parts of India -- five Ku-band transponders with spot beams covering northern, north-eastern, eastern, southern and western regions of the country, a Ku-band transponder with its footprint covering the Indian mainland region and six C-band transponders with their footprints covering the entire country. 17 state governments have so far sent proposals to the central government requesting setting up of EDUSAT Networks for Elementary Education.

Kerala became the first state to launch virtual classes through EDUSAT in elementary education. The networking project is operationalized in three phases. Already, the ISRO runs several pilot projects on EDUSAT with the Ku-band transponder on board INSAT-3B, which is already in orbit. In the <u>first phase,</u> the Visveswaraiah Technological University in Karnataka is the main beneficiary. Under this, all engineering colleges of the University are networked with 100 nodes. Besides Karnataka, the Y B Chavan State Open University at Nashik in Maharashtra and the Rajiv Gandhi Technical University in Madhya Pradesh are covered under the pilot project.

In the <u>second phase</u>, the EDUSAT spacecraft is being used in semi-operational mode with at least one uplink in each of the five spot beams. About 100 to 200 classrooms are connected by each beam. In addition to Karnataka, Maharashtra and Madhya Pradesh included under the first phase, coverage will be extended to two more states and one national institution.

In the third phase, EDUSAT national network would become fully operational later this year. Kalam's inauguration of the EDUSAT operations in Kerala was part of the national network operation. By launching of its own satellite to achieve the goals of UEE and providing quality education to all Indian space programs has taken up the role of facilitator to the education program of India.

STUDSATs

‘Indian Space Research Organisation (ISRO) will soon launch two Education satellites to help the student community. It has collaborated with the student community to develop and launch satellites.

The first Student satellite to be launched by ISRO would be *Pratham*, which has been under development for some time by the IIT-Bombay. The second satellite will be STUDSAT-2, which will be built by a consortium of multiple engineering colleges affiliated to Visveswaraya Technological University (VTU). The STUDSAT-2, according to the STUDSAT team, is a twin satellite mission that aims to demonstrate inter-satellite communication and increasing temporal resolution for remote-sensing applications. STUDSAT-2 will be the second satellite to be launched by the consortium of engineering colleges after the STUDSAT-1, which was launched in 2010.

The objective of the STUDSAT-1 satellite was to see to it that educational institutions develop miniature satellites and communication link between the satellite and ground station. The STUDSAT-2 will aim to demonstrate inter-satellite communication with twin nano satellites. On the 21st September, the Indian Space Research Organisation (ISRO) successfully launched a rocket in to space carrying a 1950 kg satellite dedicated to the cause of education, 'EDUSAT'. The rocket was launched from the country's only spaceport at Sriharikota and placed its payload on a designated orbit, 5000 km away minutes later’. (Ashwathi, 2013)

Future Aspects

As per the focus of this paper, the educational use of communication satellites with references to EDUSAT and STUDSAT is yet to be analyzed. According to the goals of universalization of elementary education, to develop awareness in rural and remote areas with cheaper costs, the programmes adopted by Indian government are laudable. Still more needs to be done to achieve the goals of national development.

Description of different levels of educative initiatives in the above session is indicating the determination of Indian government to reduce the communication gap in the nation by expanding the telecast to remote rural areas. In future the goal is to further improve the program to achieve the national development on the aspects enunciated in our constitution. It is not only in the field of education, weather, medicine, agriculture and communication all the fields are planned to be revolutionized to cater to the needs of populous country of ours with beaming interests, knowledge and enthusiasm to come up in life through helping world and seeking their own interests peacefully and amicably.

Conclusion

The role of education in the national development has been correctly identified by our national leaders and the efforts done by them from that time have resulted in the present scenario. Hope the situation will pave the way for further improvement in literacy and help us in achieving our goals of 'Vasudaivakutumbakam'.

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